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Intrusion Detection with Feature Selection and Dimension Reduction using WEKA

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Abstract— **As Internet is growing with a high speed, there are large number security audit data and complex intrusion behavior which makes the current intrusion system inefficient. Intrusion detection using data mining and machine learning can be one of the solutions to this problem. For this we can build intrusion detection system using machine learning algorithm. One of the machine learning and data mining tools that can be used for this purpose is WEKA which uses various algorithms. With this tool we can develop a model using various algorithms which can distinguish normal and malicious traffic and also we can analyze which algorithm gives accurate result. For a model to be created a dataset is given with large number of features and all the features are not that important. Feature selection helps in reducing computational time. We should be able to select various attributes which helps in developing an effective model in WEKA. The same model can be trained and used for other test data. The analysis is performed with a traffic data called VPN-nonVPN dataset from ISCX which consist of 14 different traffic categories. This dataset consist of two class called VPN and non-VPN, and the model can classify correctly whether the traffic is coming from VPN or a non-VPN. This paper mainly deals with creation of model for intrusion detection using WEKA and also shows how the accuracy can be increased by feature selection and dimension reduction.**

Keywords— ***WEKA, Machine Learning, Data Mining, Classifier, Data Collection, Feature Selection, ROC curve***

1. Introduction

Data mining is defined as process of extracting useful information from a large dataset. It involves removing unwanted features, cleaning the data and making it suitable for using in a model. Machine learning is a method to train a machine so that it can be used for intrusion detection without human intervention. WEKA tool is use to create a model and train it to perform in an effective manner for various dataset. While downloading many datasets it may be in various formats such as pcap, csv. Converting the data into a format readable by a model using a tool is one of the major tasks. Intelligent intrusion detection system can be built only if we have an effective dataset [3].A data has a number of features and not all the features are useful, hence selecting only the needed feature is another task. Most of the paper has used NSL-KDD dataset for the purpose of intrusion detection. But this paper deals with data downloaded from ICSX which has been collected from VPN and non-VPN. The model created will classify whether the traffic is coming from a VPN or not.

First section of paper deals with collection of dataset from various sites which can be in the form of arff or csv format.

Collecting a proper data can be a tedious task. This section discuss about the data used in this paper and also the process of collecting the data.

In third section we deal with feature selection and reduction of the traffic data which can be done by using two methods: filter and wrapper. It is observed that the reduced features affect the accuracy of various models.

In fourth section we discuss about performance of different algorithm and classifier which comes under rules, Bayes, trees, lazy using a particular dataset. For the same dataset, different algorithms produce different result.

In fifth section data is divided into test and train data using WEKA. It shows how the accuracy of a model differs using a train data and again reevaluating the same model for test data.

2. Related Work

Effective data can be collected for analysis of a model which consist of real world traffic and is also known as ISCX VPN- nonVPN traffic dataset[1][2].Weka is one of the strongest tool which is collection of machine learning algorithm for data mining task [3]. Weka consists of a number of tools for data pre-processing, association rules and visualization. It is also used for developing new machine learning algorithm. Selecting important feature on the basis of rough set based feature selection approach have led to a simplification of the problem, faster and more accurate detection rates [4]. Feature selection is a tough task than feature extraction. Selecting correct and required features using two methods called filter and wrapper method can increase the accuracy of a classifier [5][6]. Weka tool consist of a number of machine learning algorithms which can be classified such as: i) Bayes: Naïve Bayes and Bayes Net ii) Tree: j48, NBTree iii) Rule: Decision Tree, jRip, oneR iv)Lazy: jBk. All these classifiers have their own advantages and their accuracy depends on the type of dataset [7] [8] [9]. Different models can be built and classifier accuracy can be compared based on the same dataset. This is the accuracy of the model when we take training data and when we use the built model for test data differs. The dataset can be divided into train and test dataset to build a more efficient model [6][10].

About the dataset

The dataset used in this paper is real world traffic present is ISCX (Information Security Center of Excellence). It consists of network traffic (VPN and non- VPN dataset). The steps for generation of dataset by ISCX is given below
[1] [2].

- A set of tasks were defined to generate a representative dataset of real-world traffic in ISCX (Assuring that the dataset was rich enough in diversity and quantity).
- Accounts were created for users Alice and Bob in order to use services like Skype, Facebook, etc.
- A regular session and a session over VPN were captured, which had a total of 14 traffic categories: VOIP, VPN-VOIP, P2P, VPN-P2P, etc.

Different types of traffic generated and their contents are:

Table 1: Description of Dataset

TRAFFIC	CONTENT
Web Browsing	Firefox and Chrome
Email	SMPTS, POP3S and IMAPS
Chat	ICQ, AIM, Skype , Facebook and Hangouts
Streaming	Video and YouTube
File Transfer	Skype, FTPS and SFTP using Filezilla and an external service
VoIP	Facebook, Skype and Hangouts voice calls (1h du ration)
P2P	uTorrent and Transmission (Bit torrent)

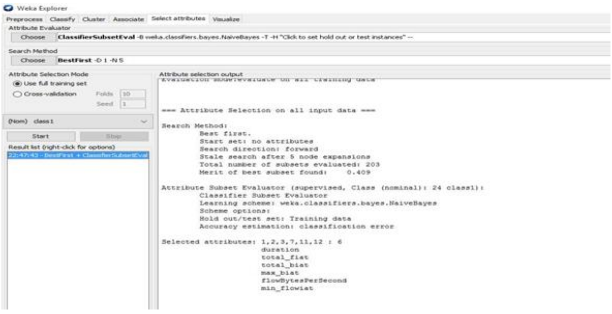
The traffic was captured using WireShark and Tcpdump, generating a total amount of 28GB of data. For the VPN, an
external VPN service provider was used and connected to it using OpenVPN (UDP mode).

3. Feature selection and dimension reduction

Machine Learning and Data Mining has been used to improve the accuracy of classifier. A dataset consist of large number of features and not all the features are important. Selection of feature and reducing unwanted features is one of the most important factors to increase the efficiency of the classifier. There are two methods for feature selection and reduction: wrapper method and filter method. Both of them are discussed below:

Wrapper Method: In wrapper method we use subset evaluator to create all possible subset from your feature vector. Then it will use a classification algorithm to induce classifier from the features in a subset. It will consider the subset of features with the classification algorithm performs the best. For example we have 10 features, the evaluator try to find subset with those 10 features.

1st attribute: 3 features
2nd attribute: 3 features
3rd attribute: 4 features



ClassifierSubsetEval -B weka.classifiers.bayes.NaiveBayes -T -H "Click to set hold out or test instances" --

BestFirst -D 1 -N 5

● Use full training set
○ Cross-validation Folds 10 Seed 1

(Nom) class1

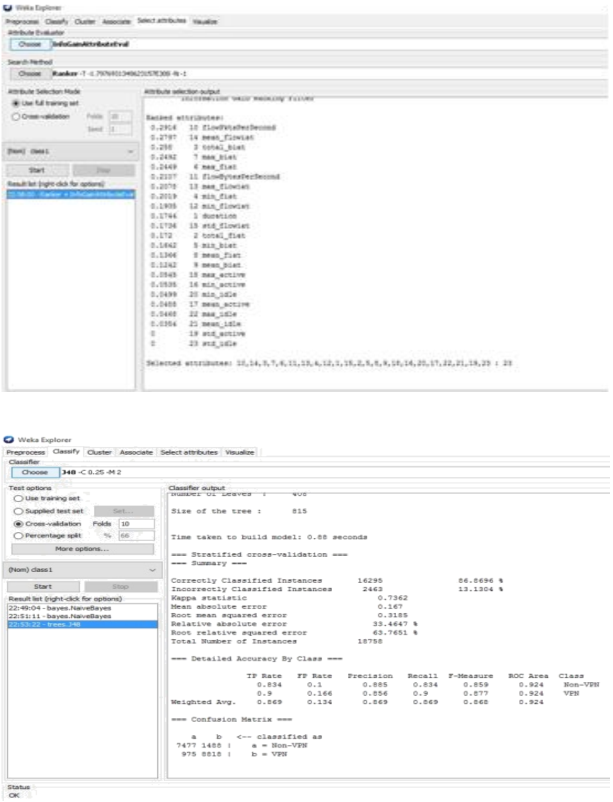
22:47:43 - BestFirst + ClassifierSubsetEval

```
Evaluation mode:evaluate on all training data


=== Attribute Selection on all input data ===

Search Method:
        Best first.
        Start set: no attributes
        Search direction: forward
        Stale search after 5 node expansions
        Total number of subsets evaluated: 203
        Merit of best subset found:    0.409

Attribute Subset Evaluator (supervised, Class (nominal): 24 class1):
        Classifier Subset Evaluator
        Learning scheme: weka.classifiers.bayes.NaiveBayes
        Scheme options:
        Hold out/test set: Training data
        Accuracy estimation: classification error

Selected attributes: 1,2,3,7,11,12 : 6
                     duration
                     total_fiat
                     total_biat
                     max_biat
                     flowBytesPerSecond
                     min_flowiat
```

Figure 1: Feature reduction using wrapper method

Result Analysis: As shown in Figure 1, after using wrapper method the selected attributes are (1, 2,3,7,11,12) .

Filter method: In filter method instead of only giving the selected attributes, all attributes are given in a ranking order. The attribute with last order has least priority. An attribute evaluator and a ranker is used to rank all features in the dataset. The number of features to be select from feature vector can always be defined. The features that has lower rank can be omitted one at a time and the accuracy of classifier can be seen. One of the disadvantage of this method is the weight put by the ranker algorithm are different than those by the classification algorithm. So algorithm will be over fitted.



InfoGainAttributeEval

Ranker -T -1.7976931348623157E308 -N -1

● Use full training set
○ Cross-validation Folds 10 Seed 1

(Nom) class1

22:58:00 - Ranker + InfoGainAttributeEval

```
        Information Gain Ranking Filter

Ranked attributes:
 0.2914   10 flowPktsPerSecond
 0.2797   14 mean_flowiat
 0.258     3 total_biat
 0.2492    7 max_biat
 0.2449    6 max_fiat
 0.2107   11 flowBytesPerSecond
 0.2078   13 max_flowiat
 0.2019    4 min_fiat
 0.1935   12 min_flowiat
 0.1744    1 duration
 0.1736   15 std_flowiat
 0.172     2 total_fiat
 0.1642    5 min_biat
 0.1366    8 mean_fiat
 0.1242    9 mean_biat
 0.0545   18 max_active
 0.0535   16 min_active
 0.0499   20 min_idle
 0.0488   17 mean_active
 0.0468   22 max_idle
 0.0354   21 mean_idle
 0        19 std_active
 0        23 std_idle

Selected attributes: 10,14,3,7,6,11,13,4,12,1,15,2,5,8,9,18,16,20,17,22,21,19,23 : 23
```

J48 -C 0.25 -M 2

○ Use training set
○ Supplied test set
● Cross-validation Folds 10
○ Percentage split % 66

(Nom) class1

22:49:04 - bayes.NaiveBayes
22:51:11 - bayes.NaiveBayes
22:53:22 - trees.J48

```
Number of Leaves  :     408

Size of the tree :      815


Time taken to build model: 0.88 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances       16295               86.8696 %
Incorrectly Classified Instances      2463               13.1304 %
Kappa statistic                          0.7362
Mean absolute error                      0.167
Root mean squared error                  0.3185
Relative absolute error                 33.4647 %
Root relative squared error             63.7651 %
Total Number of Instances            18758

=== Detailed Accuracy By Class ===

               TP Rate   FP Rate   Precision   Recall  F-Measure   ROC Area  Class
                 0.834     0.1        0.885     0.834     0.859      0.924    Non-VPN
                 0.9       0.166      0.856     0.9       0.877      0.924    VPN
Weighted Avg.    0.869     0.134      0.869     0.869     0.868      0.924

=== Confusion Matrix ===

    a    b   <-- classified as
 7477 1488 |    a = Non-VPN
  975 8818 |    b = VPN
```

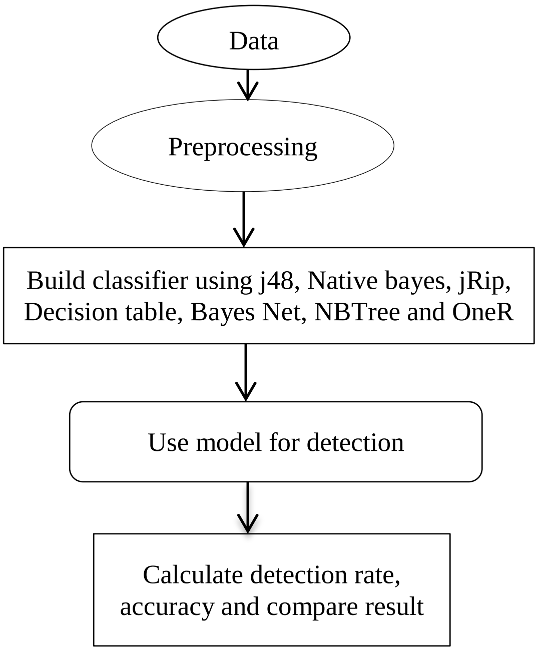
OK

Figure 2: Feature reduction using filter method

Result Analysis: As shown in Figure 2, after using filter method the attributes to be removed are (23,19,21,22,17) .

4. METHODOLOGY

After feature selection and dimension reduction the datasets is used to build classifier. In this method data is selected and preprocessed and a model is build using various classifiers.



Data

Preprocessing

Build classifier using j48, Native bayes, jRip, Decision table, Bayes Net, NBTree and OneR

Use model for detection

Calculate detection rate, accuracy and compare result

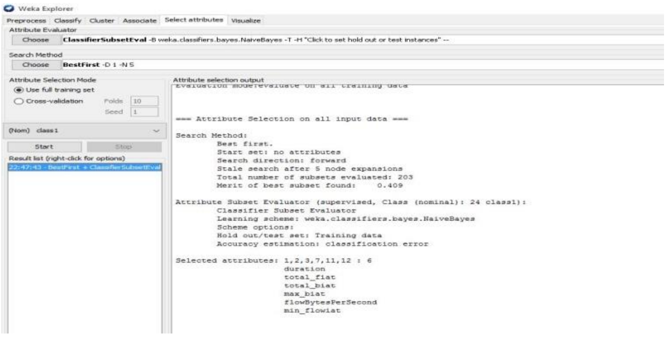
Figure 3: Methodology of building classifier

Some of them includes j48, Naïve Bayes, Decision Table, NBTree, JRip and jBK. This model is used for detection and TP and FP is calculated.

5. Building classifiers

As all the features are not required to build a model. Reduction of some of them can increase the efficiency. Hence the cleaned dataset after using wrapper method and filter method for feature selection and dimension reduction is used to build the model.

i. Building classifier with data from wrapper and filter method



ClassifierSubsetEval -B weka.classifiers.bayes.NaiveBayes -T -H "Click to set hold out or test instances" --

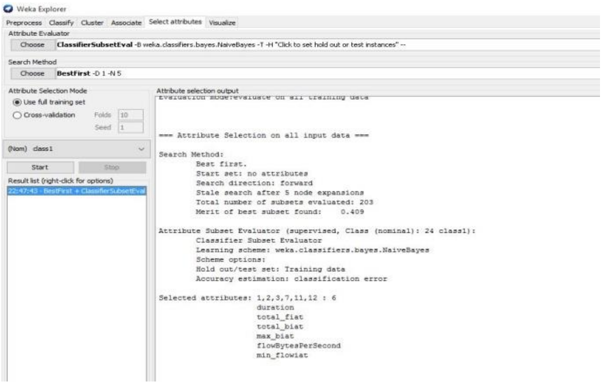
BestFirst -D 1 -N 5

● Use full training set
○ Cross-validation Folds 10 Seed 1

(Nom) class1

22:47:43 - BestFirst + ClassifierSubsetEval

```
Evaluation mode:evaluate on all training data


=== Attribute Selection on all input data ===

Search Method:
        Best first.
        Start set: no attributes
        Search direction: forward
        Stale search after 5 node expansions
        Total number of subsets evaluated: 203
        Merit of best subset found:    0.409

Attribute Subset Evaluator (supervised, Class (nominal): 24 class1):
        Classifier Subset Evaluator
        Learning scheme: weka.classifiers.bayes.NaiveBayes
        Scheme options:
        Hold out/test set: Training data
        Accuracy estimation: classification error

Selected attributes: 1,2,3,7,11,12 : 6
                     duration
                     total_fiat
                     total_biat
                     max_biat
                     flowBytesPerSecond
                     min_flowiat
```



Attribute Evaluator: **ClassifierSubsetEval** -B weka.classifiers.bayes.NaiveBayes -T -H "Click to set hold out or test instances" --

Search Method: **BestFirst** -D 1 -N 5

Attribute Selection Mode: ● Use full training set ○ Cross-validation Folds 10 Seed 1

(Nom) class1

Result list (right-click for options): 22:47:43 - BestFirst + ClassifierSubsetEval

Attribute selection output

```
Evaluation mode:evaluate on all training data



=== Attribute Selection on all input data ===

Search Method:
        Best first.
        Start set: no attributes
        Search direction: forward
        Stale search after 5 node expansions
        Total number of subsets evaluated: 203
        Merit of best subset found:    0.409

Attribute Subset Evaluator (supervised, Class (nominal): 24 class1):
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        Scheme options:
        Hold out/test set: Training data
        Accuracy estimation: classification error

Selected attributes: 1,2,3,7,11,12 : 6
                     duration
                     total_fiat
                     total_biat
                     max_biat
                     flowBytesPerSecond
                     min_flowiat
```

Figure 4: Building classifier using j48

Figure 4 shows the model created after using the feature selected data using wrapper method.

Table 2: Accuracy of classifier after feature reduction with wrapper method

Classifier	Accuracy (%)	Attributes
Naïve Bayes	53.22	With all attributes
Naïve Bayes	55.5017	With selected attributes
J48	86.8696	With all attributes
J48	89.726	With selected attributes

Result Analysis: Table 2 shows the accuracy of classifiers after feature reduction using wrapper method. As seen the accuracy of classifier is increased in case of both Naïve Bayes and J48 to 55.5017 and 89.726 after feature reduction.

Table 3: Accuracy of classifier after feature reduction

Classifier	Attribute removed	Correctly classified instance
J48	23	89.7217
J48	23,19	89.743
J48	23,19,21	89.7537
J48	23,19,21,22	89.7057 **over fitted**
J48	23,19,21,22,17	89.7057

Result Analysis: Table 3 shows the accuracy of classifiers after feature reduction using filter method. As seen the accuracy of classifier is increased in case J48 to 89.7057 after feature reduction.

6. Result

The values for the evaluation measures can be different for the different data sets used and accordingly the algorithms may perform in the different way for the different datasets.

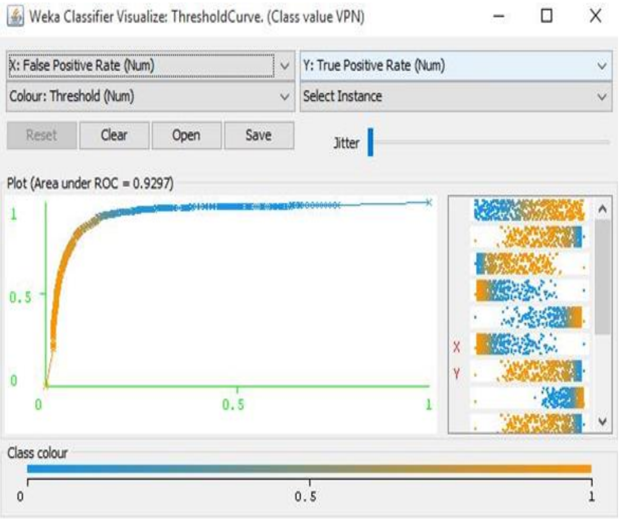
Table 4: Comparison of various classifiers

Classifier	TP	FP	Correctly classified instance	Incorrectly classified instance	Class
Bayes Net	0.728 0.874	0.126 0.272	80.387	19.613	Non-VPN VPN
Naïve Bayes	0.045 0.978	0.022 0.955	53.22	46.78	Non-VPN VPN
J48	**0.876** **0.916**	**0.084** **0.124**	**89.727**	**10.273**	**Non-VPN** **VPN**
NBTree	0.748 0.882	0.118 0.252	81.7624	18.2576	Non-VPN VPN
Decision table	0.764 0.867	0.133 0.231	81.9864	18.0136	Non-VPN VPN
JRip	0.81 0.933	0.067 0.19	87.392	12.608	Non-VPN VPN

Table 4 shows that for the same real VPN-nonVPN dataset, different algorithms works in a different ways. J48 classifier shows the highest percent of correctly classified Instances (89.727%) after feature selection and dimension reduction which is followed by jRip (87.392%). As far as TP measure is concerned, j48 Classifier gave the highest value of all i.e. 0.876 which is followed by value 0.81 in case of jRip. Taking these evaluation measures into consideration, we could easily recommend j48 Classifier as the best Classifier for Credit Dataset . However this may not be same for all the datasets. A general Classifier needs to be built that should be adaptable to the different types of the datasets.

7. ROC Curve Analysis

An example of a ROC curve, obtained from the open source software Weka, is shown in Figure 5. The area under these curves signifies how well the test used can distinguish between the examples. The more the example classes overlap relative to the test, the less the area under the ROC curve will be. ROC curves shows how well a test does at distinguishing between classes without taking the relative frequency of the classes into account.


Weka Classifier Visualize: ThresholdCurve. (Class value VPN)

X: False Positive Rate (Num)

Y: True Positive Rate (Num)

Colour: Threshold (Num)

Select Instance

Plot (Area under ROC = 0.9297)

Figure 5: ROC curve to represent result

8. Conclusion

Collecting data from different sites and has always been a tedious task. Weka tool provides a list of classifier which can be used to classify a dataset. Also the dataset can be divided into train and test data for re- evaluating the model. Performances of different classifier are not same for a single dataset. Hence, an efficient model can be created using data mining and machine learning for intrusion detection.

9. Conclusion

Collecting data from different sites and has always been a tedious task. Weka tool provides a list of classifier which can be used to classify a dataset. Also the dataset can be divided into train and test data for re- evaluating the model. Performances of different classifier are not same for a single dataset. Hence, an efficient model can be created using data mining and machine learning for intrusion detection.

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Stock Market Forecast Using Time Series Analysis

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Abstract— **Stock market, one of the financially volatile markets has attracted thousands of investors' hearts since its existence. The profit and risk of it has great beauty and everyone wants to get some benefits from it, so the stock price forecasting has always been a popular field of study in the area of financial data mining. Many methods like technical analysis, fundamental analysis, statistical analysis etc. are being used to predict the stock price in the share market but no one method has proved to be consistent forecasting tool. This paper contributes to the field of Time Series Analysis, which aims to forecast the stock market price using previous recorded stock prices. It discusses about how the Moving Average method can be used to identify the unknown and hidden patterns in share market data considering SARIMA as noble method. The proposed system consists of building and training the models using the past data of the selected stock and the results obtained from the model for comparing with the real data so as to ascertain the accuracy of the model. This result contributes to the development of more robust forecasting for the purpose of qualitative and quantitative information regarding the stock prices. In addition, it enables the users to make the smart decision for stock trading.**

Keywords— ***Moving Average, ARIMA , SARIMA, Time series analysis, Mero lagani, Stock market***

I. INTRODUCTION

Prediction of stock market data is known as a prominent issue for stock traders. Stock market data has a highly dynamic property due to a conflicting extent of influential factors

A stock market is a public market for the trading of company stock and derivatives at an agreed price. Stock market is the important part of economy of the country and plays a vital role in the growth of the country. Both investors and industry are involved in stock market and wants to know whether some stock will rise or fall over a period of time. It is based on the concept of demand and supply. If the demand for a company's stock is higher, then the company share price increases and if the demand for company's stock is less then the company share price decreases. Indeed, forecasting the trend of stock market rise or fall incident need to be focused because the obtained result can be utilized for customers in decision making finalizing whether to buy or sell the particular shares of a given stock.

Stock market analysis and prediction will reveal the market patterns and predict the time to purchase stock. The successful prediction of a stock's future price could yield significant profit. This is done using large historic market data to represent varying conditions and confirming that the time series patterns have statistically significant predictive power for high probability of profitable trades and high profitable returns for the competitive business investment

Due to involvement of many number of industries and companies, merolagani.com contain very large sets of data from which it is difficult to extract information and analyze their trend of work manually.

II. RELATED WORK

The paper [1] describes a multi-agent system that uses numerical, financial and economical data in order to evaluate the company's position on the market, profitability, performance, future expectations in the company's evolution. Determining the effect of political, governmental and social decisions along with detecting the way in which the price is constructed based on technical and fundamental analysis methods and the bid/ask situation helps in determining a more precise buy/sell signals, reducing the false signals and determining some risk/gain positions on different periods of time. In order to validate the results a prototype was developed in this paper. In the paper [2], they proposed a stock price predication model which is combinational feature from technical analysis and sentiment analysis (SA). The features of sentiment analysis are based on Point wise mutual information (PMI) which is a term expansion method from multidimensional seed word. The features of technical analysis based on expert rule from trading information. Experimental results show that the use of sentiment analysis and technical analysis achieves higher performance than that without sentiment analysis in predicting stock price.

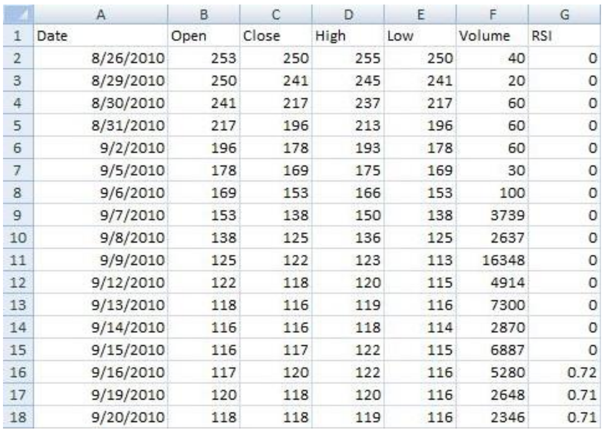
The effectiveness [3] of long short term memory networks trained by back propagation through time for stock price prediction is explored in this paper. Arrange of different architecture LSTM networks are constructed trained and tested. LSTMs had been conventionally proven successful for time series prediction. Hengjian Jia found that LSTMs learn patterns effective for stock market prediction and he obtained decent RMSEs with different architectures of LSTM. This study helped us realize this problem as a time-series problem, and gave an insight to solve this problem with a sliding window approach.

Deep Neural Networks, being the most exceptional innovation in Machine Learning, have been utilized to develop a short-term prediction model. The paper [4] plans to forecast these short – term prices of stocks. The paper discusses about two distinct sorts of Artificial Neural Networks, Feed Forward Neural Networks and Recurrent Neural Networks.

The applications of Deep Learning in different financial domains were explained by J. B. Heaton and his colleagues [5]. Their study discussed a few prediction problems in the financial domain. It also stated a few advantages deep learning predictors have over traditional predictors. A few of them being, over fitting can be easily avoided and correlation in input data can also be handled easily.

III. ABOUT THE DATASET

This project requires historic data of stock market as the project also emphasizes on data mining techniques. So, it is necessary to have a trusted source having relevant and necessary data required for the prediction. We are using Merolagani website (http://www.merolagani.com/) as the primary source of data. The site is updated on daily basis and it is also a repository for years of stock market data for Nepal. We have performed web scraping to get all the required data from this website using Scrappy tool to scrape the data.



	A	B	C	D	E	F	G
1	Date	Open	Close	High	Low	Volume	RSI
2	8/26/2010	253	250	255	250	40	0
3	8/29/2010	250	241	245	241	20	0
4	8/30/2010	241	217	237	217	60	0
5	8/31/2010	217	196	213	196	60	0
6	9/2/2010	196	178	193	178	60	0
7	9/5/2010	178	169	175	169	30	0
8	9/6/2010	169	153	166	153	100	0
9	9/7/2010	153	138	150	138	3739	0
10	9/8/2010	138	125	136	125	2637	0
11	9/9/2010	125	122	123	113	16348	0
12	9/12/2010	122	118	120	115	4914	0
13	9/13/2010	118	116	119	116	7300	0
14	9/14/2010	116	116	118	114	2870	0
15	9/15/2010	116	117	122	115	6887	0
16	9/16/2010	117	120	122	116	5280	0.72
17	9/19/2010	120	118	120	116	2648	0.71
18	9/20/2010	118	118	119	116	2346	0.71

Figure 1: Datasets

IV. TIME SERIES ANALYSIS

A set of regular time-ordered observations of a quantitative characteristic of an individual or collective phenomenon taken at successive periods/ points of time is known as a time series method. Although many other soft computing methods have been developed recently but moving average method is still considered as the best method by many people due to its easiness, objectiveness, reliability, and usefulness.

Moving average

It is the method to analyze the data points by generating their averages in the form of series of different subsets of data. Moving average method comes in various forms, but their underlying purpose remains the same, that is to track the trend determination of the given time series data. It is mostly used to highlight longer term trains or cycles, for example, in the financial data like stock price returns or trading volumes. Mathematically, it is the type of convolution. So, it can be viewed as an example of a low pass filter used in signal processing.

AutoRegressive Integrated Moving Average (ARIMA)

One of the most common methods used in time series forecasting is known as the ARIMA model, which stands for AutoRegressive Integrated Moving Average. ARIMA is a model that can be fitted to time series data in order to better understand or predict future points in the series. Differencing, autoregressive, and moving average components make up a non-seasonal ARIMA model which can be written as a linear equation:

$Yt= c+\phi 1ydt-1+\phi pydt-p+...+\theta 1et-1+\theta qet-q+et$.........(1)

Where yd is Y differenced d times and c is a constant.

There are three distinct integers (p, d, and q) that are used to parameterize ARIMA models. Together these three parameters account for seasonality, trend, and noise in datasets. The process of fitting an ARIMA model is sometimes referred to as the Box-Jenkins method.

- p is the auto-regressive part of the model. It allows us to incorporate the effect of past values into our model using the Partial autocorrelation graph.

- d is the integrated part of the model. This includes terms in the model that incorporate the amount of differencing (i.e. the number of past time points to subtract from the current value) to apply to the time series which may be 0, 1 or 2.

- q is the moving average part of the model. This allows us to set the error of our model as a linear combination of the error values observed at previous time points in the past using autocorrelation graph.

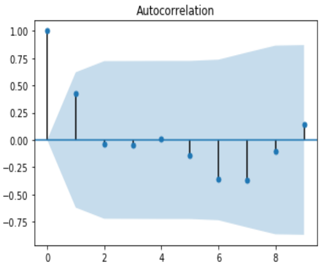


Figure 2: Autocorrelation

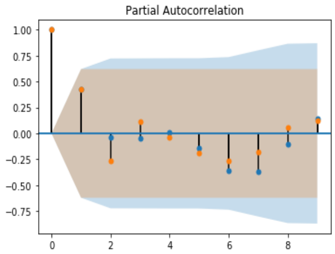


Figure 3: Partial Autocorrelation

Seasonal AutoRegressive Integrated Moving Average (SARIMA)

The ARIMA model above assumes non-seasonal series, which needs to be de-seasonalized. In this case, the model is specified by two sets of order parameters: (p, d, q) as described above and $(P,D,Q)m$(P,D,Q)m parameters describing the seasonal component of m periods. It has been formulated.

$\Phi(B)\Delta dXt= \theta(B)\alpha t$..(2)

Where αt is such that

$s\Phi(Bs)\Delta Ds\alpha t= s\Theta(Bs)$..(3)

$\Phi(B)s\Phi(Bs)\Delta Ds\Delta dXt= \theta(B)s\Theta(Bs)\alpha t$.........................(4)

And we write Xt ARIMA (p, d, q) × (P, D, Q) s. The idea is that SARIMA models are ARIMA (p, d, q) models whose residuals αt are ARIMA (P, D, Q). With ARIMA (P, D, Q) we intend ARIMA models whose operators are defined on Bs and successive powers.

V. MODEL DIAGNOSTICS

We have also performed the model diagnostics which suggests that the model residuals are normally distributed based on the following:

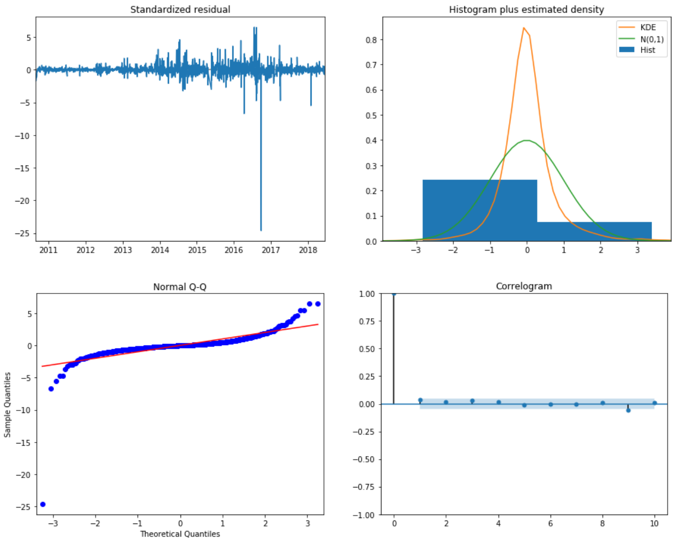


Figure 4: Model Diagnostics

- In the top right plot, we see that the red KDE line follows closely with the N (0, 1) line (where N (0, 1)) is the standard notation for a normal distribution with mean 0 and standard deviation of 1). This is a good indication that the residuals are normally distributed.

-The qq-plot on the bottom left shows that the ordered distribution of residuals (blue dots) follows the linear trend of the samples taken from a standard normal distribution with N (0, 1). Again, this is a strong indication that the residuals are normally distributed.

-The residuals over time (top left plot) don't display any obvious seasonality and appear to be white noise. This is confirmed by the autocorrelation (i.e. correlogram) plot on the bottom right, which shows that the time series residuals have low correlation with lagged versions of it.

VI. METHODOLOGY

After feature selection and dimension reduction the datasets is used to build classifier. In this method data is selected and preprocessed and a model is build using various classifiers.

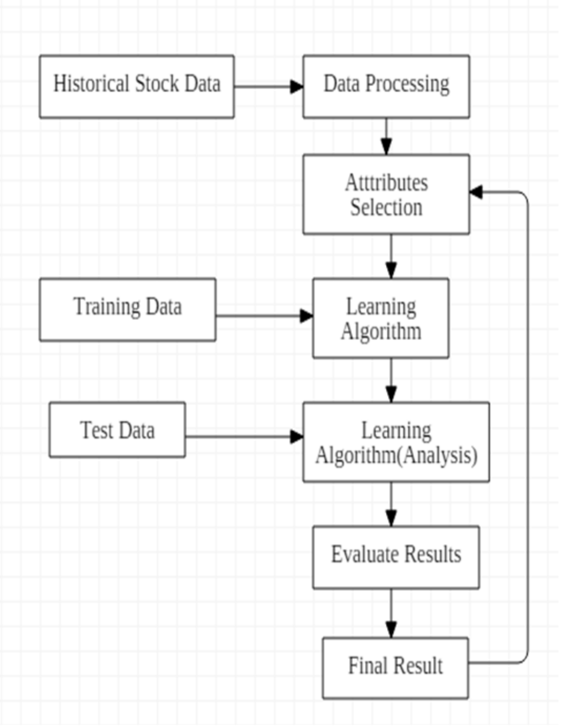


Figure 5: Block Diagram

VII. RESULT ANALYSIS

Evaluating the Stock market prediction has at all times been tough work for analysts. Thus, we attempt to make use of vast written data to forecast the stock market indices. We have implemented the application of time series analysis using SARIMA and ARIMA model and their salient feature. Our initial analysis show significant ACF and PACF between different input parameters.

In this project, the factors that are taken into account for change in the closing price of a particular company are: Date, Closing price, Opening price, High, Low, Volume, RSI. We performed analysis on obtained data to establish relation between our output parameters and the selected factors (Date and Closing price)

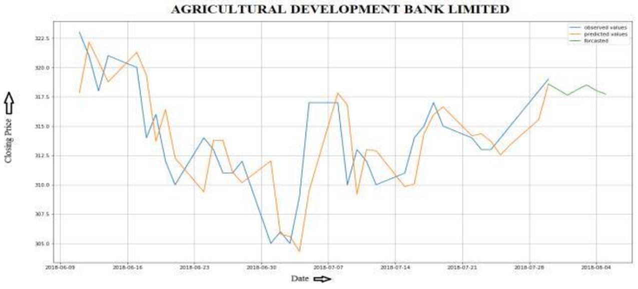


Figure 6: Actual vs. Forecasted: ADBL

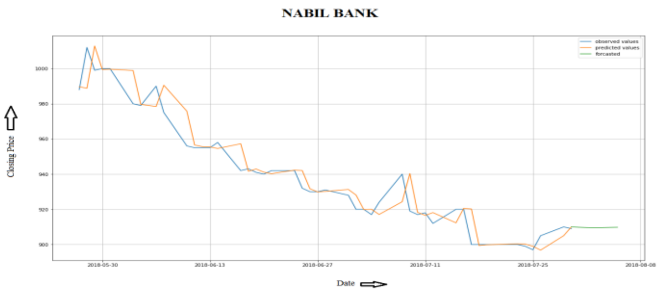


Figure 7: Actual vs. Forecasted: Nabil

The fig 6 and 7 shows the data of Agriculture Development Bank Limited and Nabil Bank respectively. A total of 3587 data were used for ADBL and 4513 data were used for Nabil Bank for calculation using only their Closing price and Date.

The result obtained in both the cases was fairly accurate as from fig taken. The prediction is fairly accurate unless there is huge and sudden variation in actual data. On other hand, this also proves the hypothesis that stock market is actually unpredictable. After the phase of forecasting, the result will be displayed to the users in the form of web pages which will benefit the financial analysts, investors to take trading decision by observing market behavior.

We obtained the MSE (Mean Square Error) using the SARIMA model as 30.01 whereas the MSE using the ARIMA model is 205.82. If Y' is a vector of n predictions generated from a sample of n data points on all variables, and Y is the vector of observed values of the variable being predicted, then the within-sample MSE of the predictor is computed as

$$\text{MSE} = \frac{1}{n}\sum_{i-1}^{n}(Y_i - \widehat{Y}_i)^2$$

VIII. CONCLUSION

Financial analysts, investors can use this prediction model to take trading decision by observing market behavior. The system we have designed is quite simple and works on time series analysis. While completing the project various problems were tackled and resolved to make the system more flexible. The project has been a great learning experience for us. Importance of team work is well understood through the project. This project did provide us the opportunity to learn new language Django, Python, also the practical approach of software engineering. Thus, we can say that the project was the great opportunity for us to test all the knowledge we have gained over the years studying engineering.

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Breast Cancer Prediction using Machine Learning Algorithm

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Abstract— **The second important cause of cancer deaths in women today is Breast Cancer and it is the most common type of cancer in women. Disease diagnosis is one of the applications of AI which can be implemented and are proving successful results. The main idea behind this project is to see to what extent can machine learning algorithms be used for detecting breast cancer of biopsied cells from women with abnormal breast masses. To create the classifier, the WBCD (Wisconsin Breast Cancer Diagnosis) dataset is employed [1]. This dataset is widely utilized for this kind of application because it is virtually noise-free and has just a few missing values. The objective of this project is we predict breast cancer tumors as either Malignant (being cancerous) or Benign (being non-cancerous) based on a given patient's symptoms and attributes so that we can pay proper attention towards health. The use of two popular algorithm KNN (K Nearest Neighbors) and Logistic regression is done in the project and hence based on their accuracy which is very close to each other we used KNN for further prediction. The performance of both algorithms is close to each other. Accuracy of KNN is (97.84%) which is greater than logistic (97.14%).Hence; we implemented KNN for prediction of breast cancer.**

Keywords— ***Wisconsin Breast Cancer Diagnosis, Malignant, Benign, K nearest Neighbors, Logistic Regression***

I. INTRODUCTION

Looking back at the recent health statistics report it was found that around 10 to 50% people get wrongly diagnosed of one or other disease every year. And this condition is not so different talking globally, so this is a problem for all. And here comes the role of technology which can help solve these problems. This will drastically reduce patient death, save medical practices a lot of money, and aid doctors in the patient care process. It's important to remember that AI won't replace doctors; it will become the most powerful tool they've ever used. And once enough AI startups start impacting the field of healthcare, it will become as common a tool as the stethoscope has been.

As we all know cancer is one of the most feared diseases in the world. Almost everyone knows someone who has been affected by cancer. The rate of people getting cancer has increased dramatically recently. External factors such as environment, lifestyle, genetic, food intake and so on have played a significant role in deciding whether a person would be suffering from cancer or not. It was found that around 8.8 million deaths occurred due to cancer in 2015 and is estimated to reach 12 million by 2030. In a country whose one third population is women, we took an initiative in the topic of breast cancer.

Breast cancer is the most prevalent cancer type in women in most parts of the world. The disease is characterized by two terms benign and malignant. The term "benign" refers to a tumor, condition, or growth that is not cancerous. This means it is localized and has not spread to other parts of the body or invaded and destroyed nearby tissue. The opposite of benign is "malignant" tumor. Malignant tumors are cancer, where the cancer cells can invade and damage tissues and organs near the tumor. Also, cancer cells can break away from a malignant tumor and enter the lymphatic system or the bloodstream.

Our project is based on implementation of machine learning based algorithms to predict and diagnose the class of breast cancer. In order to predict the class of breast cancer there has to be a model with accurate prediction that will help the doctors to diagnose the cancer whether it is benign or malignant. To achieve the prediction model we implemented "KNN" as well as "Logistic Regression" and tested the accuracy amongst these two algorithms. It was found that KNN gave slightly more accuracy than logistic so we implemented KNN to integrate our project. This project is used to identify the breast cancer condition whether it's benign or malignant.

II. RELATED WORK

New technologies like supervised learning, data analysis and prediction, data mining and knowledge discovery have developed allowing researchers and developers to discover knowledge and find hidden patterns in large data sets[2] . From our research we came up with few of the existing technology that is used in disease prediction:

Brisk: For women with a family history of the disease, the app walks them through their age-specific risk of developing the disease, beginning with a question about whether the family history involved a first-degree relative, a second-degree relative, a mother and paternal aunt, and so on. The app clearly cautions that it is not fail-safe. It is not a substitution for a formal cancer risk assessment by a skilled physician. It doesn't include risk factors other than family history.

Breast Cancer Recurrence Score Estimator:

Researchers from John Hopkins Kimmel Cancer Centre have created a free of cost web-based app, designed to assist in the prediction of the risk of the return of breast cancer in patients. The app itself was created by Leslie Cope Ph.D., an associate professor of oncology at the Johns Hopkins University School of Medicine and Kimmel Cancer Centre member, with the help of a team of graduate students who assisted with the coding. Called the 'Breast Cancer Recurrence Score Estimator', it is possible to use it for stage 1, 2, node negative and ER-positive breast cancers. They developed the app based on data taken from over 1,113 patients' medical records from five US hospitals. The researchers then added additional information from 472 other patients as a means of testing the estimator.

III. ABOUT THE DATASET

For this project, The Wisconsin Breast Cancer dataset from the University of California at Irvine (UCI) Machine Learning Repository is used to differentiate benign (non-cancerous) from malignant (cancerous) samples[1] . There are 699 number of instances and 10 attributes plus the class attribute. In the given data set, it had 16 missing attribute values. There are 16 instances that contain a single missing (i.e., unavailable) attribute value, now denoted by "?".
Data set characteristics is multivariate where attribute has integer type characteristics.
It has 2 class distribution having:
Benign: 458 (65.5%)
Malignant: 241 (34.5%)

Following Table 1 shows the description of breast cancer dataset and Table 2 consists brief details of attributes present in dataset.

Table 1: Description of data set

Datasets	Number of attributes	Number of instances	Number of classes	Number of missing values
Wisconsin Breast Cancer (Original)	11	699	2	16

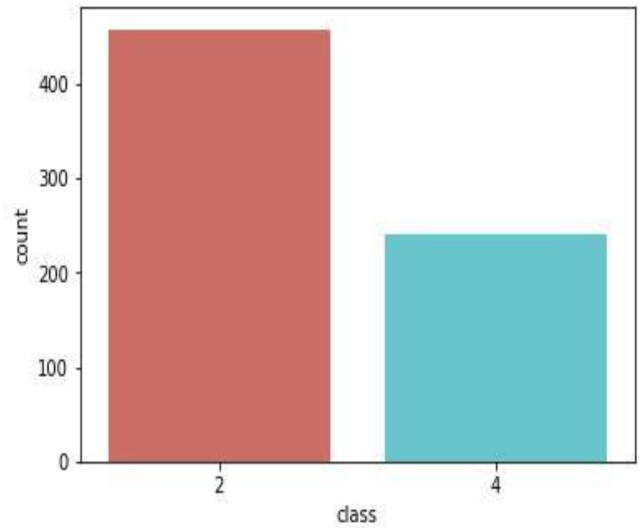


Table 2: Attribute of breast cancer dataset

Number	Attribute	Domain
1.	Sample number	ID Number
2.	Clump Thickness	1-10
3.	Uniformity of Cell Size	1-10
4.	Uniformity of Cell Shape	1-10
5.	Marginal Adhesion	1-10
6.	Single Epithelial Cell Size	1-10
7.	Bare Nuclei	1-10
8.	Bland Chromatin	1-10
9.	Normal Nucleoli	1-10
10.	Mitoses	1-10
11.	Class	1-10

Clump thickness: Benign cells tend to be grouped in monolayers, while cancerous cells are often grouped in multilayer. Uniformity of cell size/shape: Cancer cells tend to vary in size and shape. That is why these parameters are valuable in determining whether the cells are cancerous or not.
Marginal adhesion: Normal cells tend to stick together. Cancer cells tend to lose this ability. So loss of adhesion is a sign of malignancy.
Single epithelial cell size: Is related to the uniformity mentioned above. Epithelial cells that are significantly enlarged may be a malignant cell.
Bare nuclei: This is a term used for nuclei that is not surrounded by cytoplasm (the rest of the cell). Those are typically seen in benign tumors.
Bland Chromatin: Describes a uniform "texture" of the nucleus seen in benign cells. In cancer cells the chromatin tends to be coarser.
Normal nucleoli: Nucleoli are small structures seen in the nucleus. In normal cells the nucleolus is usually very small if visible at all. In cancer cells the nucleoli become more prominent, and sometimes there are more of them.

IV. METHODOLOGY

KNN: (K Nearest Neighbor) is a non-parametric, lazy learning algorithm. KNN searches the memorized training observation for the instances that most closely resemble the new instance & assign to it their most common class. Neighbors based classification is a type of lazy learning as it does not attempt to construct a general internal model, but simply stores instances of the training data. The 'K' in KNN is a hyper parameter that a designer, must pick in order to get the best possible fit for the data set Classification is computed from a simple majority vote of the k nearest neighbors of each point[3] . When we say a technique is non-parametric, it means that it does not make any assumptions on the underlying data distribution. In other words, the model structure is determined from the data.

This algorithm is simple to implement, robust to noisy training data, but it needs to determine the value of K and the computation cost is high as it needs to computer the distance of each instance to all the training samples[4].

The K-Nearest neighbor algorithm essentially boils down to forming a majority vote between the k most similar instances to given 'unseen' observation. Similarity is defined as a distance metric between two data points so a popular choice is Euclidean distance, especially when measuring the distance in the plane, we use the formula for the Euclidean distance[5]. According to the Euclidean distance formula, the distance between two points in the plane with coordinates (x, y) and (a, b) is given in equation in equation (1.1) and for our dataset equation can be given in (1.2)

$$\text{dist}((x, y),(a,b)) = \sqrt{(x—a)^2 + (y—b)^2} \qquad (1.1)$$

$$\text{dist}((\text{train\_x},\text{train\_y}),(\text{test\_x},\text{test\_y})= \sqrt{(\text{train\_x}-\text{test\_x})2 +(\text{train\_y}-\text{test\_y})2} \qquad (1.2)$$

LOGISTIC REGRESSION

Logistic Regression is one of the most used Machine Learning algorithms for binary classification. It is a simple Algorithm that you can use as a performance baseline, it is easy to implement and it will do well enough in many tasks. Logistic regression is a machine learning algorithm for classification. In this algorithm, the probabilities describing the possible outcomes of a single trial are modeled using a logistic function.

Logistic Regression measures the relationship between the dependent variable (our label, what we want to predict here benign and malignant) and the one or more independent variables (our attributes), by estimating probabilities using its underlying logistic function [6]. These probabilities must then be transformed into binary values in order to actually make a prediction. This is the task of the logistic function, also called the sigmoid function. The Sigmoid-Function is an S-shaped curve that can take any real-valued number and map it into a value between the range of 0 and 1, but never exactly at those limits. These values between 0 and 1 will then be transformed into either 0 or 1 using a threshold classifier.

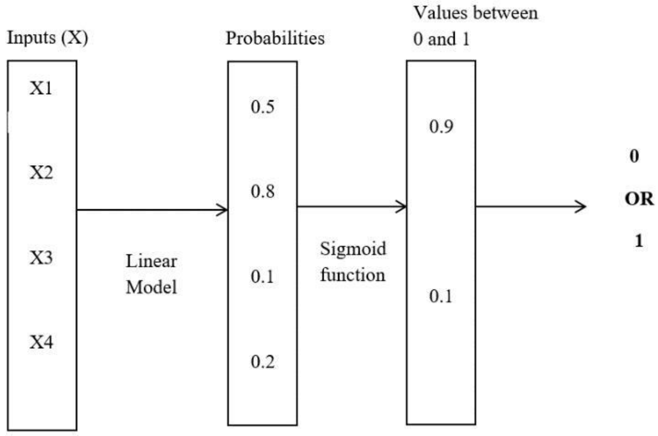


Figure 5: Steps illustrating logistic regression

Logistic regression is designed for this purpose (classification), and is most useful for understanding the influence of several independent variables on a single outcome variable. But it works only when the predicted variable is binary, assumes all predictors are independent of each other, and assumes data is free of missing values.

- Finds relationship between output and one or more inputs by calculating logit function

Logit = b0+b1*x1+b2*x2+………b9*x9 where x1…x9 are the attributes for given breast cancer and b0…b9 are the coefficients of training data.

- Probabilities values are then converted into binary values by sigmoid function given in equation 1)

$$\text{Sigmoid function} = 1/ (1+ e\text{-}X) \qquad (1.3)$$

- The values between 0 and 1 representing labels of our output.

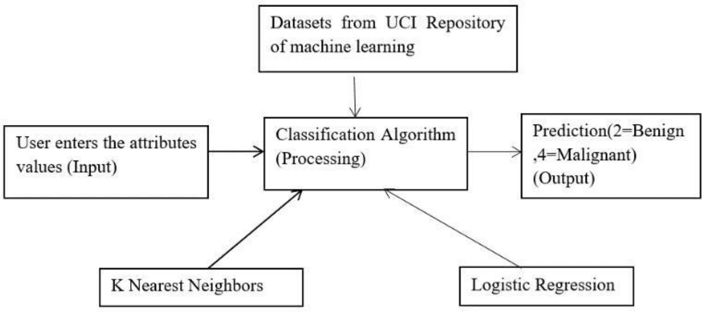

Datasets from UCI Repository of machine learning
User enters the attributes values (Input)
Classification Algorithm (Processing)
Prediction(2=Benign ,4=Malignant) (Output)
K Nearest Neighbors
Logistic Regression

Figure 6: System Architecture

V. RESULT ANALYSIS

The motive of our project was to predict the class of breast cancer a person has and to carry out this task we used dataset from UCI archive the largest dataset provider for research and studies. From further study and analysis from our thus collected data set we came up to the conclusion of using KNN algorithm to build our model. We choose KNN because it best fits for small size data set between few hundreds to nearly thousand and since our data set lied within that range and since our output is of binary class (0 or 1) so classification was the best fit for creating our model. After the implementation of KNN algorithm we used 80% of the dataset to train the machine and later 20% to test the accuracy of our model. Our data set consists of total of 699 instances among which Benign: 458 (65.5%) Malignant: 241 (34.5%). Using the train test split we could easily predict the class of breast cancer as either benign or malignant and this prediction model gave us a confidence level of 97.845%. Since our goal was also to analyses the and accuracy of different algorithms so we also tested our dataset using another algorithm called Logistic Regression which gave us a confidence level of (97.14%). From the final result after comparison we achieved KNN slightly more precise in its prediction so we used KNN based model to integrate it with our frontend and backend API.

From the analysis above we can conclude that the model created gives excellent accuracy in predicting breast cancer from tumor data, therefore all the exploration and manipulation of the dataset were valid for this purpose. Hence from our project we were able to build a tool for the doctors that will help them reduce the inconsistency or misdiagnosis of disease. [7] For the further study between the datasets we performed correlation analysis and plotted a graph between attributes.

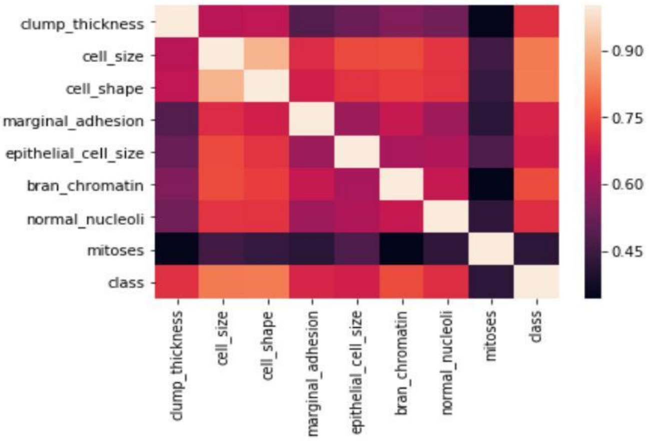
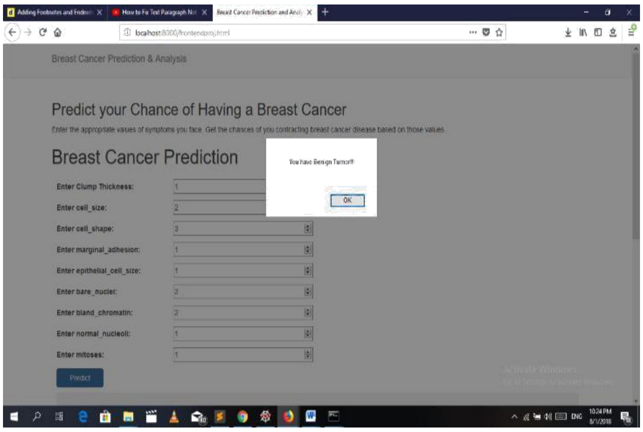


Figure 7: Correlation between attributes

Following is the table showing result of accuracy and algorithms:

Table 3: Accuracy table

Algorithm	Accuracy
KNN	97.84%
Logistic Regression	97.14%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localhost:8000/frontendproj.html
Breast Cancer Prediction & Analysis
OK
Predict
10:24 PM
8/1/2018

Predict your Chance of Having a Breast Cancer

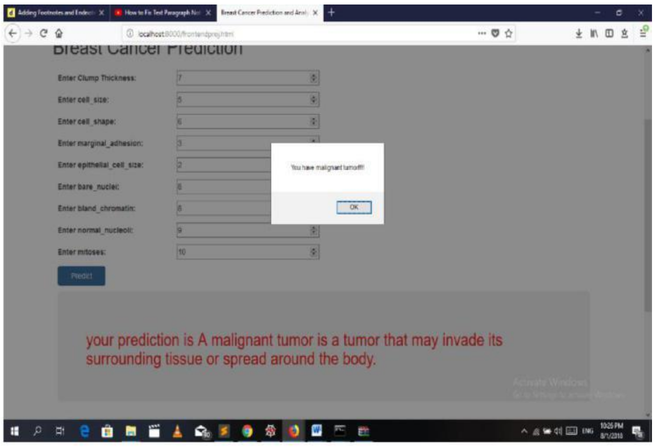
Enter the appropriate values of symptoms you face. Get the chances of you contracting breast cancer disease based on those values.

Breast Cancer Prediction

Enter Clump Thickness: 1
Enter cell_size: 2
Enter cell_shape: 3
Enter marginal_adhesion: 1
Enter epithelial_cell_size: 1
Enter bare_nuclei: 2
Enter bland_chromatin: 2
Enter normal_nucleoli: 1
Enter mitoses: 1

You have Benign Tumor!!

Figure 8: Prediction 1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localhost:8000/frontendproj.html
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OK
Predict
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Enter Clump Thickness: 7
Enter cell_size: 5
Enter cell_shape: 6
Enter marginal_adhesion: 3
Enter epithelial_cell_size: 2
Enter bare_nuclei: 8
Enter bland_chromatin: 8
Enter normal_nucleoli: 9
Enter mitoses: 10

You have malignant tumor!!!

your prediction is A malignant tumor is a tumor that may invade its surrounding tissue or spread around the body.

Figure 9: prediction 2

VI. CONCLUSION

There are various data mining techniques available in medical diagnosis, where the objective of these techniques is to assign a patient to either a ‘healthy’ group that does not have a certain disease or a ‘sick’ group that has strong evidence of having that disease[8][9]. The system we have designed is quite simple and it works both on Logistic Regression and KNN based algorithm. From the analysis of the dataset we can conclude that the model we have created gives us good accuracy in predicting breast cancer from tumour data. Therefore all the exploration and manipulation of the dataset were valid for this purpose and it highly increases the accuracy of prediction. With the completion of this project we were able to visualize the impact of data mining and machine learning algorithms in the field of medicine [10]. Hence this project has been a great learning experience for us.

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Decentralized Application for Common Student Record on Hyperledger Fabric

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Abstract—**This paper describes the application which makes the record of students decentralized within the network of Universities. Existing record handling method in educational sectors are centralized. The very governing architecture leads to vulnerability in the loss of records on the failure or damage of the central record storage facility. In addition, there is no transparency on the management of records. In order to address these major issues, we implemented distributed ledger technology also known as blockchain technology. With the use of blockchain technology a ledger is created and distributed among the Universities, This makes the activities more transparent and secured as every activity on the network is recorded on this ledger. Also, the records that one University stores record on the local storage via an application, the record is distributed among the participant of the network. Among numerous existing platform for blockchain application development, we implemented Hyperledger Fabric, Hyperlegder Composer, and IBM Blockchain platform. The resulting product is the composer application that runs locally on the device and is connected to the IBM Blockchain services' instance. This paper describes the development of a decentralized application which is able to share the record among the participant of the network, on top of the Hyperledger Fabric architecture.**

Keywords—*Blockchain, Hyperledger Fabric, Hyperledger Composer, IBM Blockchain Service*

I. INTRODUCTION

The development of technology has formed a chain reaction on digitization. Currently, almost every piece of data or information has been converted into digital form. Nowadays even paper money is being replaced by digital money. However, there are always new problems arising with the development especially in the technological field. The major problem which is developing in the serious issue is the risk of losing data. If the storage facility of any particular data is damaged, the data is bound to disappear since digital information is more vulnerable to even small risks. If data is lost the retrieval is almost impossible. All of these major problems can be concluded to the single problem of centralized data architecture.

Prevention is better than cure. So making the record secure can be the ultimate solution to guarantee its security. One of the specific sector for decentralization of data is records of educational sectors. Student's records are mainly the academic certificates that reflect the qualification that they have achieved. These are the valuable assets for the future use and are necessary for as long as they live. Records of students can be viewed in order to get the summary of the qualification and the amount of knowledge they have. Eventually, for every professional practice, these documents are compulsory.

Since records reflect the past, they need to be highly secured. Otherwise, theoretically, the past is erased with the damage on the records. The ease in accessibility and security of these documents can provide huge comfort for anyone who is willing to protect their past. The written or hard copy of documents are very vulnerable to physical damage and in many cases, they get lost. The recovery of the document is inefficient as the data are centralized in a single record system. The recovery of the documents take the large amount of time, effort and it might cost some money as well. And if the single record system of the educational sector gets damaged then the proof of record is lost.

Decentralization of the records like academic certificates not only makes the practices for student easier but also make the whole system more meaningful and efficient. Implementation of the decentralized architecture of data makes the record secured, less vulnerable to damage and eases the accessibility.

II. RELATED WORKS

Though there is an immense development of distributed ledger technology in the area of cryptocurrencies, the implementation in the business level is not too popular. It has just started to catch the eye of business companies for the implementation of record handling. There are numerous other blockchain platforms that offer the scripting. Ethereum and EOSIO are some of those platforms. However, the Ethereum network is public where every node is equal. This cannot help build the business level applications. So, Hyperledger Fabric and r3Corda are showing many implementations in small organizations. In recent times distributed ledger technology has been implemented in medical record handling. MedRec is one of the blockchain applications makes the medical records decentralized. In addition, there are numerous ongoing distributed ledger technologies fully contributed towards record decentralization. Since this technology is coming forward in recent times, only a few developed applications have been produced and implemented in business level for record decentralization.

BI. ABOUT HYPERLEDGER FABRIC AND HYPERLEDGER COMPOSER

Hyperledger Fabric is one among many Hyperledger projects hosted by Linux Foundation. Hyperledger Fabric project has been supported and hugely promoted by IBM. The focal point of this platform is that it allows the permission network along with the implementation of unique architecture to facilitate the business-level use cases. The primary goal of this platform has been to enhance business level use cases. The smart contract which is termed as ‘Chaincode’ in the fabric network defines the type of assets and transactions that run on the application. Chaincode that runs on the network is needed to develop by programmers as desired for any particular field.

Hyperledger Composer is one of the toolsets that provides ease in the development of Hyperledger Fabric Application. Using composer the application is modeled in Composer Modelling Language and the logic of the application can be written in programming languages including, JavaScript, and Golang. Composer toolset provides the developer a familiar environment for the development of application since it offers numerous familiar languages for coding and also offers a testing platform.

IV. HYPERLEDGER FABRIC ARCHITECTURAL DESCRIPTION

The architecture of Hyperledger Fabric can be depicted logically in three categories as shown in figure 1. The three main logical partitions with which the architecture can be visualized as Membership, Blockchain, and Chaincode.

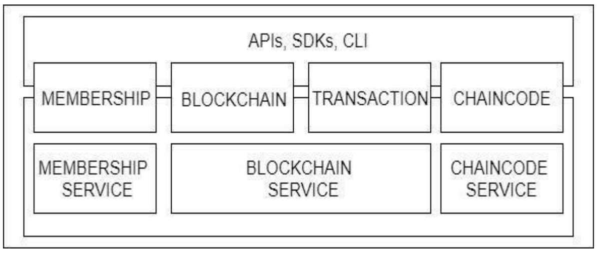


Figure 1: Hyperledger Fabric Architecture

- The membership service deals with the management of members within the network. The identity of the participant along with credentials management is handled here. Furthermore, the required information for validating the authenticity of the participants falls under this depiction.
- The blockchain service mainly deals with the management of Distributed Ledger and Consensus. Creating blocks with suitable cryptographic hash and updating the ledger is handled by blockchain service. Prior to creating blocks, the validations are done with appropriate consensus algorithm. Upon successful validation, the block is created and added to the ledger.
- Chaincode service has the main function of storing and managing chaincode that runs on the network. There are several ways of managing the chaincode storage. It can either run on the local system or can run on the cloud. The participant interacts with one another over HTTP channels.

These logical depictions which carry specific task in the network are termed as Orderer, Peer, Certificate Authority, and Endorser. Orderer provides communication layer and Endorser provides the service of endorsing the transaction with appropriate policy. After the endorsement policy is passed the transaction it is validated with the help of the Certificate Authority and the block is created. After this, the final verification is done by Peers and is decided to add to the ledger or not.

V. ABOUT THE APPLICATION

The decentralized application for the common student record is the implementation of distributed ledger technology for increasing the transparency of record management. In addition, the major aim of this paper is to share the records among the universities. The application block diagram is shown in figure 2.

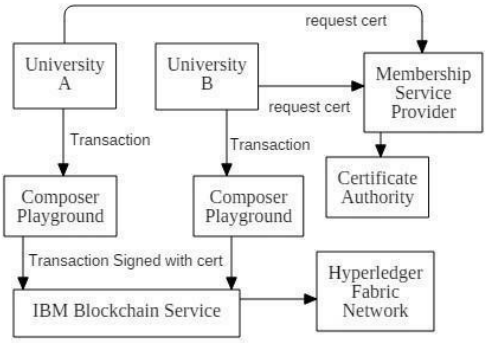


Figure 2: Application Block Diagram

Universities need to install the application on the local device after configuring the runtime environment which includes installing composer tools. Since this is a network application, there needs to be a dependable internet connection. Initially, the request is sent to the membership service provider. As the response, the required credentials are returned to the requester i.e University. The credentials consist of connection profiles along with private and public key for the University to participate and transact on the network. All these steps are carried out via Composer CLI commands. Once all the credentials are achieved the necessary cards are also generated and kept in the wallet which is stored as a file in the local system.

The user interface used for the connection with the network and carrying out a different tasks on the application is Composer Playground. Composer Playground is the generic user interface which falls under Hyperledger Composer toolset. Whenever the application is used to transact the records, the information is signed with the private key of that very organization and then sent to the IBM Blockchain instance. The information is validated with the public key of that organization and the block is created, added to the ledger and is sent to other Universities who are on that fabric network. Along with the shared ledger, the newly updated local registry of the University that initiated the transaction is shared among the participant of that fabric network.

VI. METHODOLOGY

The application itself is coded and tested as per the incremental model of software development. The application is developed using the Composer Modelling Language along with JavaScript. The testing of application is done in one of the Composer toolset called Composer Playground. It allows runtime like simulation for testing. Once the application was developed, we used IBM Blockchain service to deploy our application.

The IBM Blockchain service provides two organization in order to simulate the multi-organization runtime environment. Other than this the starter plan eases the deployment provides and instantiates every logical depiction that the Hyperledger Fabric describes including Orderer, Endorser, and Certificate Authority. The deployment of the application is done through a series of commands. The commands are written in composer cli. The series of task that is carried out during the deployment of the application is shown in figure 3.

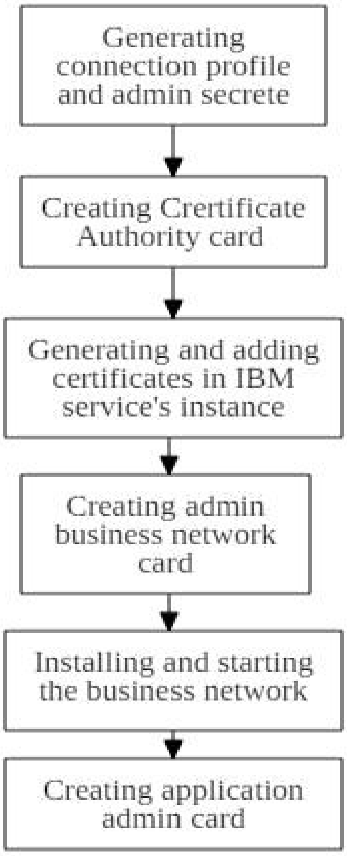
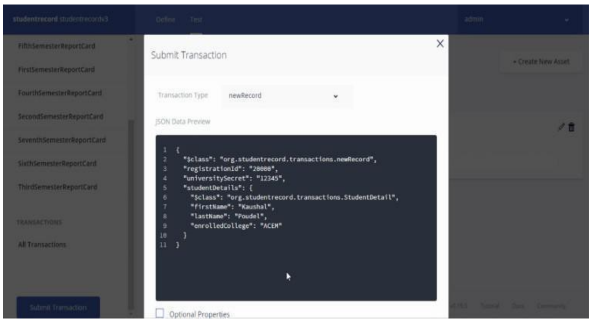

Generating connection profile and admin secrete
Creating Crertificate Authority card
Generating and adding certificates in IBM service's instance
Creating admin business network card
Installing and starting the business network
Creating application admin card

Figure 3: Deployment Steps

Initially, the enrollment secret was fetched from the generated connection profile. The same steps of tasks were done by both Universities. Once the certificate authority card was created the credentials were requested and downloaded in the local file system. Using the credentials we generated the admin card for installing the application and later instantiating it. While starting the business network both organizations' credentials were used in order to successfully start the application. Once this step was completed the composer-playground was locally-launched and the data of the application were locally stored.

VII. RESULTS

First, the distributed ledger technology was successfully implemented to increase the transparency of record management. Every time the transaction is made as shown in figure 4, the action is recorded in the ledger by the formation of a new block as shown in figure 6. Each block consists of its own unique id, what was the request and what change occurred on the registry after a successful transaction as shown in figure 7.1 and figure 7.2.



Submit Transaction

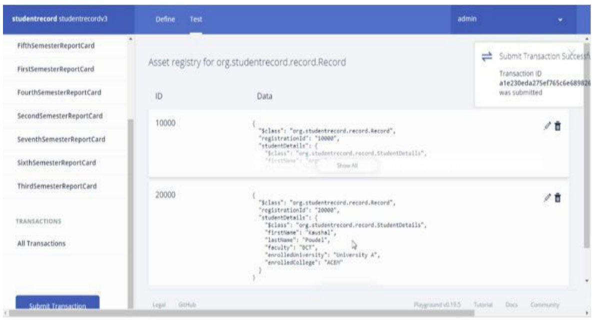
Transaction Type: newRecord

JSON Data Preview

```
{
  "$class": "org.studentrecord.transactions.newRecord",
  "registrationId": "20000",
  "universitySecret": "12345",
  "studentDetails": {
    "$class": "org.studentrecord.transactions.StudentDetail",
    "firstName": "Kaushal",
    "lastName": "Poudel",
    "enrolledCollege": "ACEM"
  }
}
```

☐ Optional Properties

Figure 4: Initiating transaction for new asset creation on University A



Asset registry for org.studentrecord.record.Record

Submit Transaction Successf
Transaction ID
a1e230eda275ef765c6e68982
was submitted

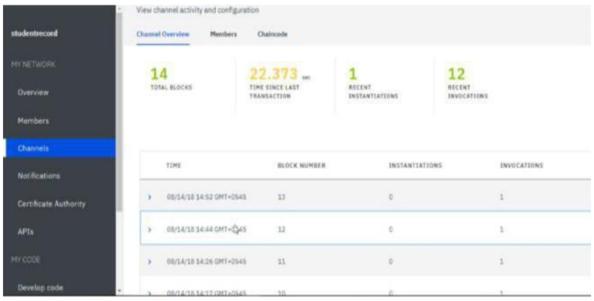
ID: 10000

```
{
  "$class": "org.studentrecord.record.Record",
  "registrationId": "10000",
  "studentDetails": {
    "$class": "org.studentrecord.record.StudentDetails",
```

ID: 20000

```
{
  "$class": "org.studentrecord.record.Record",
  "registrationId": "20000",
  "studentDetails": {
    "$class": "org.studentrecord.record.StudentDetails",
    "firstName": "Kaushal",
    "lastName": "Poudel",
    "faculty": "BCT",
    "enrolledUniversity": "University A",
    "enrolledCollege": "ACEM"
  }
}
```

Figure 5: Successful creation of new asset on University A asset registry

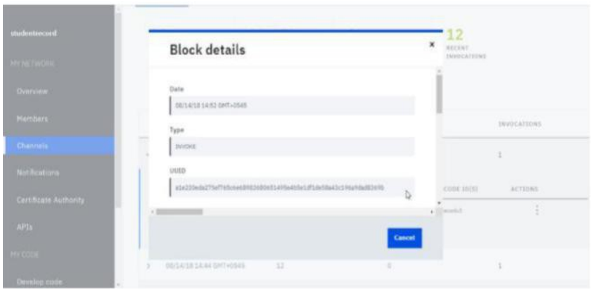


View channel activity and configuration

14 TOTAL BLOCKS — 22.373 sec TIME SINCE LAST TRANSACTION — 1 RECENT INSTANTIATIONS — 12 RECENT INVOCATIONS

TIME	BLOCK NUMBER	INSTANTIATIONS	INVOCATIONS
08/14/18 14:52 GMT+0545	13	0	1
08/14/18 14:44 GMT+0545	12	0	1
08/14/18 14:26 GMT+0545	11	0	1
08/14/18 14:12 GMT+0545	10	0	1

Figure 6: Creation of new block



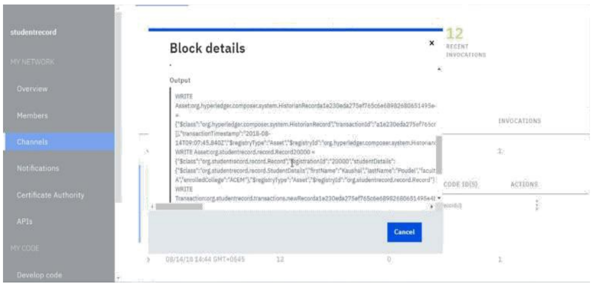
Block details

Date: 08/14/18 14:52 GMT+0545

Type: INVOKE

UUID: [illegible]

Figure 7.1: Block details (Timestamp and ID)



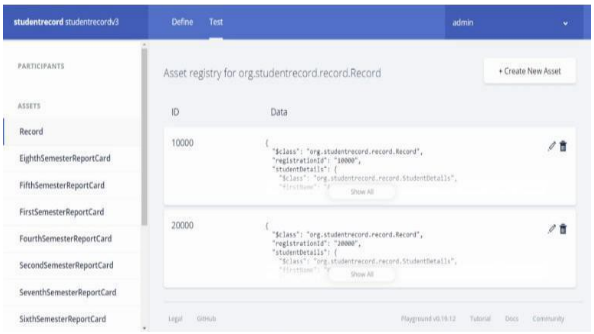
Block details

Output

```
WRITE
Asset:org.hyperledger.composer.system.HistorianRecorda1e230eda275ef765c6e68982680651495e
=
{"$class":"org.hyperledger.composer.system.HistorianRecord","transactionId":"a1e230eda275ef765c
[],"transactionTimestamp":"2018-08-
14T09:07:45.840Z","$registryType":"Asset","$registryId":"org.hyperledger.composer.system.Historian
WRITE Asset:org.studentrecord.record.Record20000 =
{"$class":"org.studentrecord.record.Record","registrationId":"20000","studentDetails":
{"$class":"org.studentrecord.record.StudentDetails","firstName":"Kaushal","lastName":"Poudel","facult
A","enrolledCollege":"ACEM"},"$registryType":"Asset","$registryId":"org.studentrecord.record.Record"}
WRITE
Transaction:org.studentrecord.transactions.newRecorda1e230eda275ef765c6e68982680651495e4
```

Figure 7.2: Block details (Output)

In addition, the identity of the organization that performed the transaction was also seen on the block and the timestamp related to that transaction. The registry which is updated on one machine is shared among the participant i.e. another University on the network as shown in figure 8. The same registry can be seen by both Universities.



Asset registry for org.studentrecord.record.Record

ID: 10000

```
{
  "$class": "org.studentrecord.record.Record",
  "registrationId": "10000",
  "studentDetails": {
    "$class": "org.studentrecord.record.StudentDetails",
```

ID: 20000

```
{
  "$class": "org.studentrecord.record.Record",
  "registrationId": "20000",
  "studentDetails": {
    "$class": "org.studentrecord.record.StudentDetails",
```

Figure 8: Shared registry on University B

VIII. CONCLUSION

We were able to implement the

distributed ledger for transparency of transactions on records with the help of IBM Blockchain service and were able to share the data among the participant of the network. We found that the decentralization of records is possible and can produce some great benefits to overcome the issues and problem faced with existing centralized system.

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Nepali Sentiment Analysis using Neural Network

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Abstract— Sentiment Analysis also known as opinion mining is the process of identifying and categorizing opinions are now being possible due to the abundance of texts on the internet. For this, we have developed a system to analyze sentiment in Nepali sentences using a Recurrent Neural Network. The system is able to classify the Nepali text sentences as either negative or positive. We collected data from various news websites as well as from social media websites then labeled some data points and trained the neural network model to form the system that can classify sentiments. This paper deals with the collection of data, training the model to run inference on it. The results of this system show that the LSTM RNN approach to sentiment analysis can obtain about 70% test accuracy on our self-created corpus.

Keywords— Natural Language Processing, Machine Learning, Neural Networks, Nepali Language, Sentiment Analysis

I. INTRODUCTION

As motivated by the rapid growth of text data, text mining has been applied to discover hidden knowledge from a text in many applications and domains. In business sectors, great efforts have been made to find out customers' sentiments and opinions, often expressed in free text, towards companies' products and services. However, discovering sentiments and opinions through manual analysis of a large volume of textual data is extremely difficult. Hence, in recent years, there have been much interests in the natural language processing community to develop novel text mining techniques with the capability of accurately extracting customers' opinions from large volumes of unstructured text data. Among various opinion mining tasks, there is sentiment classification which classifies people's opinions as a positive or negative spectrum.

There has been an abundance of Nepali text data in various Nepali news websites as well as social media websites such as; onlinekhabar.com, ratopati.com, ekantipur.com, facebook.com etc. Comments and reviews are being constantly made using Nepali Unicode which provides the ground from where the data can be collected. The Nepali language is morphologically rich and complex so the classifier needs to consider several specific language features before classifying text. Preprocessing data is one of the delicate stages in the sentiment analysis task [1].

The third section discusses the data used in this paper and their collection using web scraping techniques and with proper API's. The fourth section deals with the methodology of data preprocessing and implementation of the system. The fifth section deals with results and shows how the accuracy of the model differs using the training data and testing data.

II. RELATED WORK

The bootstrap work done in the field of sentiment analysis is by Peter D. Turney that classified the sentiment of reviews as recommended (thumbs up) and not recommended (thumbs down) [2] receiving the accuracy of 74%. Whereas in the case of Nepali Sentiment Analysis there has not been a major breakthrough. Chandan Prasad Gupta and Bal Krishna Bal proposed [1] the system of detecting the sentiment in Nepali texts using self-developed Nepali Sentiment Corpus. They use lexical methods to classify the texts.

The major breakthrough in this field happened when researchers at Stanford University proposed the recurrent neural network system for noise reduction in automatic speech recognition (ASR) system [3]. This gave a new approach to tackle sequential data in the field of natural language processing and machine learning in general. The recurrent neural network has outperformed different other models in this task of analyzing and processing sequential data such as a sequence of text.

The paper [4] by Mikolov et. al. discusses the efficient estimation of word embedding using skip gram approach which can be considered as one of the groundbreaking works increasing the efficiency of the classification system. Similarly, other various authors have used various natural language processing techniques to classify sentiment of texts in different languages. Like in this paper [5] the author discusses the approach taken to analyze Turkish political news. Also, in this paper [6] author have used a lexicon-based approach for classifying Indian text which is lexically similar to the Nepali language.

III. ABOUT THE DATASET

The dataset used in this paper has been collected from various news websites such as; bsgnews.com, annapurnapost.com, also from Facebook and Twitter for realistic reviews and comments in Nepali language and Nepali corpus dataset (16NepaliNews corpus) easily available from GitHub [7]. Web-Scrapping technologies like; Beautiful Soup for python has been used to scrap the data from various news websites mentioned above whereas API for the social networking websites were also used. The following tables show the sources of data along with their numbers.

Table 1: Data Sources with numbers

Source	Number of Data
16NepaliNews Corpus	14,364 Articles
Facebook	5,021 Comments
Twitter	324 Tweets
Annapurnapost.com	400 Articles
Bsgnews.com	1000 Articles

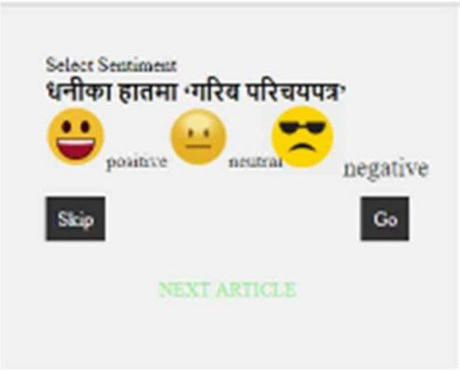
IV. METHODOLOGY

A. Data Collection

The raw data from the websites were pre-processed before it could be used. Some of the processes for preprocessing the data were:

- Removing all the HTML entities like; tags and images
- Removing all characters that are not Nepali Unicode

After preprocessing some of them were stored in a MySQL database for data labeling process and a remaining huge portion of data was stored in a file for creating word embedding using word2vec algorithm [4]. Manual annotation of data was done using the labeling system created by using web application created with PHP programming language; Laravel framework. The screenshot of the labeling application is shown below in figure 1.



धनीका हातमा ‘गरिब परिचयपत्र’

Figure 1: Sentiment Labeling Screenshot

After the sentences were manually annotated using the labeling system they were stored in JSON format in a file which is then later used for training the neural network.

B. Data Preprocessing

After data is collected, it is processed and transformed into the correct format so that the neural network can understand both inputs and outputs. The block diagram below shows the data preprocessing step of the project.

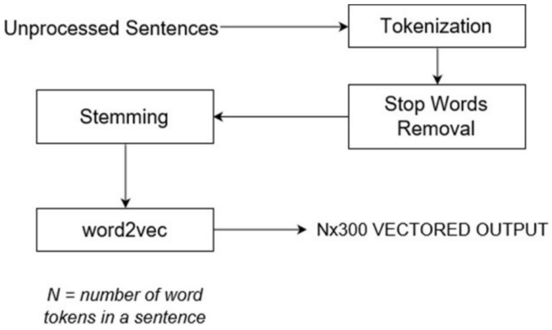


Figure 2: Block Diagram of Text Preprocessing

From the block diagram, the process is clear and following sub-sections describes each step involved in data preprocessing process.

Tokenization

The raw data were broken down to sentences and then to words. Sentences were separated by punctuations such as (?,□,.) and words were separated by commas and white spaces

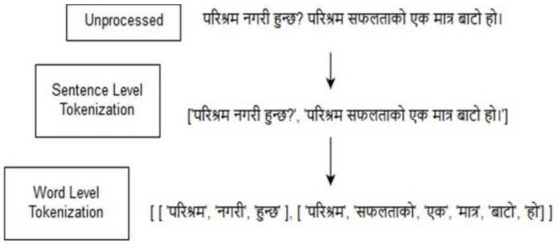

Unprocessed
परिश्रम नगरी हुन्छ? परिश्रम सफलताको एक मात्र बाटो हो।
Sentence Level Tokenization
['परिश्रम नगरी हुन्छ?', 'परिश्रम सफलताको एक मात्र बाटो हो।']
Word Level Tokenization
[['परिश्रम', 'नगरी', 'हुन्छ'], ['परिश्रम', 'सफलताको', 'एक', 'मात्र', 'बाटो', 'हो']]

Figure 3: Tokenization

Stop Words Removal

Stop words are highly frequent words in the corpus that do not provide any value to analysis. A dictionary of stop words was created and the matching words were removed.

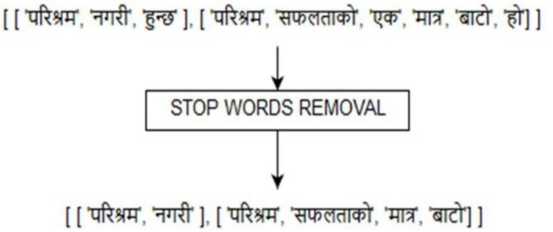

[['परिश्रम', 'नगरी', 'हुन्छ'], ['परिश्रम', 'सफलताको', 'एक', 'मात्र', 'बाटो', 'हो']]
STOP WORDS REMOVAL
[['परिश्रम', 'नगरी'], ['परिश्रम', 'सफलताको', 'मात्र', 'बाटो']]

Figure 3: Stop Words Removal

Stemming

Snowball rule-based stemming algorithm [8] was used for removing some of the stems of Nepali language such as; □□, □□□, □□ etc.

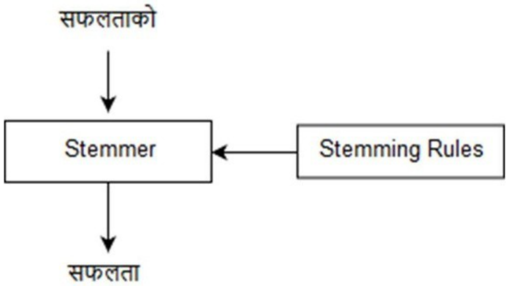


Figure 3: Stemming

Word2Vec

The word tokens were converted into 300 dimensioned feature vectors. These feature vectors or embedding vectors were created in such a way that words which are related with each other had vectors nearest to each other. This is the application of this paper [4], Efficient Estimation of Word Representations in Vector Space.

Thus, the unprocessed text sentences were converted into words embedding vector of Nx300 where N represents the number of word tokens in the sentence.

For example: Nepali sentence “□□□□ □◌□□□□ □□□ □□□P □□ P □“ is converted to feature vectors as; [[0.22, 0.56, 0.70, 0.24, 0.11, …], [0.12, 0.22, 0.36, 0.11, 0.33, …]
,..]

C. Neural Network Model

After text preprocessing the datasets were used to build the sentiment classifier. It is the final step in preparing the model for classification. The labeled data from the JSON file is then fed into the neural network as shown in figure 3 one by one after splitting them into train and test samples.

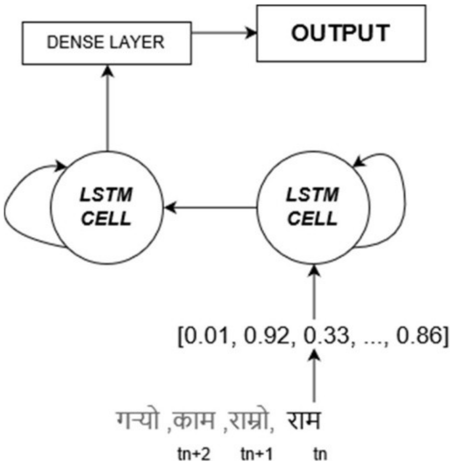


Figure 3: RNN Block Diagram

The neural network consists of two LSTM (Long Short-Term Memory) Cells connected together in a stack with the output of 128 dimensions to be reduced to 2-dimension vector using a dense layer. We use softmax cross-entropy as loss function to train the neural network optimized using Adam optimizer. The following line graph shows training accuracy during the training process.

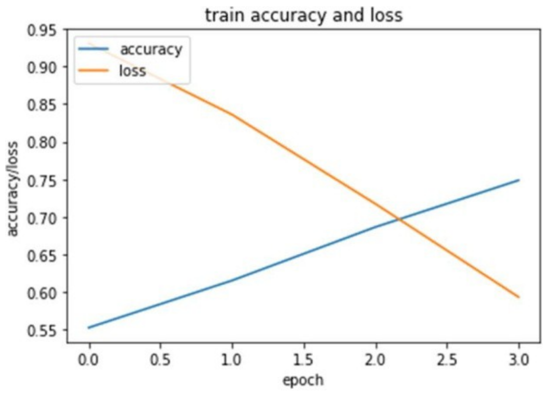


Figure 4: Accuracy and Loss vs. Epoch

After training for 4 epochs with 3000 annotated data points the model was saved for later use.

V. RESULT ANALYSIS

Using the model above we were able to reach a training accuracy of 75% and test accuracy of 70% as shown by the table below.

Table 2: Accuracy and Loss for Training and Testing Process

	Accuracy	Loss
Training	75%	0.58
Testing	70%	0.67

Table 2 shows that using the given machine learning model we can achieve test accuracy of 70%. And this percentage can be more increased by tuning the hyper-parameters of the neural network like; LSTM cell size, efficient word embedding using big Nepali text corpus etc.

VI. CONCLUSION

Collecting new data and social media reviews and comments can be done using web scraping technologies and provided API's but manually labeling those points is a tedious task. From the experiments, it is clear that the LSTM RNN model can be a better approach to sentiment analysis. Using the model, a generalized approach to sentiment analysis has been established which was good at learning from numerical sequences. Similarly, the word2vec model used for vector conversion because of it being context based can be efficient encoding mechanism for new data points as well. More care has to be taken while preprocessing data because it is the majority of the training process. Even though the data was not of high quality the model responded with a test accuracy of 70%. Hence, a model for Nepali sentiment analysis can be created using data mining process to gather data, stemming and tokenization to pre-process data and LSTM cells to train on those sequential data.

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Cryptocurrency Trend Analysis and Correlation with Twitter Sentiment

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Abstract - **This research is concerned with predicting the fluctuations in the volatile price of Bitcoin, which is nowadays increasingly used for online transactions worldwide and are considered as the global standard for transactions in the near future. Bitcoin lacks central governing authority and is built on a decentralized, peer-to-peer network with transactions being carried out by the members of the network which may be any general public. Thus daily transaction, trader's activities and general opinion of people towards Bitcoin can have direct or indirect influence on its market value. Twitter being one of the influential social media with many authentic news accounts is selected as a source of news related to Bitcoin for this research. A sentiment analysis system is devised using Linear Support Vector Classifier which gives either positive or negative label to each tweet from the news corpus with the accuracy of 84.43%. Then the sentiment score of each day is analyzed for cross correlation with corresponding price of Bitcoin of the same day which implied sentiment of today has maximum impact on price of tomorrow. Therefore to predict the increase or decrease of the price for the following day a Naïve Bayes classifier is trained with sentiment score and price which yielded an accuracy of 78.03%.**

Index Terms – Bitcoin, Sentiment, Linear Support Vector, News Corpus, Cross-Correlation, Naïve Bayes.

I. Introduction

Cryptocurrency [1] is digital currency governed by cryptographic protocol which uses Blockchain [1]. The continuous increase in adoption and widespread usage has increased its value in real world applications by substantial amount. Various cryptocurrencies have been invented since 2009 but the first one to be launched as a cryptocurrency was Bitcoin [2]. It is a form of electronic cash with no governing financial institution which can be used for online transactions or as exchange between any two parties. Nowadays due to its fluctuating and big-ticket value lion's share of bitcoin transactions occurs in exchange as a stock market rather than in online merchant transactions.

However, it does not have central governing authority and is controlled by the general public. We have seen a sea-change in its price from nothing to 17,900 USD (January, 2018) within the period of eight years. By this reason, Bitcoin is considered a very volatile currency and its price is seen to have been affected by socially constructed opinions over the internet.

II. Literature Review

In the work of Kristoufek [3] it is shown that some of the extreme drops as well as price increases in the Bitcoin exchange rate coincided with dramatic events in China. In another research carried out by American Institute for Economic Research (AIER) [4] shows a major fluctuation in price of bitcoin driven by the impactful news and sentiment over the world during the time period between 2016 and 2017.

The work of J. Bean [5] provides Twitter opinion mining idea in order to visualize the general customer attitude and satisfaction towards the airline company. Further, Nagar and Hahsler [6] suggests a strong correlation exists between the sentiment of news extracted the news corpus and the stock price movement.

Colianni et. al. [7], have used Naive Bayes to find optimal time to trade by correlating prices with Twitter. Pagolu et. al. [8] work on predicting stock through twitter sentiment presents strong correlation between Twitter sentiment and stock price movement.

First of all, it is better to have a domain specific sentiment analyser rather than general sentiment classification tool. For that reason, a sentiment analyser specific to Cryptocurrency news and statements is developed.

Furthermore, a correlation analysis is performed between the historical price of Bitcoin and its corresponding sentiment score to identify the extent of correlation. Then a new technique of using sentiment score to visualize the fluctuating trend on the Bitcoin's price is used. The sentiment score - total percentage of positive and negative sentiment score - of the day is used as indicator for the price fluctuations.

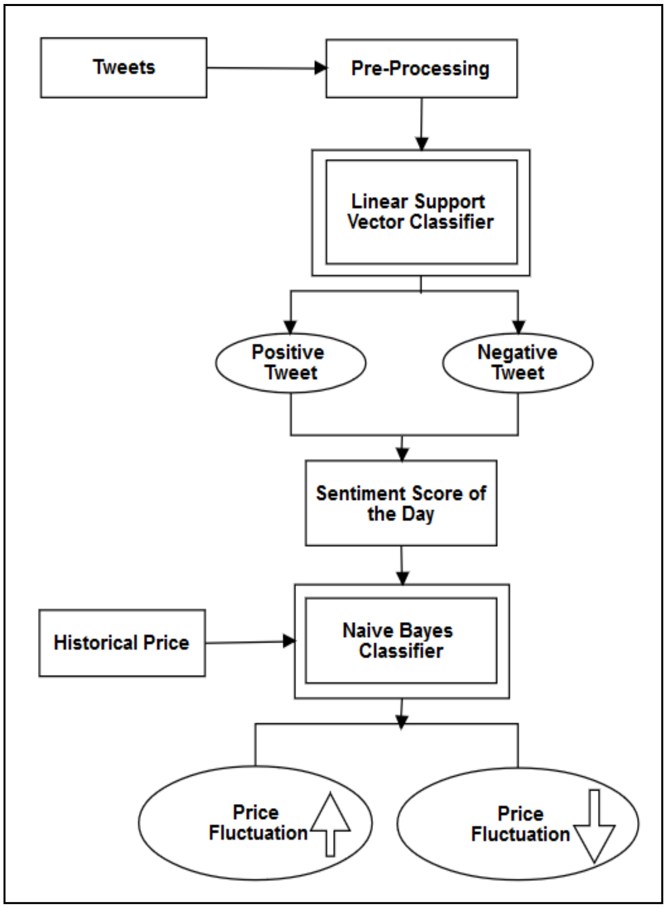

Fig 1. System Flow diagram

III. Data Collection And Preprocessing

Coinmarketcap [10] was used as the source of price data of different cryptocurrencies. For the sentiment analysis Twitter is used as source of news related to Cryptocurrency. The news tweets are collected from January 1 of 2015 to December 31 of 2017 from the tweeter accounts [9] like BitcoinNews(@BTCTN), CryptoCurrency(@cryptocurrency), CryptoYoda (@CryptoYoda1338), BitcoinMagazine (@BitcoinMagazine), Bitcoin Forum (@BitcoinForums), CoinDesk (@coindesk) and Roger Ver (@rogerkver).

A. Dataset Creation

The collected tweets are manually labelled as positive, negative and irrelevant or neutral. Total of 2585 positive, 1669 negative and 3200 irreverent tweets are labelled manually (dataset in Appendix-A).

B. Removing Repeated and Irrelevant Tweets

The irrelevant and repeated tweets - promotional and advertising tweets - are removed by using FuzzyWuzzy [11] method. They are further processed to word tokenization and stop words filtering.

C. Regex Search

Regex [12] search is applied to avoid hyperlinks linking to the other website from the twitter. Furthermore, different kinds of emojis and symbols are removed from each tweet using Regex.

IV. Feature Extraction

For text classification Bag-of-Words method of feature extraction is used.

A. Bag-of-Words

The frequency distribution of each word in the pool of tweets are used as a feature. The most common words after stop word filtering are regarded as the pivotal words and given its frequency score. It consisted of two bags of words namely positive word's frequency score and negative word's frequency score.

V. Sentiment Analysis And Correlation

A. Sentiment Analysis

The features extracted from Bag-of-Words for 4,254 manually labeled tweets are trained with Linear Support Vector Classifier [13] for the classification. A binary classifier is devised to distinguish between the positive tweet and negative tweet.

1) Linear Support Vector: It is a classifier that classifies by constructing hyperplanes which separates the cases that belong to different categories.

$$C(x) = \begin{cases} 1, & w.\emptyset(x) + b \geq k \\ -1, & w.\emptyset(x) + b \leq -k \end{cases} \qquad (1)$$

where, $w=\{w1,\ldots,w_n\}$ represent a weighted vector,

$x=\{x1,\ldots,x_n\}$ represent input and $\emptyset(x)$ is a kernel function

B. Correlation with Price

The tweets from January 1, 2018 to June 30, 2018 are collected and sentiment score of each day is calculated. For time lag between the impact of sentiment on the price of cryptocurrency (Bitcoin), cross correlation test is performed which showed the lag of one day meaning that sentiment of today has impact in price of tomorrow. Further, Pearson correlation test is performed with the sentiment score and corresponding price change of the next day.

The Pearson Correlation coefficient test is a measure of the linear correlation between two variables.Mathematically,

$$r = \frac{cov(X,Y)}{std.(X) * std.(Y)} \qquad (3)$$

Where, $cov(X,Y)$ is covariance

std.(X), std.(Y) is the standard deviation

r is the Pearson coefficient between X and Y

V. Naïve Bayes Classifier

The Naïve Bayes Classifier is trained with three features: sentiment score of the day, corresponding market price of Bitcoin and rise or fall (rise as 1 and fall as 0) of price next day.

A) Naïve Bayes

It is a conditional probability model which assumes that features are statistically independent of one another. Mathematically,

$$p(C_k|x) = \frac{p(C_k)p(x|C_k)}{p(x)} \tag{2}$$

Where,
$p(C_k)$ is prior probability of class C_k
$p(x|C_k)$ is class conditional feature probability
$p(C_k|x)$ is probability x belonging to class C_k

VI. Results And Analysis

All of the following study were carried out with the price data and sentiment data related to Bitcoin from January 1st 2018 to June 30th 2018.

The overall accuracy of sentiment classification by Linear Support Vector Classifier with validation split of 1:3 is achieved as 84.43% as shown in table below:

Table I. Confusion Matrix

Accuracy	***Precision***	***Sensitivity***	***Specificity***
84.43%	87.89%	80.17%	88.76%

Confusion Matrix for LSVC for Sentiment Classification

The confusion matrix exhibits greater specificity than sensitivity which implies that the model is better at classifying the negative sentiments than it is for positive sentiments.

The Pearson Correlation Coefficient calculated between the sentiment score and percentage price change of the next day between the periods of January 1, 2018 to June 30, 2018 is given in the table below:

Table II. Sentiment and Price Correlation

Price Fluctuation	***Pearson Correlation Coefficient***
More than 4%(approx.500 USD)	Negative Sentiment:0.41
	Positive Sentiment: 0.26

Pearson Correlation Coefficient Comparison for different range of price

As Table-III shows, for the price fluctuations more than 4% (ie. more than $500 during that study period) in a single day, Pearson correlation coefficient is found to be 0.41 for negative sentiment and corresponding fall in price and 0.26 between the positive sentiment and its corresponding increase in price. This shows there is a moderate (according to Evans 1996) [14] correlation between rise of negative sentiment and consequent fall in price of Bitcoin but a weak relation between increase of positive sentiment and consequent increase in price.

The prediction accuracy for Naïve Bayes model for predicting the direction of movement of price for the next day is found to be 78.03% (when provided with price and sentiment score of the day).

Table III. Confusion Matrix

Accuracy	***Precision***	***Sensitivity***	***Specificity***
78.03%	85.27%	71.18%	85.89%

Confusion Matrix for Naïve Bayes Classifier for predicting direction of price movement

The confusion matrix shows greater Specificity than sensitivity which means that the model predicts more precisely to the fall of price rather than for the increase in price.

VII. Conclusion

The major contribution of this work is a sentiment analyser system which can distinguish between the positive and negative tweets of Bitcoin over the Twitter with the accuracy of 84.43%. Furthermore, the Naïve Bayes model which can predict the direction of price movement for the next day is another useful accomplishment. It also shows a moderate correlation of 0.41 between rise of negative opinions in the Twitter related to Bitcoin and its consequent fall in price.

Acknowledgment

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APPENDIX-A

Some example of positive and negative labelled Tweets during creation of Dataset

Positive Tweets	Negative Tweets
1. Church in Z rich Accepts Donations in Bitcoin, BCH, Ether, Ripple and Stellar	1. Trader in Chicago Firm Stole Million BTC and Faces 20 Year Sentence #Bitcoin
2. Overall Capital of Crypto Markets Exceeds $750 Billion.	2. Cryptocurrency Regulator Found Dead at His Home in South Korea #Bitcoin
3. Turkish Minister Proposes National Cryptocurrency.	3. Lawyers Discuss Challenges Posed by Cryptocurrencies During Divorce #Bitcoin
4. Amazon set to use Bitcoin as payment for people.#Bitcoin	4. Scammers Are Ruining Crypto Twitter and Twitter Is to Blame #Bitcoin
5. Australian Gold Refinery Announces Plan to Develop Cryptocurrency #Bitcoin	5. US Navy Bust Bitcoin Drug in Naval Academy #Bitcoin

Comparative study on Optical Mark Recognition (OMR)

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Abstract - *OMR is the process of reading data from filled sheets in the form of bubbles, squares, tick marks, etc. Optical mark recognition is also called as "mark sensing" because it involves the process of scanning the information filled in the predefined sheet. There has been a lot of work in different type of techniques used to implement OMR technology. Most of the papers have similar initial methodologies. However, the main algorithm is different in different papers. Therefore, this paper tries to compare different mechanism with each other and will try to implement one of the best technique among them in order to verify the result. We have purposed to use windowing technique as it gives the most accurate result. According to the test, the result obtained by program was nearly 100%.*

Keywords – OMR, algorithm

1. Introduction

Optical mark recognition (OMR) is the process of detecting marks filled in sheets and processing the marks for evaluation purpose. In today's world OMR technology has been an important part of different examination. This technology has been used in checking the answer sheets of university and college examinations, survey forms, customary inquiry forms, competitive examinations, etc. Nowadays the use of this technology has made it possible to conduct wide range of examination in short period of time. This technology not only saves time but also removes the hassle of checking those papers. Therefore, a detail study of this technology will allow us to make an efficient system which will be highly accurate and reliable. Conducting a study on different methodologies used to implement this technology will be fruitful to design a better system.

Generally, the use of the OMR system began along with the use of punch cards. Then in 1970 the use of personal computer declined the used of punch cards and thus the OMR technology shifted towards sensing mark using optical scanner [1]. Today different hardware based and software based OMR technologies are present. The hardware based OMR are usually costlier then the software based OMR. This paper focuses on software based OMR rather than hardware based OMR.

Unfortunately, despite having large number of application and use by different corporation, different algorithm has been implemented to perform the same task. Some are more efficient than others in terms of accuracy while others are more efficient in terms of performance. The use of the algorithm depends on the output desired by the user.

Therefore, in this paper a comparison of different algorithm is made in order to evaluate their performance. After evaluation, this paper focuses on building an application using one of the algorithm which will be more efficient. Normally, accuracy will be our major concerned while choosing algorithm rather than performance.

2. Literature review

2.1. A low-cost OMR Solution for Educational Application, Hui Deng, Feng Wang, Bo Liang [2]:

This paper is based on reducing the cost that arises when checking OMR sheets using different hardware and software. Often different hardware and software uses high quality papers (90-110 GSM) but the normal papers are between 60-70GSM. The availability of such high quality paper is costlier. Therefore, this method was introduced. They have following steps for the system design:

a. A Microsoft Word macro-based sheet design technique to simplify the design of questionnaire.

b. Low cost image-based OMR technique and the images can be obtained from any kinds of scanner.

3. Global and regional area image deformation corrections to improve the recognition precision.

The sheet sample contains marking area as other normal sheet but they had “L” shaped dark circular plot which they used to get the exact position for different mark answers using flag point searching algorithm. In flag point searching, they performed horizontal and vertical search. They performed vertical searching from top left portion and then they performed horizontal searching form bottom left section.

Main Algorithm:

The main algorithm used for searching mark was flag point searching where they searched in two ways one horizontal and one vertical for the mark based on the coordinate system of the “L” shaped flag.

Accuracy and Result:

They performed different test and found out that they could get 98% accuracy by using this technique. The 100% accuracy could not be obtained because of the two main reasons, one ink infiltration and second due to the distortion of the thin paper.

2.2. Robust and Low-Cost Optical Mark Recognition for Automated Data Entry, Parinya Sanguansat [3]:

This paper presents an automated data entry method. This provides user with different answer filling method such as bubble, tick-mark and cross-mark. The result for bubbles was better than other options. The design of the sheet contains three corner for detecting the alignment of the sheets.

Main Algorithm:

The backward difference method was used for detection of coroner points and other bubbles. This method is represented by following equation:

$$\Delta R[i] = R[i] - R[i-1] = \begin{cases} -1 & , R[i] < R[i-1] \\ 0 & , R[i] = R[i-1] \\ 1 & , R[i] > R[i-1] \end{cases} \quad \text{---(1)}$$

Where the $R[i]$ is the $i-th$ pixel position in the row or column. $\Delta R[i]$ is calculated by differencing the shifted version of the $R[i]$ itself. The value of the difference is used for pixel transition. This equation was used for corners detection which was used for alignment of the paper and, also used for inner bubble detection which was further processed for template matching.

Accuracy and Result:

After applying this technique, it was found that the accuracy for the bubbles, tick mark, cross mark, were 100%, 85.72%,94.29%, respectively.

2.3. **A generalized approach to Optical Mark Recognition,** Surbhi Gupta, Geetila Singla, and Parvinder Singh Sandhu [4]:

This paper presents an overall technique while making an OMR software. First the image was scanned and various image processing algorithm were implemented for effective scanning of OMR sheet.

Techniques presented:

I. 2-D transformation: The shape, size, orientation of the sheet plays vital role in the scanning of the OMR sheet. Following transformation were used:

a. Translation: It is the process of repositioning a point along a straight line. If (x_2, y_2) is translation of factor 't' in original coordinate (x, y), then (x_2, y_2) can be presented as

x_2= x + t x;

y_2 = y + t y;

b. Rotation: In this technique the sheet is rotated by certain angle along the centre coordinate of the system. The rotating angle is calculated by taking arc tan of y and x coordinate of its corresponding corner points.

c. Scaling: It is the technique of resizing of the sheet by certain value. This is done in order to make the scan coordinate lie in desired position while processing for mark.

II. Circle generating algorithm: This algorithm is based on filling the mark properly if some portion of the mark has not been filled. This allows for higher reading accuracy and proper calculation of central position of the detected mark. We need to determine the centre position of a mark in order to compare it with a template value.

III. Area fill algorithm: This algorithm serves same thing as circle generating algorithm. Author presented it in order to show any method can be used for filling a region. Here the filling starts from inside and moves outside. The filling can also start form outside toward inside but generally inside-out filling is preferred.

Accuracy and Result:

This paper presented a general approach required while making an OMR system. So the accuracy and result might vary based on different other technique used along with these techniques by OMR system designer.

2.4 **Cost Effective Optical Mark Reader,** Rakesh S, Kailash Atal, Ashish Arora [5]:

This paper presented a cost effective way of implementing OMR software. It focused on image processing techniques and software based OMR system. A sheet was scanned and processed through different image processing methods. For identifying filled bubbles, it used grayscale method. It implemented parallel processing in order to increase the performance of scanning form. It had processing rate of 400 sheets per minutes.

Main algorithms:

It used the same techniques as used by above methods for alignment and proper adjustment of sheets such as scanning for corner points and translation, rotation, scaling and region detection.

The main difference was in finding out the filled in bubbles. It used to find threshold value and implemented the greyscale technique. According to this technique, the minimum (Vmin) and maximum (Vmax), average greyscale value of all the bubbles is computed. The bubble (Vi) is said to be filled if it is closer to Vmin and lower than Vmax, i.e.

Vi< Vmin+ (Vmax– Vmin) * p

And the bubble is said to be unfilled if Vi is,

Vi> Vmin+ (Vmax– Vmin) * q

Here the p and q are the adaptive threshold value. They had taken p=0.4 and q = 0.6, these value might differ based on the sheet taken in consideration and filled in bubbles. After the filled bubbles was detected it was compared with the correct answer sheet template.

Accuracy and Result:

The accuracy rate using this technique was 99.20%.

2.5. **AUTOMATIC OMR ANSWER SHEET CHECKER,** MS. VRUSHABHA MURAMKAR, PROF. SACHIN AGARWAL [6]:

This paper presented cost effective OMR software using template matching technique. The image is converted into binary image, before processing it to find the accurate coordinates and finally the overall answer.

Main algorithm:

The main algorithm used in this paper was point correlation algorithm. In this algorithm instead of matching entire answer sheet to the actual template, the coordinates of the answer were found out and then they were matched with the coordinate represented in the resultant template.

Accuracy and Result:

This method can calculate around 50-60 paper in around 5-6 minutes. The average processing rate is 10 seconds per paper.

2.6. **Implementation of OMR technology with the help of ordinary scanner**, Garima Krishna, Hemant Ram Rana, Ishu Madan, Kashif, Narendra Sahu [7]:

This paper presented a low cost OMR software by implementation of image processing techniques. It also converted the original image into binary image and then it proceeds for detection of the mark. It is simple and easy to understand the algorithm implemented.

Main algorithm:

Windowing technique was used in this paper for OMR implementation. In windowing technique first an appropriate size window is selected. This window scans form left to right and then top to bottom of entire surface of the paper. First corner detection is done in order to rotate image as well as to find the final adjustment value of the mark after its detection. If the window contains about 90% of the black pixel, then it is said to have mark inside that selected window. This paper used 90% as criteria of detection of mark. After detection of the mark coordinate the answer was matched with the accurate coordinate and the result was evaluated.

Accuracy and Result:

The accuracy using this method can be up to 100% based on how well the technique is implemented. They had got good result using this method. Accuracy was affected by different factors such as paper quality, damage of sheet, improper placing or folding of the sheets, etc.

2.7. **POLL READER – THE WORKING PROTOTYPE OF OPTICAL MARK RECOGNITION SOFTWARE,** Maciej SMIATACZ [8]:

This paper presented development of OMR software with various difficulties and problem that arise in the process and how to tackle them. This paper was mainly focused in finding different coordinate marks based on a template file. This paper presented even the skew of 1 degree could greatly alter the detection process. The size of the paper and its dpi could cause problem while mark detection. These parameters had been managed and had been handled well in this paper.

Main Algorithm:

It used histogram processing technique of a particular region to find weather the mark was presented in that region or not. Those regions which had marks would be represented by higher resolution values.

Result and Accuracy:

This method had good accuracy and result. In the paper they had scanned for almost 75,000 papers as their system has been taken by their faculty in university, and they had found to be working correctly. Among those only 2% of the papers were rejected mainly because of the mechanical damage of the processed sheets.

2.8 **Scanner Based Optical Mark Recognition**, Chatree Saengtongsrikamon, Phayung Meesad, Sunantha Sodsee [9]:

This paper presented a basic concept of developing OMR software and ways to tackle the problems such as skew, orientation, scale factor, offset.

Main Algorithm:

This method was based on making segments of the sheet for accurately detecting the marks. Below picture shows that the row of circles were separated on two points P1 and P2

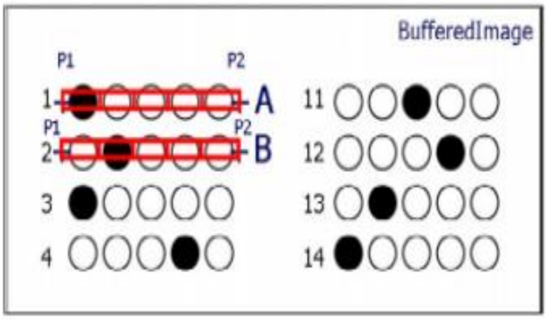


Figure: Region separation in to two points P1 and P2 as presented on paper

This technique divides the marked region into segments so that the processing time is saved and get accurate result. After that, the black marks are detected and the coordinates are calculated. To get the accurate coordinate, mean point value is calculated for the points x and y location. The mean point calculation equation is as follow:

$$T(x,y) =\{ \frac{B(x)}{n}, \frac{B(y)}{n} \}$$

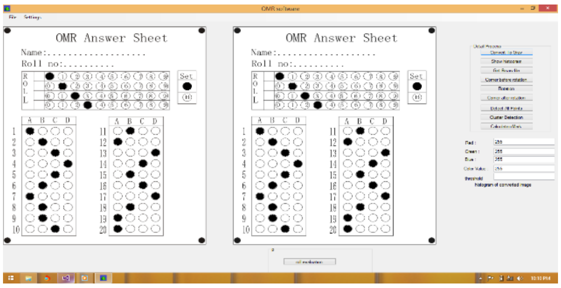
Where, T(x,y) is the location of (x,y) of tick mark. B(x) is the x location of the black pixel in the detected area. B(y) is the y location of the black pixel in the detected area and n is the number of black pixel in the detected area.

After successfully detecting the marks they were compared with the accurate marks form the template and the result was presented in the sheet along with the ID number associated with it.

Result and Accuracy:

The test was performed after the system was developed with different scanners. Among 1000 different images checked, they found no wrong answers. Therefore, the system is considered 100% accurate in detecting marks successfully.

Based on above different principle we tried to implement the windowing technique. In this technique a window is selected for recognizing a black mark based on the filled window. The window is then moved in vertical and horizontal direction for detection of other marks. And the coordinates of the marks are compared with the template mark coordinates.



Red : 255
Green : 255
Blue : 255
Color Value : 255

Figure: Screenshot of the system being developed by using windowing technique.

It was found that windowing technique gives us 100% accuracy and also high performance. Therefor among different techniques if anyone want high accuracy and good performance speed then they should choose windowing technique. However, it is not only single technique for achieving the goal. There could be other techniques to reach the goal of high accuracy and good performance OMR software.

Conclusion:

Different image processing based techniques were compared. Both accuracy and performance could be high if the system is designed carefully and different algorithms can be used as mentioned above. In the same quest we used windowing technique for simulation and found that it obtains high performance and accuracy.

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Quantum Annealing:

A Case Study on Why Quantum Annealing is considered as An Optimized Technique against Simulated Annealing

Aasish Kumar Sharma[1], Pradip Maharjan[2]

***Abstracts*—The paper presents a case study on Quantum Annealing in relation to Simulated Annealing. At first it includes some details on Annealing, Simulated Annealing and Quantum Annealing techniques for solving problems where search space is discrete. Onward, based on various experimental results, conducted on quantum annealing machine (e.g. D-Wave) in compare to different classical approaches on variant performance parameters shows why Quantum Annealing is considered optimum technique than Simulated Annealing.**

Keywords—Quantum Annealing, Simulated Annealing, discrete search space.

1. INTRODUCTION

The purpose of this paper is to escalate and evaluate possible reasons and parameters mentioned in already presented research findings related to Quantum Annealing and Simulated Annealing which is a mechanical metaheuristic (generic and approximate) method to solve combinatorial optimization problems, in order to highlight even optimum solutions. The paper evaluates and compares different research findings published in various public Medias related to the topic and presents the analysis for supporting the method with more optimum optimization method based on performance parameters.

The paper consists of altogether 5 sections. Section 1 includes introduction, section 2 covers most of the basic definitions and algorithms related to the paper content. Section 3 evaluates different experiments and research papers found related to the title and section 4 outlines the conclusion. Finally, section 5 list out all references and their details.

2. FUNDAMENTAL DEFINITIONS

Before jumping into the core analysis let us start with some fundaments details. Like what does discrete search space and annealing means as mentioned above in the abstract?

2.1. Discrete Search Space:

Discrete Space means where space are broken up into multiple states. Like in Travelling Sales Man Problem different cities represents different states and the search is to find the optimum path to travel all the cities ending at the same city where it starts, in contrast to a continuous path like in a maze [1].

2.2. Annealing:

In classical physics annealing is referred to a slow cooling process of a molten metal object in order to efficiently bring the metal into an optimum state of low-energy in solid state. In this process at first a metal object is heated to its melting point and then scheduled to cool down slowly in a controlled environment. Here, the temperature scheduled cooling plays a significant role as an optimizer to overcome the energy barriers i.e. the local minima(s) to get into global minima of the metal energy distribution, enhancing the properties of the metal. Despite, this is not the case if the heated metal is cooled rapidly, that gets stuck at higher energy state local maxima(s) making it more brittle and may have bubbles and cracks [2]. This is also related to statistical mechanics.

2.3. Statistical Mechanics:

It is a branch of modern physics related to the statistical analysis of thermodynamic system having large number of microscopic particles taken in unit volume. As it has large sample range only the most probable characteristics of the system at given temperature in thermal equilibrium is known. It is mainly based on microscopic physical laws and statistical probability theories. In thermodynamics, energy state of a system is equivalent to the energy state of each of the particles constituting in it. The probability distribution relative to

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the temperate of the system at one state to changed energy state is given by

$P(E_i, E_{i+1}, T) = e^{(E_i - E_{i+1}/k_B T)}$, (1)

Where P is the probability of, E_i, E_{i+1} (are the current and next energy state), and T (is the instantaneous temperature in Kelvin) where k_B (is the Boltzmann's constant: $1.38\times 10^{-23} J/K$).

This formula gives the probability of the change of energy from one energy state to next energy state depending on the change of temperature [3].

2.4. Combinatorial Optimization Problems:

Related to computer science, this includes set of discrete search space problems that are considered hard to solve. Its aim is to find the cost function (the change of energy) of the problem taken against variant(s) in order to minimize or maximize the cost to reduce the complexity. For example, in Travelling Salesman Problem (TSP), a salesman starts from one city, travels to all other cities and returns to the same city. For this an optimum route is required, with minimum cost. So the probabilities for all the route combinations are evaluated and the path with optimum cost is selected [3].

2.5. Monte Carlo Method (MC):

MC is an algorithm for finding stochastic (random) probability distribution to estimate the probability of occurrence of an event or state, given stationary distribution with respect to the time or space. This method is mainly used for problem classes like generating patterns from probability distribution, optimization and similar discrete space problems [4].

2.6. Markov Chain (MC):

This is a model that describes the probability of occurrence of next event dependent on sequence of previous event. The Markov Chain have to satisfy the Markov Property named after Russian Mathematician Andrey Markov. According to this property the future state is predicted based on present state not on the combination of sequence of the past states. Such a process following Markov property is taken as Markov process and the model as Markov Chain [4].

2.7. Markov Chain Monte Carlo (MCMC) Algorithm:

The combination of Monte Carlo Algorithm and Markov Chain is known as Markov Chain Monte Carlo (MCMC) Algorithm. The modern version of the MCMC method was invented in the late 1940s by Stanislaw Ulam, while he was working on nuclear weapon projects at the Los Alamos National Laboratory. Immediately, after Ulam's breakthrough, John von Neumann understood its importance and programmed the ENIAC computer to carry out Monte Carlo calculations [4].

2.8. Metropolis Algorithm:

This is based on MCMC method. Named after Nicholas Metropolis, the algorithm helps to find random sample sequence from probability distribution for the problems that cannot be directly sampled. According to Metropolis et al. [5], it provides an efficient algorithm to simulate a collection of atoms in equilibrium at a given temperature, by mainly working for two things: one is to determine the cost function $f(s)$ of the solution s (i.e. also represented as ΔE, the change in energy) and the second is the probability of the cost function i.e.

$P(\Delta E) = e^{-\Delta E/k_B T}$, (2)

Where k_B is the Boltzmann's constant: $1.38\times 10^{-23} J/K$ and T is the temperature in Kelvin)

2.9. Simulated Annealing (SA):

SA is a nature inspired (of physics), *stochastic metaheuristics* (some random rules are applied during the search), *single-solution based algorithms* (where the single solution gets evolved during the search) and *memoryless method* [6]. SA is known from the work of S. Kirkpatrick et al. [3] and V. Cerny [7], where it has been applied for graph partitioning and VLSI design. The algorithm they proposed is a derivation of *Metropolis Algorithm* as a compact and robust technique, which provides optimum solutions to *combinatorial search* with a substantial reduction in computation time. The idea is drawn from metallurgical *annealing* process and statistical thermodynamics or equilibrium i.e. *statistical mechanics* (as described earlier in this section). It combines both "*divide and conquer*" and "*iterative improvement*" strategies for heuristics. The SA algorithm prescribed is as follows:

Algorithm 2.1 Template of simulated annealing algorithm [6].

```
Input: Cooling Schedule
$s = s_0$ ; /* Generation of the initial solution */
$T = T_{max}$ ; /* Starting temperature */
Repeat
    Repeat /* At a fixed temperature */
        Generate a random neighbor $s'$ ;
        $\Delta E = f(s') - f(s)$ ;
```

```
            If $\Delta E \le 0$ Then $s = s'$ ; /* Accept the
            neighbor solution */
            Else If
            $\left(e^{-(\Delta E)/k_B T}\right) > random[0,1]$ Then $s = s_i$ ;
            Else $s$ ; remains same.
      Until Equilibrium condition
      /* e.g. a given number of iterations executed at
      each temperature T */
      $T = g(T)$ ; /* Temperature update */
Until Stopping criteria satisfied /* e.g. $T < T_{min}$ */
Return $s$ ;
Output: Best solution found.
```

The algorithm starts with initial highest temperature (melting point) for a solution. Here, the temperature T represents as an element that influence the change for the solution. Then it is gradually reduced with respect to the estimation of the quality of the solution or the cost function and the probability of the cost function change, for the selected solution. This acts like transition process between current stable states to its estimated next stable states. The process ends until there is no subsequent difference between states. As found in this method, the temperature plays the significant role for optimizing the solution. The variant probabilities estimated based on this algorithm requires many iterations for an efficient optimization, keeping the variation as small as possible.

The algorithm works efficiently even for large samplings but when a non-ergodic system is considered these estimations can grow exponentially making it a NP-hard problems to solve for SA. For example: At a temperature T, it may take N iterations, for a solution to relax once it overcomes its M barriers, having the complexity $O(N)$. For range of T, it still has polynomial time complexity (i.e. $N \times M \rightarrow O(n^2)$), but for many such solutions with different characteristics like in thermal system, this will have exponential time complexity (i.e. $O(2^n)$) making it a NP-hard problem. To overcome this situation, it required a new approach, and the idea came from quantum physics.

2.10. Quantum Physics:

In quantum physics, with the introduction of laws of quantum physics, new dimensions for solving the complex problems, starts appearing. Quantum Superposition, Quantum coupling (also known as quantum entanglement) and Quantum tunneling are some of the outcomes of quantum studies that fascinates most of the bright minds. Scientists are able to prove these concepts but all their efforts are now focused on finding the relative answers on why these things behaves so? Why the same thing, sometimes behaves like a particle and sometimes as a wave? The answers to these questions are still under experiments results [4].

2.11. Quantum Annealing (QA):

Behind all these studies, efforts are also being made to solve those NP-hard problems that are considered unsolvable with existing techniques. QA is from one of these approaches. Inspired from quantum physics and SA, in QA the change in energy of the solution i.e. the cost function as estimated in SA, is given by the change in Hamiltonian of the system states.

Hamiltonian: Let the equation for ground state of a Hamiltonian of the system is given by

$$H_v = -\frac{v^2}{2m}\frac{\partial^2}{\partial x^2} + V(x)\ , \qquad (3)$$

Where, v is the potential constant, x is the solution variable and m is the mass of the particle (considered unit mass). This is the same equation of *constant-potential well*; where, $V(x)$ is the potential function that encodes the cost function to be minimized [8].

Here, the changes are introduced using quantum fluctuations or quantum external fields (transverse field) in the same way as temperature played the role in SA. Beside that, as shown if figure 1, SA has to thermally overcome the barrier for each local minima where in QA, quantum tunneling also known as quantum jumps overcomes this situation depending on the size energy barriers. Based on this quantization nature, QA can optimize a non-ergodic system to ergodic form. Due to this it is considered as an optimization technique for SA to reduce NP-hard problems into P (polynomial time complexity) problems. More details in [9].

If H_0 , be the classical Hamiltonian of the quantum system and H' be the quantum transition between the states, then this time dependent quantum kinetic term i.e. $(\lambda(t)H')$ is added to the system, making the total Hamiltonian as $H(t)$, and the evolution of the system is characterized by solving the time dependent Schrödinger equation as:

i.e. $H(t) = H_0 + \lambda(t)H'$, (4)

$$i\hbar\frac{\partial\psi}{\partial t} = [\lambda(t)H' + H_0]\psi\ , \qquad (5)$$

If λ (0) is taken very large, then ψ starts effectively as the ground state of H′, which is assumed to be known. As λ (t) starts decreasing slowly enough then, following the quantum adiabatic theorem, the system will be carried into the ground state of the instantaneous total Hamiltonian. At the end of the annealing schedule, the kinetic term becomes zero (λ (t) = 0). Hence, one would expect the system will arrive at the ground state of H_0, thereby giving the optimized value of the original cost function [9].

These concepts were more evident when D-Wave announced its first commercial quantum annealer in 2011 [4, 10]. Below has the algorithm for QA and Quantum Transition.

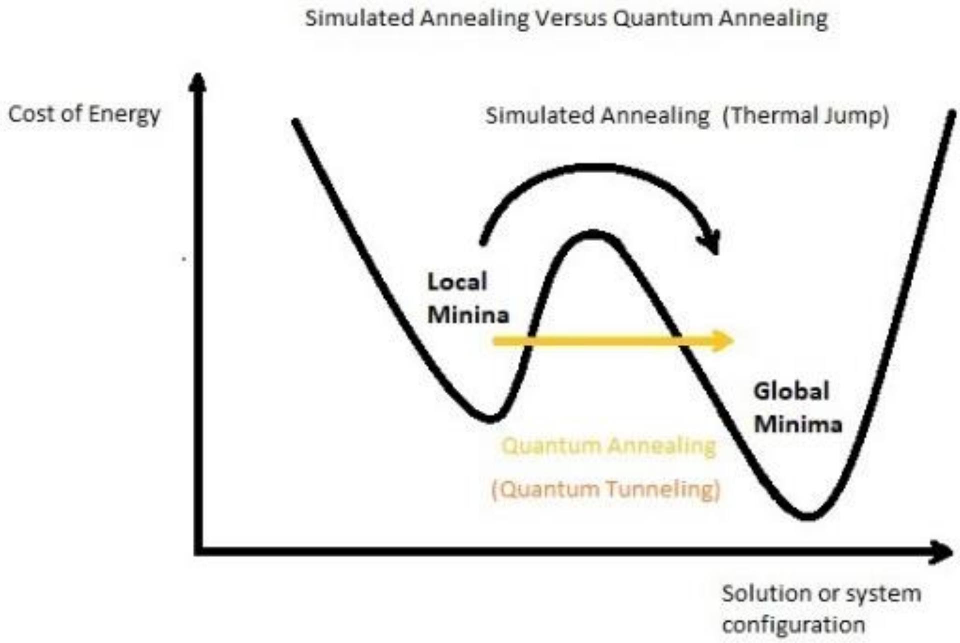

Figure 1: Simulated Annealing Versus Quantum Annealing

Algorithm 2.2: [8]

Procedure 1: Quantum Annealing

Input: Initial condition $init$; control parameter v; duration t_{max} ; tunnel time t_{drill} ; local opt. time t_{loc}.

```
$t \leftarrow 0$ ;
$\epsilon \leftarrow init$ ;
$v_{min} = cost(\epsilon)$ ;
While $t < t_{max}$ do
  $j \leftarrow 0$ ;
  Repeat
    $i \leftarrow 0$ ;
    Repeat
        $\epsilon \leftarrow Quantum\ Transition(\epsilon, v, t_{max})$ ;
      If $cost(\epsilon) < v_{min}$ then
      $v_{min} \leftarrow cost(\epsilon)$ ;
      $i, j \leftarrow 0$ ;
      Else
      $i \leftarrow i + 1$ ;
      End If
    Until $i > t_{loc}$
    $\epsilon \leftarrow Local\ Optimization(\epsilon)$.
    If $cost(\epsilon) < v_{min}$ then
    $v_{min} \leftarrow cost(\epsilon)$ ;
    $j \leftarrow 0$ ;
    End If
  Until $j < t_{drill}$
  Draw a trajectory of length $vt_{max}$ and jump there.
  Local Optimization ($\epsilon$)
End While
```

Procedure 2: Quantum Transitions

```
Input: Initial condition $\epsilon$; chain length $vt$; set of neighbors to estimate $N\ eigh$;
For all neighbor $k \in N\ eigh$ do
    Estimate the wave function $\psi_v(k)$;
End for
$best$ ← select a neighbor in $N\ eigh$ with probability proportional to $\psi_v$
Return $best$
```

QA is followed by quantum transition for change in quantum fluctuation.

3. EVALUATION: COMPARING QA AND SA PUBLISHED WORKS

3.1. Reference Paper 1:

Nishimori et al., "*Ground-state Statistics from Annealing Algorithms: Quantum vs Classical Approaches*", listed in Cornell University Library [11]. Kadowaki and Nishimori proposed about QA in 1998 as a quantum mechanical metaheuristic (generic and approximate method) to solve combinatorial optimization and sampling problems. Later the Canadian Research Institute D-Wave System's also introduced its first commercial quantum annealer that works on similar concepts [12].

Subject:

In this paper, Nishimori et al. has studied the performance of QA against the systems with ground-state degeneracy by:

a) Directly solving the Schrödinger equation for small systems - Five-spin toy model and
b) Quantum Monte Carlo Simulations for larger systems - Two-dimensional Villain fully-frustrated Ising model.

Result:

The results shows that the quantum annealing is not able to identify all degenerate ground-states though its ground-state values are efficiently estimated. That is, the method fails to find certain ground-state configurations independent of the annealing rate. Which is not the case with SA, where all the degenerate states are reached with almost equal probability, if the annealing rate of the temperature is sufficiently slow. A great improvement to the quantum transitions to all states with equal weight is seen in QA but this also takes proportional annealing time. That is why, no speed gain is mentioned. Therefore, the result concludes that QA is superior to SA only when ground-state energy is needed.

3.2. Reference Paper 2:

Chi Wang et al., "*Quantum versus Simulated Annealing in Wireless Interference Network Optimization*", Published in Nature, Open scientific reports [13].

Subject:

The paper includes, application of D-Wave System's quantum annealing machine on a real-world application in wireless networking. Targeting the scheduling of the activation of the air-links for maximum throughput that subject to interference avoidance near network nodes. D-Wave (DW) quantum annealer implementation is made error resistive by a Hamiltonian extra penalty weight adjustment that enlarges the gap and substantially reduces the occurrence of interference violations resulting from inevitable spin bias and coupling errors. The outcomes of experiment are compared with classical annealing counter part SA.

Result:

QA benefits more than SA from gap expansion process (process followed in this experiment), both in terms of ST99 speedup and network queue occupancy. The results are compared based on three matrices: actual network performance, accuracy and speed and the results are in the favor of QA.

3.3. Reference Paper 3:

Richard Y. Li et al., "*Quantum annealing versus classical machine learning applied to a simplified computational biology problem*", is an open article published in Nature, open article [14].

Subject:

The paper has applied study on quantum machine learning approach to classify and rank binding affinities using simplified data sets of a small number of DNA sequences, derived from actual binding affinity experiments. They trained commercially available D-Wave quantum annealer (DW) to classify and rank *transcription factor binding*. Transcription factors regulate gene expression, but how these proteins linked to their target DNA is unknown. The experiment is compared with most of the classical approaches like SA, SQA (Simulated Quantum Annealing), MLR

(Multiple Liner Regression), LASSO (Least Absolute Shrinkage and Selection Operator), and EGB (Extreme Gradient Boosting) for same data sets. This is the first application of QA to real biological data.

Result:

Despite of technological limitations, a slight advantage in classification performance and nearly equal ranking performance is seen using the quantum annealer for undertaken data set which was fairly small. Therefore, it is proposed that QA might be an effective method for implementing machine learning for limited computational biology problems. DW has shown occasional advantage over SA due to its limited qubits. The test was more error prone with increase in amount of training data compared to classical methods.

3.4. Evaluation Summary: Performance of QA and SA Through Published Works

Summary of evaluation based on mentioned performance parameters compared between QA and SA for selected research papers

Table 1: Evaluation Summary: Performance of QA and SA Through Published Works

Details	Ref. 1	Ref. 2	Ref. 3
Published Year	2009	2016	2018
Title of Paper	Ground-state Statistics from Annealing Algorithms: Quantum vs Classical Approaches	Quantum versus Simulated Annealing in Wireless Interference Network Optimization	Quantum annealing versus classical machine learning applied to a simplified computational biology problem
Author	Nishimori et al.	Chi Wang et al.	Richard Y. Li et al.
Area of Study	Physic	Networking	Biology
Target Application	Ground-state degeneracy systems simulation	Wireless interference network optimization by gap expansion process	TF-DNA machine learning
Quantum Annealer	Self-designed System	DW	DW
Problem Complexity	NP-Hard	NP-Hard	NP-Hard
Sample Size	Both (small and large)	Limited	Small
Overall Speed	Same	More than SA	Similar to SA
System Error in Standard Deviation	Limited (with standard deviation of about 0.05)	Limited (with standard deviation of about 0.05 and 0.035)	Relative increase with sample size
Overall Performance	Competitive	Optimized	Partial Optimized

3.5. Discussion

Based on these studies as shown in Table 1, it is evident that QA is eligible to provide some optimization for existing real-world NP-hard problems but requires more exercises. It also shows that the technique has the capability to break down the problem time complexity in some way, even though, the available resources are not enough to mitigate all the scope of the studies as mentioned in these published works.

4. CONCLUSION

After studying all these papers, QA despite of limited performance has shown clear sign of improvements in the overall performances. In Nishimori et al. experiment it has been shown that QA can efficiently estimate the ground-state of the system for small as well as large sample size simulations in compared to SA. In Chi Wang et al. experiments also there is improvement in speed with overall optimized performance. Coming to Richard Y. Li et al. experiments regarding machine learning for a computational biology problem, the result shows partial improvement in the overall performance due to relative increase in error with increase in data size. There are many more studies going on the related topic but with the analysis of materials in hand it shows QA can be considered an optimization technique better than classical SA for some cases.

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Theoretical Foundations of Computational Studies in Problem Solving Using Mathematical Induction and Apagogical Argument

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ABSTRACT

Computers are limited by space and time. With the building concept of theoretical foundations definition of both the types of problems that can be solved using a computer and the quality of their solutions can be dictated. Theoretical foundations required to study various sub-disciplines in computer science. The actual solution to a computational problem usually lies outside these circumference, thus an approximate solution must always be computed. Topics included in the problem solving with the concept of theoretical foundations include propositional and predicate logic with applications to logic programming, database querying, and program verification; and graph theory with applications to analysis of algorithms; sets, relations, and functions and their applications in databases, functional programming.

Keywords – Theoretical Foundations, functional programming, logic programming.

I. INTRODUCTION

In theoretical computational studies, the theory of computation is the branch that deals with how efficiently problems can be solved on a model of computation, using an algorithm. The field is divided into three major branches: automata theory and languages, computability theory, and computational complexity theory, which are linked by the question: "What are the fundamental capabilities and limitations of computers?".

In Theory of computability we study, which problems can in principle be solved by computers and how difficult the given problem is. The difficulty is defined by quite coarse level according to how difficult model of computation is requires. In addition theory of computability gives good advice how to efficiently solve some special type of problems.

In Theory of computational complexity we study, how efficiently the problem can be solved. Theory of computational complexity reminds analysis of algorithms, but we don't determine time and space complexity of an individual algorithm, but the worst case complexity class of the problem itself. Theory of computational complexity gives also good aids for reducing a problem into other already known problems.

The Theory of Computation is also concerned with finding the most efficient methods for solving specific problems. This is where the concept of problem solving develops. For example, multiplying numbers can be done more efficient than via the simple method learned in elementary school.

The nature of efficient computation (and computation in general) is indeed the formative question of the Theory of

Computation. We consider this question (or rather a cluster of questions) to be one of the most fundamental scientific questions ever asked. Unfortunately, the fundamental status of this question is usually disregarded due to its immediate technological impact.

Moreover, research in theory of computation has been extremely successful and productive in the few decades of its existence, with continuously growing momentum. This research has revolutionized the understanding of computation and has deep scientific and philosophical consequences, which will be further recognized in the future. Moreover, this research and its dissemination through education and interaction have been responsible for enormous technological progress.

II. RELATED WORKS

Lenore Blum, in his paper “Alan Turing and the Other Theory of Computation (expanded)”, has explained how Alan Turing’s work has been recognized in the foundations of numerical computation, its influence in modern complexity theory, and how it helps provide a unifying concept for the two major traditions of the theory of computation.

Naimul Ferdous, has described the Program for Turing Machine capable of recognizing the language 1^n0^n, where n>0. He has made state diagrams and has used the C programming language to code the whole program and has been successful to determine if the number given is accepted to be turing machine compatible or not.

Oded Goldreich and Avi Wigderson, have summarized the main topics in Theoretical foundations in scientific researches to provide an assessment of the Theory of Computing (TOC), as a fundamental scientific discipline, highlighting the seeks to understand computational phenomena, be it natural, man-made or imaginative.

Lawrence S. Moss, in his paper entitled “Connections of co algebra and semantic modeling” has presented the area of co algebra to people interested in the kinds of semantic modeling that is prominent at TARK. Co algebra is a general study of a great many kinds of models, and these include type spaces and Kripke models, and many others.

Naimul Ferdous, has described the Program for Pushdown automata (PDA) capable of recognizing the language w#w belongs to R where w {0, 1}* and∑={0,1,#}where n>0. Similarly, he has also described the program for deterministic finite automata (DFA) for the implementation of string pattern ab*cb* with the use of state diagrams and C-programming language.

Margaret Archibald, has addressed all aspects of infinity in automata theory, logic, computability and verification and focus on topics such as automata on infinite objects; combinatorics, cryptography and complexity; computability and complexity on the real numbers; infinite games and their connections to logic; logic, computability, and complexity in finitely presentable infinite structures; randomness and computability; transfinite computation; and verification of infinite state systems.

J. Aspnes, D.K. Goldenberg, A. S. Morse, W. Whiteley, Y. R. Yang, B. D. O. Anderson, P. N. Belhumeur provide a theoretical foundation for the problem of network localization in which some nodes know their locations and other nodes determine their locations by measuring the distances to their neighbors.

José Quesada, Walter Kintsch and Emilio Gomez, in their paper "A Computational Theory of Complex Problem Solving Using Latent Semantic Analysis"; have introduced a new conceptualization of microworlds research based on "A problem Representation" which treats protocols as objects and "Similarity Metric" which is defined in the problem space.

III. METHODOLOGY

This Chapter deals with the classification of problems and also explains about the solution to those problems with the concept of theoretical foundations.

Classification of Problems:

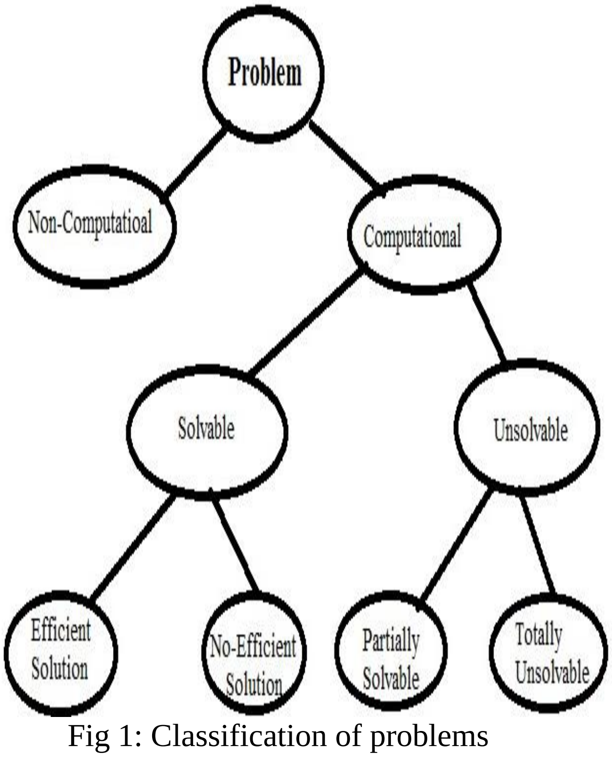

Fig 1: Classification of problems

The above classified problems can be solved computationally using the mathematical concepts and there are certain elements we use to prove it with the concept of Theory of Computation. Some of the elements used are briefly described below:

A. Logical Symbols:

Let A and *B* be some logical symbols i.e. truth valued sentences, which describe some events.
E.g. *A*= The Fountain is clear, *Q*= Monkey lives in fountain

- ~*A*: *A* is false (not *A*, !*A*)

B. Sets:

- set=a collection of elements or members
  E.g. A= {a, b, c, d}

C. Relations:
E.g. a (binary) relation between *A* and *B* is defined as a subset of *A* £ *B*:
R = {(a; b)| a belongs to A ^ b belongs to B ^ R (a; b)}

- E.g. *A* and *B* are natural numbers and *R* is a successor relation:

R (*a*; *b*), if and only if *b* = *a* + 1.

D. Functions:

A relation between *A* and *B f subsets A X B* is a function or mapping from set *A* to set *B*, if the following conditions hold:
1. For each element of *A* there is a mapping in *B*.
2. For each element of *A* there is only one mapping in *B*

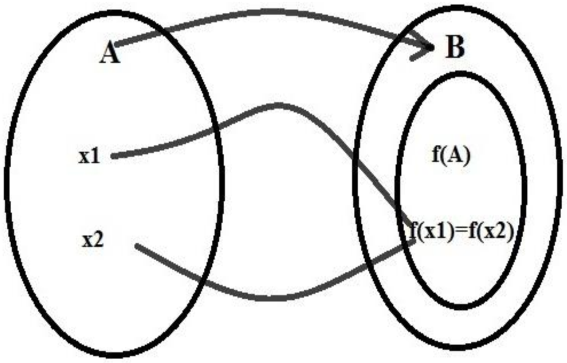

Figure 2: A=definition set, B=goal set, f (A) = value set

Here, y = f(x) where (x; y) belongs to f:

E. Countability:

Set *A* is countable, if
1. *A* is finite or

2. There exists a bijection *f* : N→ *A*, for which
A = {f (n)| n 2 belongs to N*}*

F. Proofing Methods:

Proving the problem statements using the elements using has two basic methods which are classified into the Mathematical Induction and the other one is the Undirected Proof. Both of them are explained below:

- MATHEMATICAL INDUCTION

Mathematical Induction is a 'mathematical proof' technique. Proving an infinite sequence of statements is necessary for proof by induction, a rigorous form of deductive learning. It is essentially used to prove in cases such as to prove that a property P (n) holds for every prime numbers n, i.e. for n= 2,3,5,7… and so on. Symbols and Metaphors can be informally used to understand the concept of mathematical induction, such as the metaphor of falling dominoes or climbing a ladder.

Let us suppose that the Logical Function P (n) holds true for all natural numbers. To prove this statement we usually have two parts to solve:

Case 1: When we keep n as null, i.e. n=0, P (0) is true.

Case 2: The very next is the induction step. That is, here we prove that for all n; P(n) →P(n+1).

The example for mathematical induction is given down below:

E.g. $\sum_{i=1}^{n} \mathrm{i} = ((\mathrm{n}^2 + \mathrm{n})\,/2)$
For all n>=0

We get two conditions with the above mentioned equation.

Condition 1: When n=0;

$$\sum_{i=1}^{n} \mathrm{i} = 0 = ((0^2 + 0)\,/2)$$

Condition 2: Induction assumption;
€*k belongs to* N such that the claim holds for all *n* <=*k.*

n=k+1:$\sum_{i=1}^{k+1} \mathrm{i} = 1 + 2 + 3 \ldots + \mathrm{k} + (\mathrm{k} + 1)$

$\sum_{i=1}^{\mathrm{k}} \mathrm{i} = ((\mathrm{k}^2 + \mathrm{k})\,/2)$. So,

$\sum_{i=1}^{\mathrm{k}+1} \mathrm{i} = ((\mathrm{k}^2 + \mathrm{k})\,/2) + (\mathrm{k} + 1)$.

$\sum_{i=1}^{\mathrm{k}+1} \mathrm{i} = ((\mathrm{k}+1)^2) + (\mathrm{k} + 1))\,/2)$

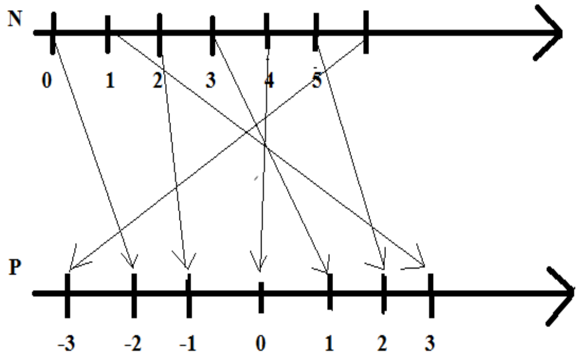

Figure 3: Generation of n Natural Integers.

- CONTRADICTION METHOD

Proof by contradiction is based on the law of non-contradiction as first formalized as a metaphysical principle by Aristotle. The contradiction method also known as the "Undirected Proofing", "Proof by assuming the opposite" or "Proof by Antithesis", we start by making a claim by start our proofing through contradiction. It starts by assuming that the opposite proposition is true, and then shows that such an assumption leads to a contradiction. If the final statement contradicts with the claim we had made at the beginning, we conclude that the claim made was true.

There are certain aspects for the contradiction method like:

1. The contradiction we want to reach is actually unknown.

2. Our implication that, P→ Q is true for every case except at the time when P^¬ Q.

The example for various aspects of the proof by contradiction is given below:

E.g. Let us suppose *A* is an infinite set and *B* is a Finite subset of A and *C* is the complement of *B* in *A*.

Problem Statement: To show C is also infinite.

Proof:

Contradiction made: *C* is finite. Because both *B* and *C* are finite, also *A* is finite.

Here, the contradiction has arrived as we know that, A is infinite during the supposition.

Contraposition: Suppose that we want to prove "if there is X, then there is Y". Instead we prove an equivalent claim "If there is no Y then there is no X".

i.e. ($P \rightarrow Q \equiv \neg Q \rightarrow \neg P$).

There is a special case in Antithesis method that is, let us suppose, P and ¬Q and with it try to conclude ¬P; in this case the contradiction that we need to look : (P^ ¬P).

In the Undirected Proofing, some cases like for all "For all 'a' belongs to A…" such that "for all 'a' that belongs to A"; can be proved directly using the existential and universal claims.

Existential Claim: ¬Ǝx belongs to XP(x). Construct such x by guessing, producing or even by inventing a producing algorithm. But in doing so we must always show that the wanted property really holds.

E.g. In Russia there is a country, which is bigger than any other country in the world.

Universal claim *Ɐx belongs to XP*(*x*): select an arbitrary *x* from *X* and show that the wanted property *P*(*X*) holds for it.

E.g. Let *S* = *{x belongs to R*|(x_2 - 3*x* + 2 <= 0)*}* and *T* = {*x belongs to R*|1 <= *x* <= 2*g*}.
Prove: *S* = *T*.

IV. CONCLUSION

Some may find it obscure but Theoretical Foundations has gone far towards answering the question of what problems can be solved and which ones cannot. The theory of computation provides the basis for creating "correct models" of computational tools: software, digital circuits, concurrent systems etc. For instance, automata theory has been used for in building compilers and abstract machines. A sound understanding of theory of computation is critical for understanding of different algorithms.

Mathematical Induction method can be extended to prove statements about more general well-founded structures such as trees. It in some form is the foundation of all correctness proofs for computer programs. Mathematical Induction is an inference rule used in formal proofs; and are, in fact, examples of deductive reasoning.

An existence proof by contradiction assumes that some object doesn't exist, and then proves that this would lead to a contradiction; thus, such an object must exist. Although it is quite freely used in mathematical proofs, not every school of mathematical thought accepts this kind of non-constructive proof as universally valid.

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Image Steganography for Secure Message Transmission Using Modified Hash LSB Technique and Twofish Cryptographic Algorithm

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Abstract—**Cryptographic algorithm secures message transmission over an open channel by scrambling the plain message with the help of a secret key, producing the cipher text. Intruders can get this scrambled message and tries to decrypt it and get the original message from it. Steganography hides the message inside digital media such that intruders does not know about the message transmission and removes his/her attention. The combination of both provides another layer of security, thus preventing the opportunity to work on the encrypted data for an intruder. This makes the transmission of message highly secure than using each separately. This paper is focused on combining both cryptography and image steganography for highly secure message transmission. The message is encrypted using twofish encryption method with key length of 256 bits. This encrypted message is then embedded inside the RGB component of the pixel of the cover image using modified Hash LSB (HLSB) in (3, 2, 3) format producing stego image which is now ready to send over an open channel. After the implementation, MSE, PSNR, SSIM and KL Divergence (Relative Entropy) are calculated. The results show high security and greater similarity between cover image and stego image, making our system robust.**

Keywords: Steganography; Cryptography; Modified Hash LSB; Twofish Encryption

I. INTRODUCTION

Cryptography is the technique of scrambling and changing text using a key, such that no one except the key holders can get the message. This is the study of technique with mathematical algorithm that goes in one way but is very hard to get reverse in the similar way. It is used for communication in today's world. From years ago many algorithm has been proposed and used and with the breaking of each of them / finding the backdoor, each time new algorithms are being proposed. Although todays Advanced Encryption Standard (AES), is known to be secure but the cipher are still openly accessed to intruders which doubts on the security technology. Attacks are always being going on but no cipher is broken to get the original message. We are totally dependent upon and our information is totally secure by the cryptographic algorithm. Our information is secure for us, as we think but may not appear to be. Cryptography never hides the cipher which may create a problem regarding security. It says to protect our confidentiality, integrity and authentication but with such open environment it still possess a risk.

So information hiding seems very important, this can be achieved by using the steganography, it hides information into its bits that is less affective to its visual perception. This hides the information and doesn't attract the attention of unintended people. Seems simple but still a very powerful method to hide and protect our data when used along with cryptography. Different substitutions based of pixel difference, simple Least Significant Bit (LSB) substitution, substitution in edge/ smooth areas are used, to solve the problem of capacity, quality. With not giving the chance to know our data to intruders to work on with, we can feel safe in the context of security, confidentiality and authentication.

S. Mittal, S. Arora and R. Jain used RSA for message encryption [1] to get the cipher text and hide it using Simple LSB, they said that it can be used when secrecy is preferred over power of bulk data transmission. In hybrid approach of image steganography by D. Kaur H. K. Verma and R. K. Singh, they used X-OR operation to get the new cipher text of a message text and this cipher text was compressed using LZW compression scheme. This increased the hiding capacity by reducing the size of secret data. The data hiding capacity was 4.71 times greater than traditional LSB method. But the PSNR was less than the LSB method.

K. Joshi and R. Yadav used LSB with Shifting for hiding the encrypted message [18], where message was encrypted using Vernam Cipher algorithm. It uses simple LSB, where message bits was hidden 1 bit per pixel in grayscale image with 1 bit left circular shifting operation carried out in the 4 LSB of cover Image and the resultant is XORed with the message bit. Now this resultant message bit after shifting followed by XOR operation is then concealed in the LSB of cover Image. It although gave good result and improved security over simple LSB method but the problem was with the hiding capacity, which was just a single bit per pixel for grayscale image, which was very low.

Using Hash-LSB, M. H. Abood proposed the image cryptography with RC4 [6] and Pixel shuffling, where the image was encrypted using the RC4 stream cipher algorithm and then pixel shuffling was done. Hash-LSB was used to find the position of a bit inside the pixel of cover image. It used the position of the concealed picture pixels. The embedding process here used 3, 3, 2 LSB pattern. Here only Grayscale image was encrypted and hidden into RGB image. The Hash-LSB technique embeds secret grayscale image pixel bits into the RGB image into 3 LSB of R, 3 LSB of G and 2 LSB of B. The embed position of each pixel (8-bit) of secret image in the LSB (red, green, blue) of cover image is represented by p, where p is LSB bit position per pixel and it is dependent upon static value of pixel number as shown in equation (1). Let us suppose the grayscale value of secret image pixel is 245. Its binary value is 11110101. Bits to be hidden in R is 111, in G is 101 and in B is 01. Now bit position where bits can be hidden, k is given by formula in (1).

$$P = H \% L \qquad (1)$$

Where, P is the position of bit, from where we can start to hide bits.

H is the position of any hidden picture pixel.

L is the total number of bits substitution in each component pixel, which is 4 in case of Hash-LSB technique.

If R, G, B of cover image is (11010100, 11100010, 10001001) and the value of P is 1 then, new R, G, B would be (1101**111**0, 1110**01**1**1**, 100010**01**). This cause the secret image bit to be inserted inside the cover pixel's 4th LSB. The distortion caused due to this bit alone is -8 to +8.

II. PROPOSED METHODOLOGY

Our methodology uses the combination of both cryptography and steganography (cryptography followed by steganography), to provide the security through the message scrambling along with hiding the scrambled/encrypted message, thus achieving the greater level of data integrity, confidentiality and security, than obtained if both are used separately. We have used twofish encryption method for message encryption followed by Modified Hash-LSB Steganography method. The use of twofish encryption strengthens the message security and also large message can be encrypted by it easily unlike RSA [1] or any other stream cipher where large message encryption is a pain. Twofish with key length of 256 bits is used as its performance is better in term of speed than other AES candidates for same key size [15]. The proposed modified Hash-LSB method embed the encrypted message bits into the component of a pixel (R, G, B) in 3, 2, 3 format as the value of luminance of an image is heavily dependent upon the value of green pixel. The resultant stego image is send over the open channel, the receiver first decodes the message bits to get the cipher text and then uses the secret key to decrypt the message and get the original plain message. This prevents steganalayst to easily get the plain text easily through random iterations to find the pattern.

A. *Modified Hash-LSB*

Modified Hash-LSB method uses the formula of Hash-LSB method [6] as given in (1), but in different way, such that it never touches the 4th LSB bit. As the Hash-LSB was touching and altering the 4th bit, the effect due to its change alone ranges from +8 to -8, while in our method we removed that such that we are only changing only upto 3rd LSB. The effect of changing all three LSB itself ranges from +7 to -7, which is less than changing 4th bit alone. From (1)

$$P = H \% L$$

Where, the value of L is 3 in our case and H is obtained dynamically from the 4 MSBs of R, G, B component of a pixel of cover image / stego image.

Depending upon the value of position p for each component (R, G, B) of a pixel, the message bits (3, 2, 3) are inserted in the pixel starting from that position in clockwise direction.

Let us suppose message bits be 11110101. Let R, G, B of cover image be (11010100, 11100010, 10001001). Then 4 MSB of R, G, B is (1101, 1110, 1000) which is decimal equivalent to (13, 14, 8).

Using P = H % L where L is 3 in our case.

The value of P is 1 for R and 2 for G, and 2 for B then, new R, G, B would be (11010**111**, 111000**01**, 10001**110**). This cause the secret image bit to be inserted inside the cover pixel within 3rd LSB. The distortion caused due to this bit alone is -8 to +8.

For green component if the value of P is 2, then it is treated as 1 as we only insert into first two LSB of green component, to not loose the luminance characteristics of the original image by much. This luminance of an image is given by (2).

$$Y = 0.3*R + 0.5859*G + 0.113*B \qquad (2)$$

B. Twofish Cryptography Algorithm

It was one of the top 5 finalists of Advanced Encryption Standard (AES) contest. It is 128 bit block cipher accepting the key up to length 256 bites. It uses 16 round Fiestel network with a bijective F function made up of four key dependent S-Boxes, a fixed 4-by-4 maximum distance separable matrix over GF (2^8), a pseudo-Hadamard transform, bitwise rotations, and a carefully designed key schedule. In our proposed method we used this algorithm in CBC mode with 0 padding for the key. Reference [14] shows brief description of twofish algorithm and its building block.

C. Proposed Design

In our design we have implemented Modified Hash-LSB and twofish cryptographic algorithm to make message meaningless and hide in the image at sending side. Incase if the steganalayst does decode the hidden bits, it would be meaningless without the secret key. This shows two level of security added up one after another thus making the system very secure and tight. Sender side is shown below in figure 1.

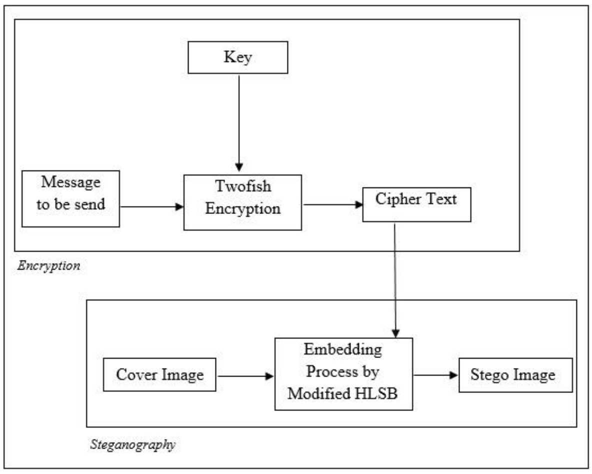


Figure 1: Sender side of the Proposed Design

Reverse of these are carried out in the receiving end to get the meaningful original message back from the hidden encrypted message. Using the modified Hash-LSB we get the encrypted text, which is decrypted using the secret key to get back the original plain message. All the steps carried out for this at the receiving end is shown in the figure 2.

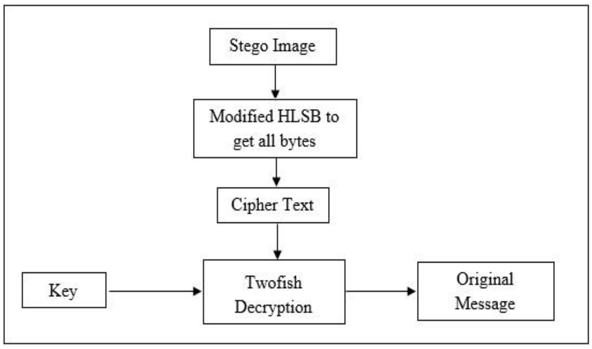


Figure 2: Receiving Side of the Proposed Design

III. RESULT ANALYSIS

Based on the proposed methodology and proposed algorithms we have developed a system, which implements this proposed algorithms using ASP DOT NET(C#). As a target measures, we studied parameters-MSE, PSNR, SSIM and KL Divergence (relative entropy) for the system.

$$\mathrm{MSE} = \frac{1}{\mathrm{MN}} \sum_{j=1}^{m} \sum_{k=1}^{n} |x(j,k) - x'(j,k)|^2 \qquad (3)$$

Where MSE is mean squared error that calculates the average of square of difference between two images cover image $\mathbf{x(j,k)}$ and stego image $\mathbf{x'(j,k).}$ M and N in equation (2) are the total width and height of the image in pixel.

$$\mathrm{PSNR} = 10 \log \frac{(255)^2}{\mathrm{MSE}} \qquad (4)$$

PSNR stands for Peak Signal to Noise Ratio. We have 255 as all the images have R, G and B component, each made up of 8 bit. Its unit is dB and measures the quality image degradation between two images. The higher value of PSNR indicates more similarity between two images in our work.

$$D\,(P_c \,||\, P_s) = \sum P_c \,\log \frac{Pc}{Ps} \qquad (5)$$

Relative entropy is a measure of difference of one probability distribution from another. It is used to measure the level of security in Image steganography. It is given in eq. (5).

The value of MSE and PSNR are not predictable for maximum range. MSE can be minimum of 0 in case of no change in both cover image and stego image and can go upto maximum of 255^2, while PSNR may range from 0 to infinity. Where 0 is for two images having maximum MSE and infinity is for two same images whose MSE is 0. This shows higher PSNR shows better similarity between two images. In steganography the bit change cannot be predicted and cannot be uniform, this leads impossible to calculate the higher possible PSNR for any steganography algorithm, but yes we can predict the minimum possible PSNR for the algorithm.

In Hash-LSB we have calculated the minimum possible PSNR as we always get any of the four possible options (embedded anticlockwise) to hide text using this algorithm and compared with our modified Hash-LSB algorithm.

TABLE I: MSE for all possible positions p in HLSB

P	Change in (R,G,B) value	$(Y_c - Y_s)$	MSE = $(Y_c - Y_s)^2$
0	(14,13,3)	12.1557	147.761
1	(7,14,9)	11.2066	125.5878
2	(11,7,12)	8.7573	76.6903
3	(13,11,6)	11.0229	121.5043

Where $(Y_c - Y_s)$ is the luminance difference between cover image and stego image.

At minimum MSE,

When MSE = 76.6903

$$\text{PSNR} = 10 \log \frac{(255)^2}{76.69}$$

= 29.28 dB

In our proposed modified case the change is always limited to (R, G, B) change by (7, 3, 7) as we only alter 3 Red, 2 Green and 3 Blue LSBs.

Thus,

$(Y_c - Y_s) = 0.3*7 + 0.5859 * 3 + 0.113 * 7 = 4.6487$

$\text{MSE} = (Y_c - Y_s)^2 = 21.60$

$$\text{PSNR} = 10 \log \frac{(255)^2}{21.60}$$

= 34.78 dB

This clearly shows that the minimum PSNR is better for Modified HLSB as compared to HLSB method.

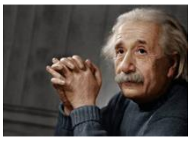
RGB Cover Images used in our test

1

2

3

4



5

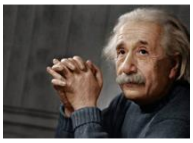
Stego Image for above cover Image

1

2

3

4



5

Cover images 1, 2, 3 and 4 are 256×256 pixels images while image 5 is 210×150 pixels image. Using the proposed method, message of different length are embedded into above cover images. The length of embedded messages are shown in the table II.

The timing parameters are also measured for our different findings. All the parameters were found based upon the average time taken for embedding and extracting with 10 iterations. All these timing parameters are shown in the table III.

TABLE II: Message length, MSE and PSNR calculations of different stego images

Images	Message Length	MSE	PSNR
1	237 bytes	0.007181	69.5687dB
2	1532 bytes	0.046798	61.4284dB
3	539 bytes	0.018858	65.3756dB
4	323 bytes	0.010181	68.0528dB
5	9162 bytes	0.50552	51.0934dB

TABLE III: Time taken for embedding and extracting message

Images	Time to embed	Time to extract
1	183.355 ms	81.134 ms
2	206.324 ms	99.338 ms
3	185.296 ms	93.726 ms
4	183.828 ms	89.732 ms
5	982.337 ms	195.344 ms

TABLE IV: SSIM and KL Divergence of pixel component

Images	SSIM	$D_R(P_c\|\|P_s)$	$D_G(P_c\|\|P_s)$	$D_B(P_c\|\|P_s)$
1	0.9998	0.00001170	0.00000827	0.00000997
2	0.9999	0.00003236	0.00002307	0.00003371
3	0.9988	0.00049879	0.00034917	0.00043749
4	0.9998	0.00000701	0.00003425	0.00005581
5	0.9999	0.00001309	0.00001637	0.00001566
6	0.9991	0.00002625	0.00001627	0.00002093

These findings shows that the system is 0.000498794 secure and from the above findings we can see that the original cover image and the output/ stego image are almost similar and cannot be distinguished by our naked eye. This also means the security barrier is very high and with any type of message and any image format, the results are always far better and in acceptable range than Hash Algorithm. The minimum possible value of Hash LSB algorithm was around 29.28dB but with our improved algorithm, the value is increased to 34.78dB.

Image 5 shown above with the full text placement for all pixels in the image, the result yielded SSIM of 0.9801. With large message of 9162 characters also it gave almost same image, imperceptible through our naked eye. Its PSNR was 51.0934dB and D(Pc||Ps) was 0.007149,0.002994,0.004267 for red, green and blue. The overall system security is strengthens more by the use of twofish encryption, thus making the overall system robust.

IV. CONCLUSION

In this paper we proposed a method that uses both cryptography and steganography and can hide the secret message same as Hash LSB but in slightly different way with better imperceptibility and tight security. The algorithm was modified slightly to use in better way yielding better result. Number of tests with variety of images and varying message length were performed to evaluate the system. The evaluation was done through the calculation of PSNR, SSIM and relative entropy, which was good and in acceptable range. Our algorithm also guarantees the minimum PSNR value that is better than the one obtained through the use of Hash-LSB. At any condition, without the secret key, the original message is possible by only breaking the twofish algorithm which is like breaking the encryption that is going on today over the open channel. Also large messages can be embedded very easily. Embedding of images can be obtained easily by converting it to byte array. But before this finding the exact sequence and the bytes that make up the random message is also another difficult work. Also our method has more dynamism when it comes to finding the position for inserting the message bits in the cover image pixel as compared to conventional hash algorithm which was like static approach to use the pixel number. The hiding capacity has been unchanged with 1 byte per pixel but the system has very high security as the possible attraction of message to an unauthorized person is removed.

Moreover with the transmitted stego image only without having the knowledge of cover image, and meaningless message with no any pattern makes it even harder to know about message and communication for steganalayst making the system robust.

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Facial Expression Recognition using Inception Layer in Deep Neural Network

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ABSTRACT

Facial Expression Recognition (FER) is a very active research topic due to its potential application in many fields such as Human Machine Interface, Driving Safety and Health Care. This work proposes an Inception Network to classify the Human Facial Expressions which also solves the short comes of the Convolutional Neural Network (CNN). The performance of the Inception Network was done with CNN in terms of accuracy, training time and error on publicly available FER datasets chosen was CK+ which has 7000 images. The Inception Network was compared with the CNN using the CK+ datasets and also with the reference Kaggle datasets to find the network accuracy. The experimental results obtained after training the network shows that the Inception Network performed better recognition of Human Expressions than CNN in both FER datasets. The overall accuracy of Inception Network was 88.3% and that of CNN was 62.0% while training on CK+ datasets. Similarly, the overall accuracy of Inception Network was 82.0% and that of CNN was 70.0% while training on Kaggle datasets. Also, when the images were applied some manipulation the result obtained was better in Inception Network than that in CNN for both the datasets.

Keywords:
Facial Expression Recognition, Deep Neural Network, CNN, Inception Layer

1. INTRODUCTION

Facial Expression plays a vital role in Human Machine Interaction and is most important nonverbal channel to recognize human emotions like anger, disgust, fear, happiness, sadness, and surprise. Most of Human emotional expressions are able to be observed on their face than any other signs. Thus, for cutting-edge interfaces, which need to communicate with a human user, real-time facial expression recognition system has to be utilized for situation understanding. Face detection is implemented to find face for every frame after detection face position and pixel data inside the detected area is used for face tracking model [1]. Deep Neural Network is used in pattern recognition and classification task. Histogram of Gradient (HOG) for feature description is widely used for the object detection in computer vision [1]. Increase in neural network depth increases in the complexity of network and training time which grow significantly with each additional layer leading to failure in finding the optimum network configuration [9]. To address the problem arises in Facial Expression Recognition in multiple well known standard face data set used in a Deep Convolution Neural Network followed by an Inception Layer. This network consists of Convolutions Layer each followed by Max Pooling and the Layers of Inception. The architecture takes registered facial image as input and classifies them on the basis of six basic expressions. The experiment is carried out on publicly available facial expression Cohn Kanade (CK+) datasets and is also cross validated with the Kaggle datasets which is used in the Convolutional Neural Network proposed in [1].

Apart from Robotics and Human Machine Interaction, Facial Expression Recognition is also useful in field like Education, Research, Security, Marketing, Animation, Automobile Safety and Behavior Science [1]. Convolutional Neural Network is the current state of the art for Object Recognition and Image Classification but some of the short comes of CNN has push to find better approaches. CNN are the deeper network rather than wider. The very deep network is prone to over fitting and also increase computational cost so using multiple filter size at same level to get network wider than deeper for better feature extraction and classification. CNN mislead when orientation and perspective of image is changed. When train the CNN with an image and test the network with change in orientation CNN will misinterpret the image thus creating situation where the network needs to be trained in every possible orientation. CNN with very deep network get representational bottleneck problem. Applying smart factorization methods, convolutions can be made more efficient in terms of computational complexity i.e. **Factorize 5x5** convolutions **to two 3x3** convolution operations to improve computational speed. The ability to detect and track user's state of mind has the potential to allow a computing system to over relevant information when a user needs help. Criminal Suspects during interrogation is also a useful aspect in which this system can form a base. It is proven that facial clues are more often than a lie to the trained eye. Cleaver Marketing is feasible using emotional knowledge of a patron and can be done to suit what patron might need badges on his / her state of mind at any instant. Surveillance and security, computer models obtained up to 71percentage correct classification of innocent or guilty participation based on the macro feature extracted from the video camera footage.

2. RELATED WORK

Jinwoo Jeon et al. suggest the use of HOG feature descriptor to detect a human face, correlation tracker to track detected face and Convolution Neural Network (CNN) based recognizer on the model. The CNN model is trained and tested with Kaggles dataset , result shows the high-test accuracy and low computation time by the recognizer enabling real-time high- performance, it takes 110ms (9.1fps) to process a single frame in the worst case, after it detects a face, process time drops to 43.7ms. Processing times were measured on a Nvidia GeForce GTX 650 Ti GPU. The average accuracy for all categories was 70.74 per. The reason for a low testing accuracy of some category is seen as the number of images for the category is imbalanced, causing classification error. This work suggests for choosing datasets which has higher images in each category [1].

3. PROPOSED APPROACH

3.1 Inception Network

Assume that each unit from an earlier layer corresponds to some region of the input image and these units are grouped into filter banks. In order to avoid patch-alignment issues, current incarnations of the Inception architecture are restricted to filter sizes 1*1, 3*3 and 5*5 this decision was based more on convenience rather than necessity, why not use all of them and let the model decide by doing each convolution in parallel and concatenating the resulting feature maps before going to the next layer. Now the next layer is also an Inception module then each of the convolutions feature maps will be passes through the mixture of convolutions of the current layer. The main idea is that to know ahead of time if it was better to do, for example, a 3*3 then a 5*5. Instead, just do all the convolutions and let the model pick what is best. Additionally, this architecture allows the model to recover both local feature via smaller convolutions and high abstracted features with larger convolutions.

Architecture that will be using 1*1, 3*3, and 5*5 convolutions along with a 3*3 max pooling. Max pooling is added to the Inception module for no other reason than, historically, good networks having pooling. The paper suggests first doinga1*1convolution reducing the dimensionality of its feature map, passing the resulting feature map through a ReLU, and then doing the larger convolution (in this case, 5*5 or 3*3). The 1*1 convolution is keys, because it will be used to reduce the dimensionality of its feature map. Figure 3.1 shows the inception module with the dimensionality reduction.

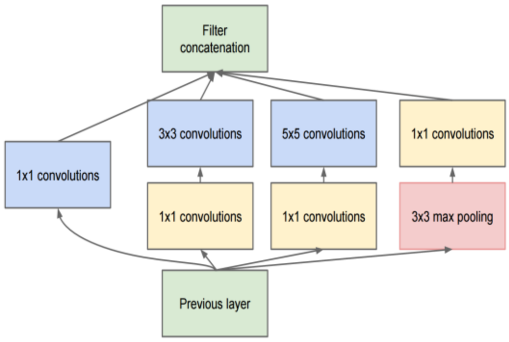


Figure 1: Inception Network with Dimensionality Reduction

4. IMPLEMENTATION

4.1 Data Collection

The Datasets that will be used in this research is CK + datasets which contain around 1,000 images of each category with different illumination conditions. (i.e. Angry, disgust, Happy, Neutral, Surprise, Sadness). The Extended Cohn Kanade database (CK+) [10] displayed different expressions starting from the neutral for all sequences, and some sequences are labeled with basic expressions. The selected only the final frame of each sequence with peak expression in our experiment, which results in 7000 images.

The CK+ datasets for my thesis is publicly available datasets for Human Facial Expression Recognition which has almost of Seven Thousand original datasets of 640*490 image of Six different categories (Happy, Sad, Disgust, Anger, Surprise and Fear). Each category has almost of thousand images of 640*490 image size. The total original dataset is divided into two Training and Testing percentage for each class. These division are in three group as (60 training - 20 testing), (70 training -30 testing) and (60 training - 40 testing) datasets. The datasets used for the comparison of the both CNN and Inception Model is for validating the result obtained from this model on the CK+ datasets is accurate, so the reference datasets is from Kaggle datasets which also have the same categories of images with around 35,880 images in total. Figure 4.1 shows the image of CK+ datasets for different facial expressions.

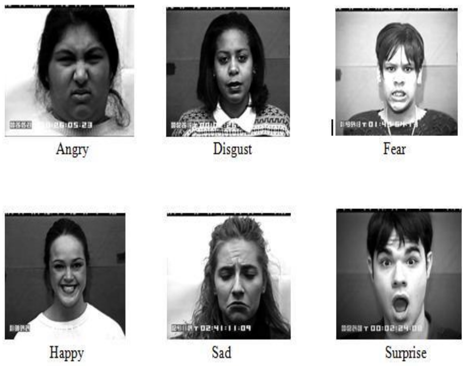


Figure 2: Facial Expressions of the CK+ datasets

The activation value which makes the training to converge to the minima gives the learning rate which was between 0.1 to 0.001 also the datasets were trained for different epoch where the training steps varied from 100 to 10000. The datasets (CK+) was divided into 80-20, 70-30 and 60-40 ratio to check the highest percentage accuracy obtained from these sets.

4.2 Image Manipulation

The CK+ datasets images where applied some sort of manipulation (like intensity value variation, cropping and flipping) to check the percentage of accuracy that can be achieve when these sorts of manipulation are applied to the images. The model was trained with the data sets and the accuracy of the model was noted while applying manipulation. Figure 3 show the image after manipulation like cropping, flipping and intensity varying.

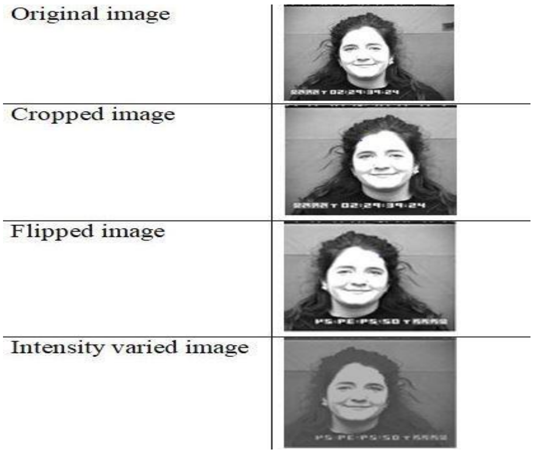
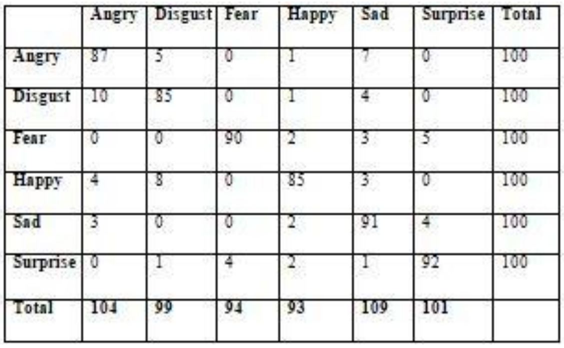


Figure 3: Image manipulation on original image of CK+ datasets.

5. RESULTS AND DISCUSSION

Table 1: Confusion Matrix of Inception Model with CK+ datasets.



	Angry	Disgust	Fear	Happy	Sad	Surprise	Total
Angry	87	5	0	1	7	0	100
Disgust	10	85	0	1	4	0	100
Fear	0	0	90	2	3	5	100
Happy	4	8	0	85	3	0	100
Sad	3	0	0	2	91	4	100
Surprise	0	1	4	2	1	92	100
Total	104	99	94	93	109	101	

Accuracy formula:

(TP+TN)/(TP+TN+FP+FN)

Accuracy of CNN:

(87+85+90+85+91+92) / (600) = 88.3%

The table 1 shows the confusion matrix of Inception model while training the CK+ datasets on this model. The model reorganization capacity is tested which is shown by the accuracy of all the category. This is done by selecting an image from one category and running the command which will in result give the recognition percentage accuracy (here in angry image the model can recognize the given image with 87% accuracy). The overall accuracy of the model is calculated from the above formula which gives 88.3% accuracy for the Inception model with CK+ dataset. Figure 4 shows the Confusion Matrix of Inception with CK+ Datasets

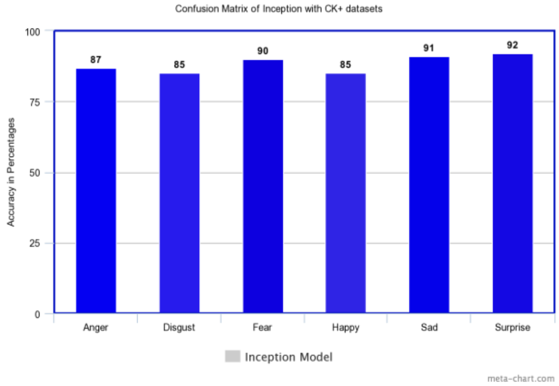
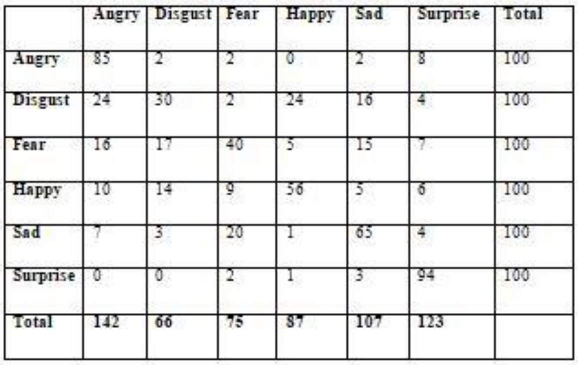


Figure 4: Confusion Matrix of Inception with CK+ Datasets

Table 2: Confusion Matrix of CNN Model with CK+ Datasets



	Angry	Disgust	Fear	Happy	Sad	Surprise	Total
Angry	85	2	2	0	2	8	100
Disgust	24	30	2	24	16	4	100
Fear	16	17	40	5	15	7	100
Happy	10	14	9	56	5	6	100
Sad	7	3	20	1	65	4	100
Surprise	0	0	2	1	3	94	100
Total	142	66	75	87	107	123	

Accuracy formula:

(TP+TN)/(TP+TN+FP+FN)

Accuracy of CNN:

(85+30+40+56+65+94) / (600) = 62%

The table 2 shows the confusion matrix of CNN model while training the CK+ datasets on this model. The model reorganization capacity is tested which is shown by the accuracy of the category. This is done by selecting an image from one category and running the command which will in result give the recognition percentage accuracy (here in angry image the model can recognize the given image with 85% accuracy). The overall accuracy of the model is calculated from the above formula which gives 62% accuracy for the CNN model with CK+ dataset. Figure 5 shows the Confusion Matrix of CNN with CK+ Datasets

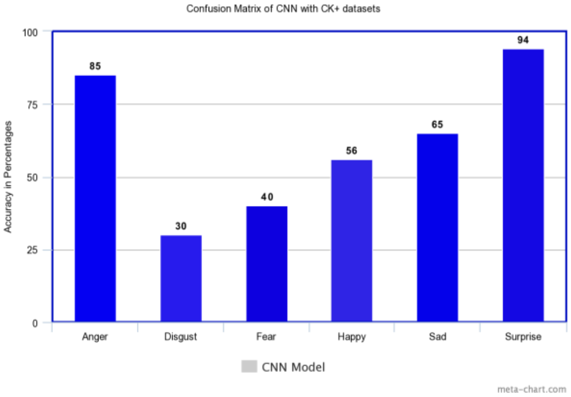


Figure 5: Confusion Matrix of CNN with CK+ Datasets

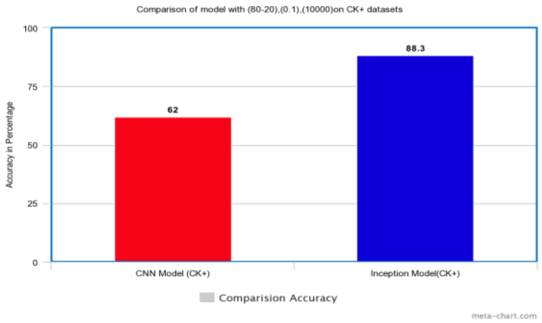


Figure 6: Comparison of the accuracy obtained on the both the model on CK+ datasets.

The confusion matrix for the CNN with Kaggle dataset gives the accuracy of the model which is 70% which is shown from [1] the confusion matrix for the inception network with Kaggle dataset gives accuracy as 82%. Similarly, for CK+ dataset the inception network with 88.3% accuracy and the CNN with 62% accuracy respectively. The low accuracy of the CNN is due to its use of single filter in network whereas inception network uses 1*1, 3*3, 5*5, 7*7 fitters together for feature extraction. The image of CK+ and Kaggle dataset were applied some distortion in the original images and with these distorted images the network was trained, and the accuracy were obtained which shows that the inception network over all behaved to be good than CNN as shown in figure 6.

6.CONCLUSION AND FUTURE WORK

The training accuracy for Inception Network was 88.3% with CK+ and 62% with Kaggle dataset. Similarly training accuracy for CNN was 82% with CK+ and 70% Kaggle dataset. The CK+ dataset was applied some distortion to check the accuracy and this was done on both the Inception network and CNN network. The higher accuracy seen in Inception model is as it uses the all the three convolutions i.e. 1*1 CONV, 3*3 CONV and 5*5 CONV together which give the better result and also extract the lower to higher features of the training image. This research concludes that Inception Network has better recognition capacity than that of CNN for images with and without distortion in both the datasets. Training the Inception Network took almost 5-6 hours with the 10000 training steps which was less as compared to CNN which took around 8-9 hours. Also, for manipulated image the training time increased drastically which took more than a day for inception network and 2 plus day for CNN. This can be overcome by using GPU instead of CPU processor. Also, the algorithm used can be further enhanced which would make the computation faster and increase accuracy.

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Fault Locating in Transmission Line Using Discrete Wavelet Transform, Neural Network and Genetic Algorithm

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***Abstract*: This research compares three different algorithms which can be used for locating faults in power transmission lines where a neural network has been trained using genetic algorithm with the combination of two different types of fitness functions. The required discrete fault current samples used for training the neural network was acquired by the formula of three phase to ground fault current. To extract the information of different frequency bands of fault current discrete wavelet transform has been used and to reduce the number of inputs to the neural network, the energy of the decomposition coefficients has been applied to the input layers of the neural network.**

***Keywords:* Discrete Wavelet Transform, Neural Network, Genetic Algorithm, Power System Faults.**

I. INTRODUCTION

Overhead transmission lines are parts of the electric power system where fault probabilities are generally higher than that of other system components. Ground faults have been considered as one of the main problems in power systems and account for more than 80% of all faults. These faults give rise to serious damage on power system equipments. A ground fault which occurs on transmission lines not only effects the equipments but also the power quality.

Therefore, it is very important to have a fast and reliable method that can detect and locate faults on transmission lines in order to reduce the time needed to resume the service to consumers and increase the reliability of the system.

Several methods have been proposed for locating fault in power transmission line. Silva, Lima and Souza [1] locate the fault using the concept of complex domain neural network. The fault current signal was transformed using Discrete Fourier Transform (for the first case) and Stationary Wavelet Transform (for the second case) and the neural network was trained using complex domain back propagation algorithm using complex domain hyperbolic tangent as an activation function. Ekici, Yildirim and Poyraz [2] trained the neural network using back propagation algorithm, where activation function used were hyperbolic tangent sigmoid for first and second layers and linear for the third layer. The input to the neural network was energy and entropy of the Wavelet Packet Coefficients of the fault current. Bhowmik, Purkait and Bhattacharya [3] trained the neural network using back propagation algorithm, where hyperbolic tangent sigmoid function was used to activate the input nodes and linear function was used to activate hidden and output nodes. The fault current signal was transformed using Discrete Wavelet Transform. Mahanty and Gupta [4] trained the neural network used to locate fault in transmission line that involves radial basis function. Naggar [5] used the genetic algorithm to optimize the fitness function (inverse of sum of square of errors for the first case and inverse of sum of absolute value of errors for the second case), where the errors involve the difference between actual value of currents and outputs of information vector (that depends on the distance of fault from sending end) at discrete instants of time. Tawfik and Morcos [6] used the Prony method to analyze the fault current signal while training the neural network.

This research mainly aims to compare three different algorithms which can be used for locating faults in power transmission lines built using discrete wavelet transform (to decompose discrete values of fault current into different frequency components), neural network (to learn the relation between faulty distance and the energy of different frequency components of the fault current) and genetic algorithm (to train the neural network).

1.1 Artificial Neural Network

An artificial neural network is made up of simple processing units called neurons, which has a capacity for storing experimental knowledge and making it available for use. It resembles the brain in two respects:

a) Knowledge is acquired by the network from its environment through a learning process.

b) Interneuron connection strengths, known as synaptic weights, are used to store the acquired knowledge [10].

The design of neural networks proceeds as follows:

a) First an appropriate architecture is selected for the neural network. The training data is used to train the neural network by adjusting its synaptic weights.

b) Second the recognition performance of the trained network is tested with data not seen before [10].

1.2 Genetic Algorithm

Genetic Algorithms are based on theory of natural selection and work on generating a set of random solutions and make them compete in an arena where only the fittest survive. Each solution in the set is equivalent to a chromosome. A set of chromosomes forms a population. The algorithm then uses three basic operators: selection, crossover and mutation, together with a fitness function to evolve a new population.[13].

1.3 Hybrid Systems

Here, the genetic algorithm is used to evolve the weights of the neural network rather than using back propagation or some other technique for training connection weights.

The chromosome in this case could be an ordered chain of weights. Each neuron comprises the weights of the arcs that connect the neuron of a layer to those of its previous layer.

Here the reciprocal of the sum of the square of errors (fitness $= \frac{1}{\sum e^2}$) or reciprocal of the sum of absolute value of errors (fitness $= \frac{1}{\sum |e|}$) reported after training the network for a predetermined number of epochs could depict the fitness of a set of weights.

Crossover cans be effected by swapping the genes. Mutation can be effected by randomly adding or subtracting a small value between 0 and 1 from weights that comprise a randomly selected gene [13].

1.4 Discrete Wavelet Transform

The discrete wavelet transform (DWT) is a linear transformation that operates on a data vector whose length is an integer power of two, transforming it into a numerically different vector of the same length. It is a tool that separates data into different frequency components, and then studies each component with resolution matched to its scale. DWT is computed with a cascading of filters followed by a factor 2 down sampling.

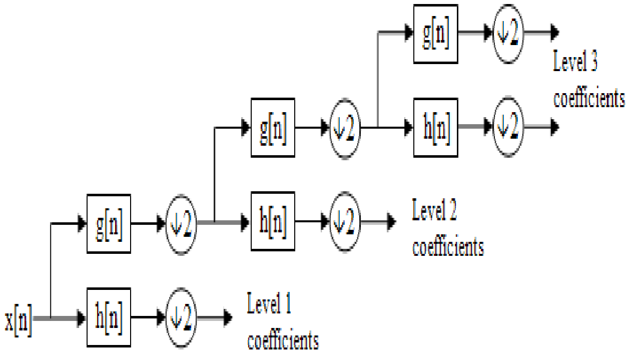

Figure.1: Block diagram of the discrete wavelet transform (h[n] and g[n] denotes high and low-pass filters respectively, ↓ 2 denotes down sampling)

Outputs of these filters are given by the following equations:

$$a_{j+1}[p] = \sum_{n=-\infty}^{+\infty} g[n-2p]a_j[n] \qquad (1)$$

$$d_{j+1}[p] = \sum_{n=-\infty}^{+\infty} h[n-2p]a_j[n] \qquad (2)$$

Element aj is used for the next step of the transform and element dj, called wavelet coefficient, determines the output of the transform. g[n] and h[n] are coefficients of low and high-pas filters respectively. For example, h[n] = {-1/2, -3/2, 3/2, 1/2}, g[n] = {1/8, 3/8, 3/8, 1/8} also called Daubechies 4/4 wavelet[12].

II. METHODOLOGY

The system in which the algorithm is applied is shown in figure.2. It consists of a generator feeding a load center through two transformers and a short transmission line. The transmission line is 50 miles long and the line capacitance is neglected. The fault is assumed to occur at different lengths from the sending end. Neglecting resistance, the symmetrical short circuit current that flow in the transmission line can be written as:

$$i(t) = E\sin(wt + \emptyset)\,[\frac{1}{X_d} + e^{-\frac{t}{Td1}}\left(\frac{1}{X_{d1}} - \frac{1}{X_d}\right) + e^{-\frac{t}{Td2}}\left(\frac{1}{X_{d2}} - \frac{1}{X_{d1}}\right)] \qquad (3)$$

where,
E = sending end voltage
ω = angular frequency
Ǿ = voltage phase angle
T_{d1} = transient short circuit time constant
T_{d2} = sub transient short circuit time constant
$X_d = x_d + x_t + x_{tl}$*L
$X_{d1} = x_{d1} + x_t + x_{tl}$*L
$X_{d2} = x_{d2} + x_t + x_{tl}$*L
x_d = steady state reactance of generator
x_{d1} = transient reactance of generator
x_{d2} = sub transient reactance of generator
x_t = transformer reactance
x_{tl} = transmission line reactance
L = length of transmission line/mile at which the fault occurs[5]

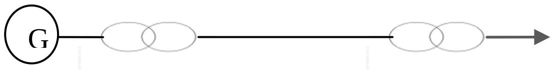

Figure.2: A generator feeding a load center through two transformers and a short transmission line

The block diagram of the method of development of programs is shown in figure.3. At first equation 3 was used to generate the fault current samples at different instants of time.

The discrete wavelet transform of the fault current samples was generated using Daubechies 4/4 as a mother wavelet. Since the lower frequency component of fault current contains less information about the fault so the approximation coefficient was omitted and the decomposition coefficients were extracted after four levels of decomposition.

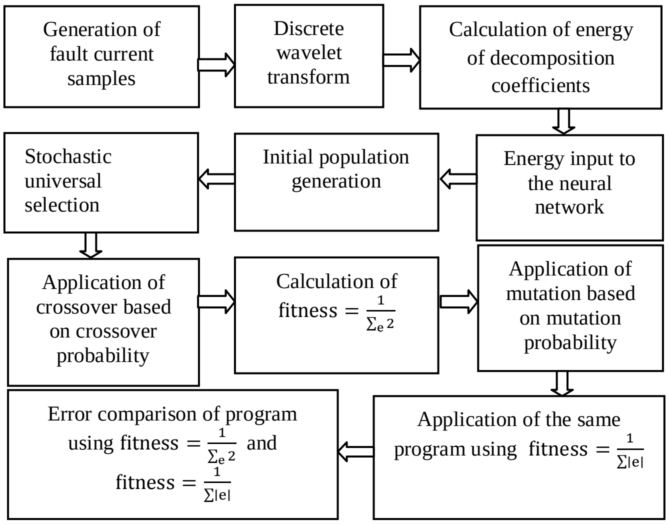
Generation of fault current samples
Discrete wavelet transform
Calculation of energy of decomposition coefficients
Energy input to the neural network
Initial population generation
Stochastic universal selection
Application of crossover based on crossover probability
Calculation of fitness = $\frac{1}{\sum e^2}$
Application of mutation based on mutation probability
Application of the same program using fitness = $\frac{1}{\sum |e|}$
Error comparison of program using fitness = $\frac{1}{\sum e^2}$ and fitness = $\frac{1}{\sum |e|}$

Figure.3: Block diagram of the method of the development of the programs

To reduce the number of inputs to the neural network the energy of the four decomposition coefficients ($E = \sum_{j=1}^{N} {d_j}^2$) was calculated and the energies of four decomposition coefficients were given to the neural network.

The neural network consists of four nodes in input layer, two neurons in the first hidden layer, four neurons in the second hidden layer and one neuron in the output layer as shown in the figure.4.

The bias was omitted in every neuron of the neural network and the unipolar sigmoid $y = \frac{1}{1 + e^{-x}}$ function was used as the activation function.

The training of the neural network was done by using genetic algorithm.

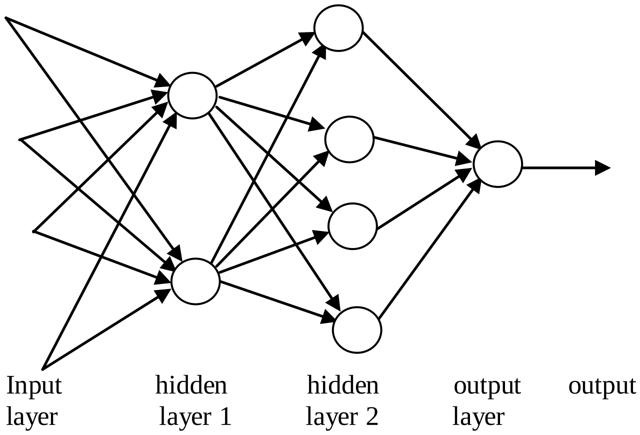

Figure.4: The neural network used in the program

For the first algorithm the fitness function used was the inverse of sum of square of errors (fitness = $\frac{1}{\sum e^2}$).

The selection algorithm used was stochastic universal sampling.

The crossover was performed between dissimilar chromosomes. The crossover was performed at that point where the sum of the fitness function values of output chromosomes after crossover was highest. If the sum of the fitness function values of parent chromosomes was higher than that of their offspring after crossover then parent chromosomes were put in the new population.

Now the mutation was performed at that weight of the chromosome which gave the maximum fitness function value. If the parent had the higher fitness function value than that of the offspring then the parent was kept on the new population, otherwise the offspring was kept.

For the second algorithm the fitness function used was the inverse of sum of absolute value of error (fitness = $\frac{1}{\sum |e|}$).

The third algorithm compares the output of these two algorithms in terms of approximate error and produces the output with minimum error. The approximate error was determined by subtracting the output (say op) of the neural network from that output which produced the output ‘op’.

III. RESULTS AND DISCUSSION

The three algorithms that are compared and analyzed are as follows:

First program: program which train the neural network using the fitness function 'fitness = $\frac{1}{\sum e^2}$'

Second program: program which train the neural network using the fitness function ' fitness = $\frac{1}{\sum |e|}$'

Third program: program which train the neural network using both types of fitness function (fitness = $\frac{1}{\sum e^2}$ and fitness = $\frac{1}{\sum |e|}$)

3.1 Complexity Analysis

The complexity was found to be dependent on the initial population size (n), number of generations (i), mutation probability (pm) and crossover probability (pc).

The complexity of the program that performs discrete wavelet transform and calculates fitness function value was found to be O(1). The complexity of the program that performs selection and crossover was found to be O(n^2). The complexity of the program that performs mutation was found to be O(n). A coding of complexity O(n) was required to generate initial population. Selection, crossover and mutation were repeated for ‘i’ iterations whose combined complexity was i X (O(n^2) + pc X O(n^2) + pm X O(n)). A coding of complexity O(n) was required to select the best chromosome from the population generated after training the neural network. A coding of complexity of O(1) was required to calculate the output of the neural network using the best chromosome.

Therefore the complexity of the whole program was found to be O(n) + i X (O(n^2) + pc X O(n^2) + pm X O(n)).

In the second program only the fitness function type was changed so the complexity of the second program was also found to be O(n) + i X (O(n^2) + pc X O(n^2) + pm X O(n)).

The third program was the combined program with both types of fitness function and therefore the complexity of this program also equals O(n) + i X (O(n^2) + pc X O(n^2) + pm X O(n)).

3.2 Output Analysis

For the analysis of the output we consider two transmission lines characterized by the following parameters:

For first transmission line, the parameters are as follows:
Phase angle between sending end voltage and current = 10^0
Synchronous Reactance of the generator = 1.7 p.u.
Transient Reactance of the generator = 0.256 p.u.
Subtransient Reactance of the generator = 0.185 p.u.
Transformer Reactance = 0.1 p.u.
Transmission line reactance per mile = 0.0042 p.u.
Transient time constant of the generator = 0.26
Subtransient time constant of the generator = 0.027

For second transmission line, the parameters are as follows:
Phase angle between sending end voltage and current = 11^0
Synchronous Reactance of the generator = 1.7 p.u.
Transient Reactance of the generator = 0.260 p.u.
Subtransient Reactance of the generator = 0.190 p.u.
Transformer Reactance = 0.1 p.u.
Transmission line reactance per mile = 0.0042 p.u.
Transient time constant of the generator = 0.27
Subtransient time constant of the generator = 0.028

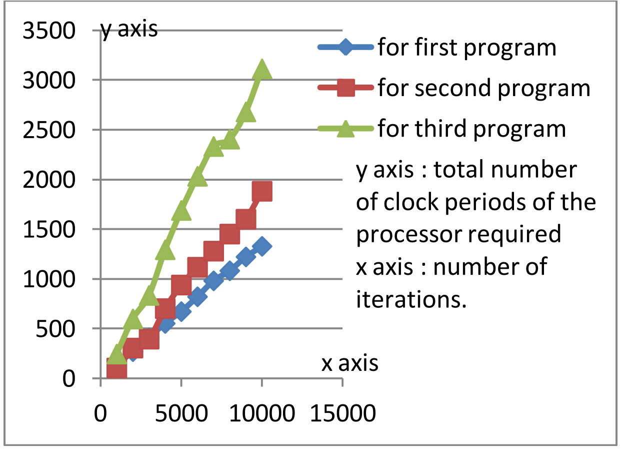

Figure.5: Plot between number of iterations and total number of clock periods of the processor required by the program (Here crossover probability is fixed to 0.5 and mutation probability is fixed to 0.01)

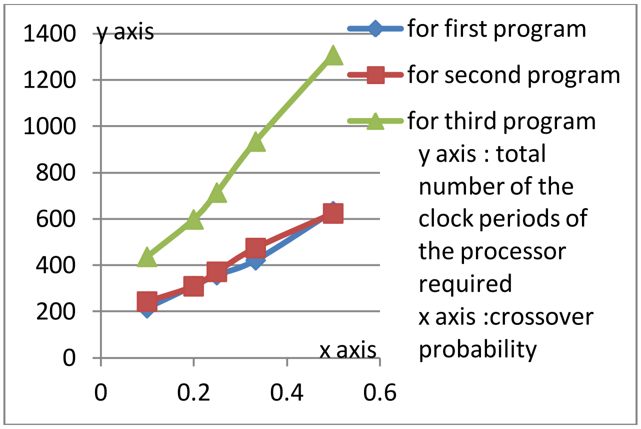

Figure.6: Plot between crossover probability and total number of clock periods of the processor required by the program (Here mutation probability is fixed to 0.01 and number of iterations is fixed to 5000 generations)

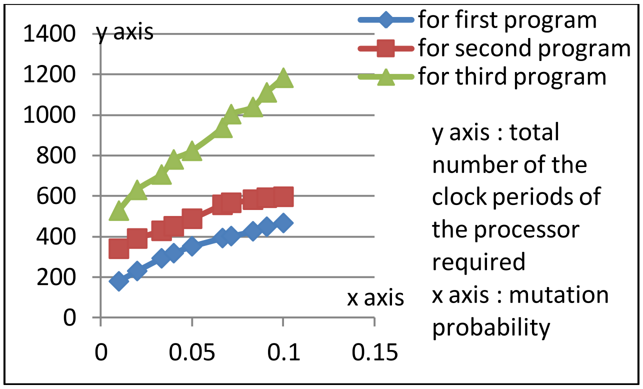

Figure.7: Plot between mutation probability and total number of clock periods required of the processor required by the prograam. (Here crossover probability is fixed to 0.1 and number of iterations is fixed to 5000 generations)

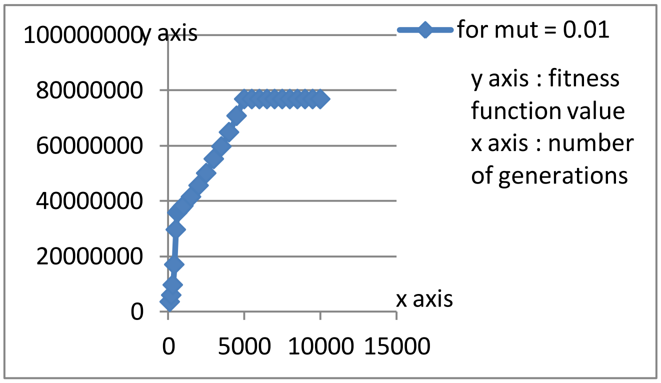

Figure.8: Plot between fitness function value and number of generation required to acquire that fitness function value for first transmission line using first program (Here mutation probability is fixed to 0.01 and crossover probability to 0.5) (Similar graph was found for 0.02 value of mutation, second program and also for second transmission line with different values of fitness function)

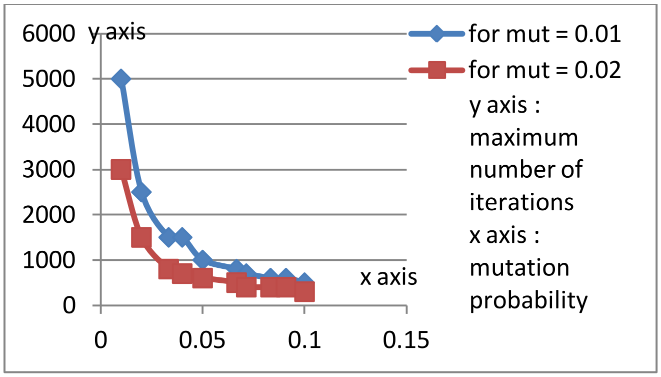

Figure.9: Plot between mutation probability and the maximum number of iterations required to reach the saturated value of fitness function for first transmission line using first program (Here crossover probability is fixed to 0.5) (Similar graph was found for second program and second transmission line with different values of maximum number of iterations)
Note: mut = mutation value

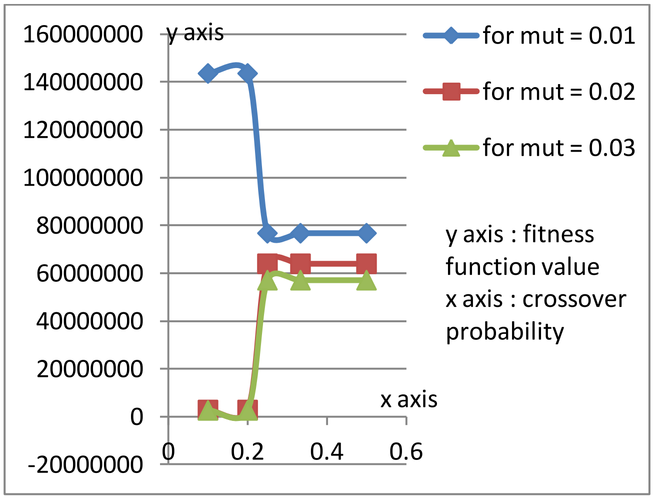

Figure.10: Plot between crossover probability and fitness function value for first transmission line using first program (Here mutation probability is fixed to 0.06667 and number of iterations to 10000) (Similar graph was found for 0.01 value of mutation probability, second program and second transmission line with different values of fitness function)
Note: mut = mutation value

	For first transmission line		For second transmission line	
	Average value of error of output	Variance of error of output	Average value of error of output	Variance of error of output
For first program	0.334168	0.02852	0.214826	0.033811
For second program	0.205851	0.041863	0.244982	0.07468
For third program	0.157681	0.021726	0.188923	0.037315

Table.1: Table of average value of errors (in miles) and variance of errors of the output of first, second and third programs.

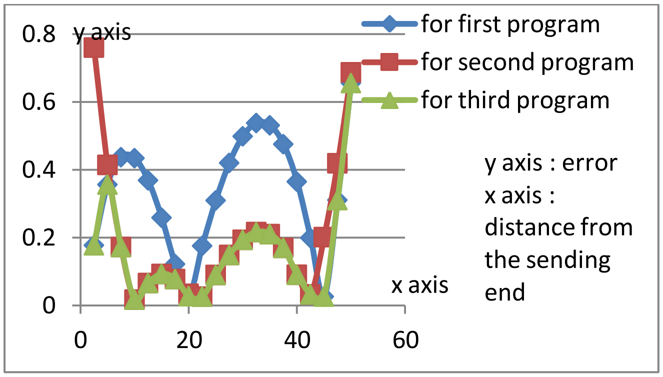

Figure.11: Variation of error (in miles) of output of the first, second and the third program as the distance (in miles) from the sending end of the first transmission line increases. (Similar plot was found for second transmission line)

IV. CONCLUSION AND FUTURE WORKS

4.1 Conclusion

In this research, three different algorithms were studied that can be used to locate fault in power transmission line. From this study it is found that all the three programs are of the same time complexity but based on the clock period of the processor they required while running, first program is the fastest and third program is the slowest among these three programs. It is also found that the increase in mutation probability reduces the number of iterations required to reach the saturated value of fitness function and therefore reduces the running time of all these three programs. Also it is found that the crossover probability and the mutation value play a significant role in the accuracy of all these three programs. Also from the output analysis it is found that the third program is always more accurate than the first and the second program but depending on the type of transmission line on which the first and the second program is used any of these two can be more accurate than that of the other. Based on the type of transmission line on which these three programs are applied, the variance of the error of the output of all these programs vary and any of them can be more consistent than that of the other.

4.2 Future Works

Instead of performing crossover at that point where the sum of the fitness function values of output chromosomes after crossover was highest it can be performed at any point where the sum of the fitness function values improves. Also, instead of performing mutation at that weight of the chromosome which gave the maximum fitness function value it can be performed at any weight at which fitness function value improves. This may make the program faster since the program will not have to search for best chromosome from the whole population during crossover and mutation. The accuracy may be improved by changing the neural network configuration to different forms and increasing the population size. Also, variance of the error of the output can also be added to the fitness function with suitable weight that may lead to reduction in the variance of error.

ACKNOWLEDGEMENT

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Caption Maker: Image Caption Generation Using Convolutional Neural Network

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ABSTRACT

Image Captioning is the process of generating textual description of an image which uses both Computer Vision and Natural Language Processing. There has been significant improvement in image classification over the years with the popularity of deep learning models like Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN). Caption generation requires models that can piece together relevant visual information about the shapes and objects present in an image along with the environment they are in and their activity. In this paper, we present a multi-model neural network method closely related to the human visual system that captions the content of an image. This is done using CNN, an object detection and localization model which extract the features of images along with a deep RNN based on Long Short-Term Memory (LSTM) units for sentences generation in natural language.

1. INTRODUCTION

As a famous proverb says, ‘A picture is worth a thousand words’, an image can be interpreted in many different ways. The description of the image is based on one’s perception of the image. Same image can be described in multiple ways. But not all such description focuses on the actual important context of the image. In the today’s digital world, huge number of images are generated daily. Manually describing these images is a quite tedious and challenging task.

Deep neural networks have ever been applied to computer vision and natural language processing and it has allowed for further research in rather new opportunities of these separate domains. Generation of caption balances the crafts of computer vision and natural language for an interdisciplinary use of knowledge. Neural image caption models can be trained to maximize the likelihood of producing a caption given an input image and can be used to generate novel image descriptions. The advancement of internet has created many data and it is ever increasing. Vast amount of pictorial data can be indexed and access to those images can be made more quickly and efficiently. The automatic description of images for search of data can as well be made easily.

2. LITERATURE REVIEW

Automatically describing the content of an image is a fundamental problem in artificial intelligence that connects computer vision and natural language processing. In this paper, we present a generative model based on a deep recurrent architecture that combines recent advances in computer vision and machine translation and that can be used to generate natural sentences describing an image. The model is trained to maximize the likelihood of the target description sentence given the training image. Experiments on several datasets show the accuracy of the model and the fluency of the language it learns solely from image descriptions [1].

Automatically generating captions of an image is a task very close to the heart of scene understanding—one of the primary goals of computer vision. Not only must caption generation models be powerful enough to solve the computer vision challenges of determining which objects are in an image, but they must also be capable of capturing and expressing their relationships in a natural language. For this reason, caption generation has long been viewed as a difficult problem. It is a very important challenge for machine learning algorithms, as it amounts to mimicking the remarkable human ability to compress huge amounts of salient visual information into descriptive language [2].

Since the introduction of Convolutional Networks (LeCun et al., 1989) in the early 1990's, Convolutional Networks (convnets) have demonstrated excellent performance at tasks such as hand-written digit classification and face detection. In the last year, several papers have shown that they can also deliver outstanding performance on more challenging visual classification tasks. Ciresan et al., 2012 demonstrate state-of-the-art performance on NORB and CIFAR-10 datasets. Most notably, Krizhevsky et al., 2012 show record beating performance on the ImageNet 2012 classification benchmark, with their convnet model achieving an error rate of 16.4%, compared to the 2nd place result of 26.1%. Several factors are responsible for this renewed interest in convnet models: (i) the availability of much larger training sets, with millions of labeled examples; (ii) powerful GPU implementations, making the training of very large models practical and (iii) better model regularization strategies, such as Dropout [3].

Our approach leverages datasets of images and their sentence descriptions to learn about the inter-modal correspondences between language and visual data. Our alignment model is based on a novel combination of Convolutional Neural Networks over image regions, bidirectional Recurrent Neural Networks (RNN) over sentences, and a structured objective that aligns the two modalities through a multimodal embedding. We then describe a Multimodal Recurrent Neural Network architecture that uses the inferred alignments to learn to generate novel descriptions of image regions [4].

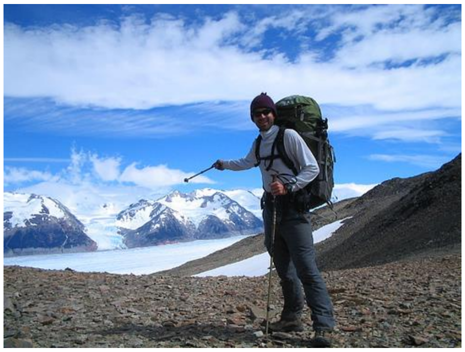
Image caption generation becomes a raising topic in computer vision and artificial intelligence. In order to solve the problem of stiff description, we intend to extract richer features using convolutional neural network (CNN). A neural and probabilistic framework has been proposed consequently which combines CNN with a special form of recurrent neural network (RNN) to produce an end-to-end image captioning. We use a model that takes advantage of word to vector to encode the variable length input into a fixed dimensional vector [5].

In the paper "An Empirical Study of Language CNN for Image Captioning,", they introduce a language CNN model which is suitable for statistical language modeling tasks and shows competitive performance in image captioning. In contrast to previous models which predict next word based on one previous word and hidden state, their language CNN is fed with all the previous words and can model the long-range dependencies in history words, which are critical for image captioning. The effectiveness of their approach is validated on two datasets: Flickr30K and MS-COCO. Their extensive experimental results show that their method outperforms the vanilla recurrent neural network-based language models and is competitive with the state-of-the-art methods[6].

3. TRAINING

3.1 Input

We used Flickr-8k dataset for image captioning. The Flickr8k data set is a collection of 8000 images with five captions each.



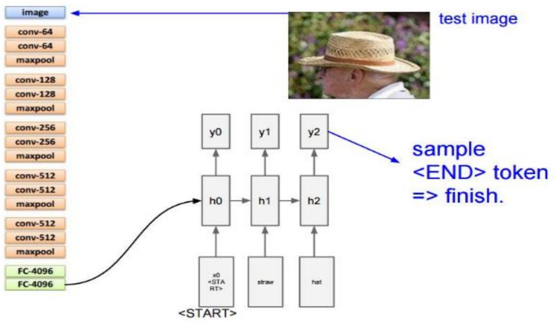
- A backpacker in the mountains using his hiking stick to point at a glacier.
- A backpacker points to the snow-capped mountains as he stands on a rocky plain.
- A hiker is pointing towards the mountains.
- A hiker poses for a picture in front of stunning mountains and clouds.
- A man with a green pack using his pole to point to snowcapped mountains.

3.2 Feature Extraction

Photo is captured through Android phone camera or chosen from existing photos in the phone gallery. Caption Maker app provide easy interface for this process. Then API call is made to the server and the image is sent to the server. The image received by the server is reduced to image size required by the model.

Pixel values extracted from the image file are normalized and passed to feature extractor.

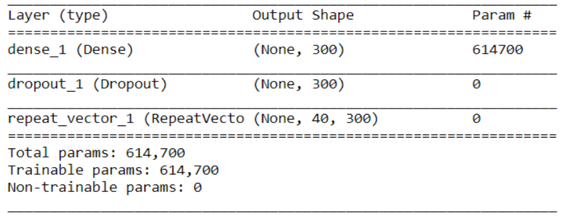
A CNN model is used to extract features from the image. The extracted features are then used to generate the caption.



At first, we convert images to arrays with corresponding intensity values of its color intensities. And then we normalize the intensity values. Then, we use pretrained weights of CNNs trained on ImageNet image classification dataset (VGG16, ResNet50, and InceptionV3) and remove the final dense layers from the mode

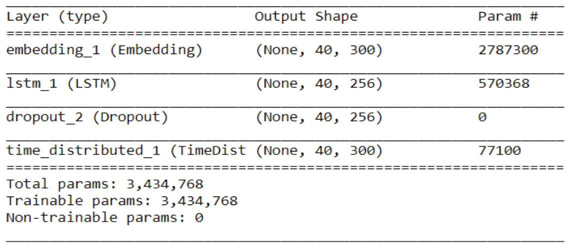
The output from the CNN, is given to the first time-step of the LSTM. We set a <START> vector and the desired label which is the first word in the sequence. Analogously, we set next word vector of the first word and expect the network to predict the second word. Finally, on the last step, we set last word with <END> token to generate image features.

Two different models are used for image features and image captions. The image features are passed through a fully connected dense layer.



```
Layer (type)                 Output Shape              Param #
=================================================================
dense_1 (Dense)              (None, 300)               614700
_________________________________________________________________
dropout_1 (Dropout)          (None, 300)               0
_________________________________________________________________
repeat_vector_1 (RepeatVecto (None, 40, 300)           0
=================================================================
Total params: 614,700
Trainable params: 614,700
Non-trainable params: 0
_________________________________________________________________
```

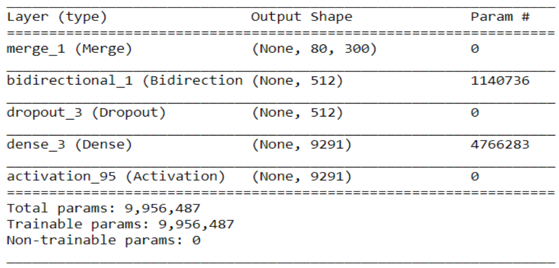
The input captions are passed through an embedding layer onto LSTM layer and then to time distributed layer.



```
Layer (type)                 Output Shape              Param #
=================================================================
embedding_1 (Embedding)      (None, 40, 300)           2787300
_________________________________________________________________
lstm_1 (LSTM)                (None, 40, 256)           570368
_________________________________________________________________
dropout_2 (Dropout)          (None, 40, 256)           0
_________________________________________________________________
time_distributed_1 (TimeDist (None, 40, 300)           77100
=================================================================
Total params: 3,434,768
Trainable params: 3,434,768
Non-trainable params: 0
_________________________________________________________________
```

3.3 Machine Learning Algorithm

Now the two models are merged together and passed to LSTM layer and finally to Dense output layer with softmax activation function.



```
Layer (type)                 Output Shape              Param #
=================================================================
merge_1 (Merge)              (None, 80, 300)           0
_________________________________________________________________
bidirectional_1 (Bidirection (None, 512)               1140736
_________________________________________________________________
dropout_3 (Dropout)          (None, 512)               0
_________________________________________________________________
dense_3 (Dense)              (None, 9291)              4766283
_________________________________________________________________
activation_95 (Activation)   (None, 9291)              0
=================================================================
Total params: 9,956,487
Trainable params: 9,956,487
Non-trainable params: 0
_________________________________________________________________
```

The training procedure also uses various machine learning algorithms to generate the best results.

3.4 Loss Function

We used categorical cross-entropy loss function in the model. Cross-entropy in information theory defines the minimum number of bits required to identify an event drawn from a set two event distributions when the coding scheme used is generated from an estimated probability distribution instead of the true distribution. We want to minimize the loss to minimize the difference between the distribution of the predicted sentences and the actual captions of the image given in the training data.

3.5 Optimization

The RMSprop optimization was used to minimize the loss and train the model. The problem with training deep networks for complicated tasks is that the gradient of these arbitrarily complicated functions can either explode or vanish as the errors are back propagated. RMSprop optimization uses a moving average of the squared gradients to normalize the gradient. This in effect adaptively changes the step size depending on the gradient value medium-RMSprop. RMSprop was developed for batch training of neural networks and it has been observed that RMSprop works well for LSTM networks.

4. PREDICTION

Test images are used to extract features from them using the same feature extraction model. The captions for new images are then generated using search algorithms – normal max search and beam search.

4.1 Normal Max Search

To perform inference, we first obtain image embedding by passing the image through the CNN model and then the dense layer. Then to generate captions using the model, we first feed the LSTM cell with < start> as the first input and image embedding as its initial states. The LSTM produces a word and its hidden states, and we keep feeding this word and hidden states again to the LSTM cell until it outputs < end> or reaches the max sentence length. At first <start> is feed into LSTM cell as input and the word with max probability is selected. Both are again feed to LSTM cell and next word with max probability is chosen and so on until <end> is selected or max sentence length is reached.

4.2 Beam Search

In Beam Search, we take top k predictions, feed them again in the model and then sort them using the probabilities returned by the model. So, the list will always contain the top k predictions. In the end, we take the one with the highest probability and go through it till we encounter <end> or reach the maximum caption length. We used various beam sizes for our experiments.

5. EVALUATION METRICS

At first, two models for image feature and image captions were created. The model for image features consists of input layer which takes image features extracted from imagenet model, a dropout layer and an output dense layer. The model for image captions consists of an embedding layer, a dropout layer and LSTM layer. The output from two models were concatenated and passed through two dense layers to form a final model.

Model	VGG-16	InceptionV3
Epoch	20	20
Loss	3.21	3.1
Validation loss	3.8	3.6
BLEU scores	BLEU-1: 0.502664 BLEU-2: 0.258071 BLEU-3: 0.173180 BLEU-4: 0.075685	BLEU-1: 0.515913 BLEU-2: 0.302460 BLEU-3: 0.222020 BLEU-4: 0.115490

Table 1: Results for initial model

Initially, for image feature extraction we used the VGG-16 model followed by InceptionV3 model and obtained the results as shown in Table1.

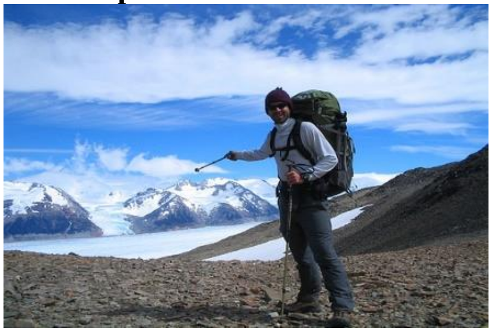
New models for image features and image captions were created to improve the loss. The model for image features consists of input denser layer which takes image features extracted from imagenet model and a repeat vector layer. The model for image captions consists of an embedding layer, a LSTM layer and a Time Distributed LSTM layer. The output from two models were concatenated and passed through a Bidirectional LSTM layer and a dense layer to form the final model. The output was obtained after using softmax activation as shown in Table2.

New model	VGG-16	InceptionV3 (without dropout)	InceptionV3 (with dropout)
Epoch	35	10	25
Batch size	128	512	756
Loss	2.77	1.8	1.6
BLEU scores	BLEU-1: 0.61403 BLEU-2: 0.40659 BLEU-3: 0.32191 BLEU-4: 0.20892	BLEU-1: 0.61403 BLEU-2: 0.40659 BLEU-3: 0.32191 BLEU-4: 0.20892	BLEU-1: 0.62931 BLEU-2: 0.46231 BLEU-3: 0.39317 BLEU-4: 0.26824

Table 2: Results for final model

6. RESULTS

6.1 Comparison



Input captions as in the dataset:

- A backpacker in the mountains using his hiking stick to point at a glacier.
- A backpacker points to the snow-capped mountains as he stands on a rocky plain.
- A hiker is pointing towards the mountains.
- A hiker poses for a picture in front of stunning mountains and clouds.
- A man with a green pack using his pole to point to snowcapped mountains.

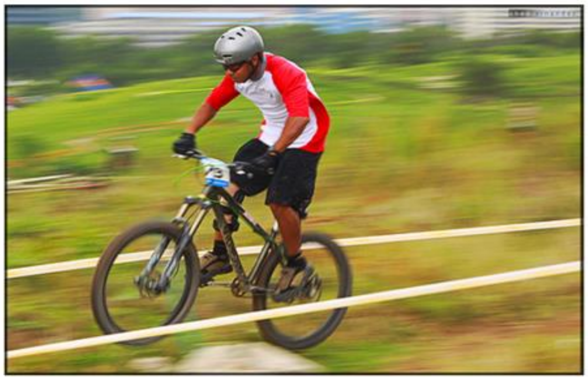
Generated caption:

A backpacker points to mountains and clouds.

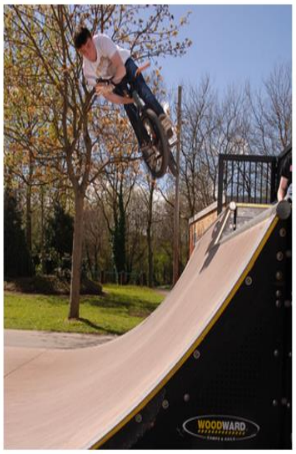
This way, during training process, a caption is generated from the input picture and its captions.

6.2 Outputs

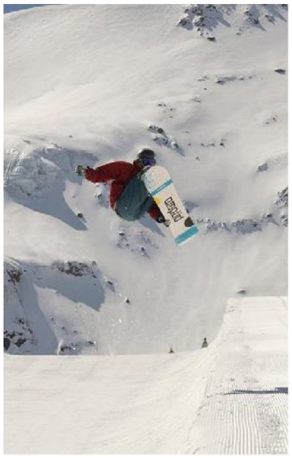
The following photos generated the following photos from this model.



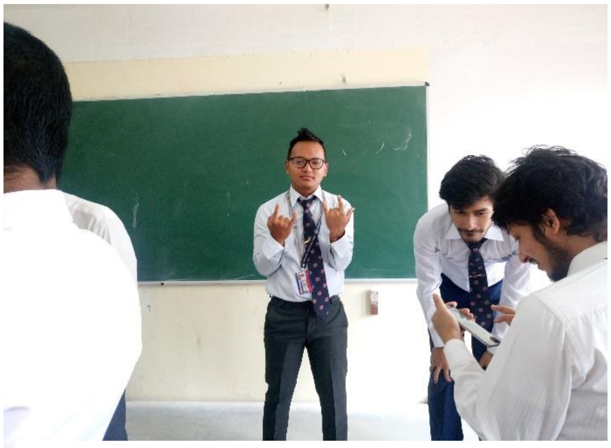
A man in a black jacket is riding a bike on a dirt road.



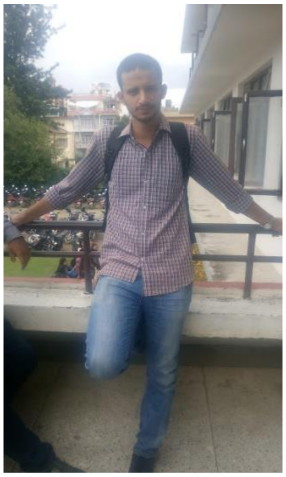
A boy does tricks on a bicycle at a skate park.



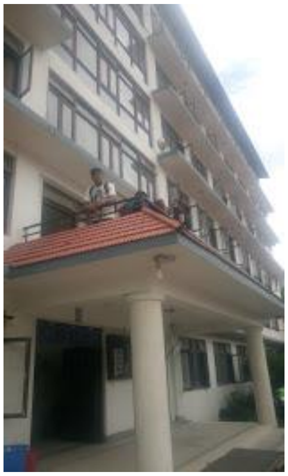
A boy does tricks on a bicycle at a skate park.



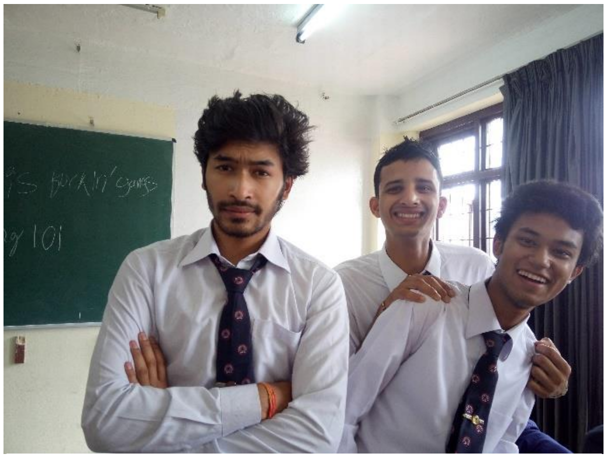
A man in white shirt posing in front of a wall.



A man in blue pants standing.



A white building with windows.



A man in white shirt standing behind a man in white shirt

7. CONCLUSION

This research work uses Convolutional Neural Networks and RNN based LSTM units to generate a caption from an image. At the end, we were able to train a model with a bleu score accuracy of 43% using InceptionV3 model with dropouts. The loss of 1.6 was obtained with it. More experiments on several datasets like Flickr30k and the MS-COCO dataset could be done to generate a model with even better accuracy.

ACKNOWLEDGEMENT

We would like to thank Dr. Basanta Joshi for advising us for the publication of this research paper.

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Handwritten Devanagari Character Recognition using Capsule Network

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***Abstract*— This thesis proposes a Capsule Network (CapsNet) to classify the Handwritten Devanagari Characters. We take a brief look into the shortcomings of Convolutional Neural Network (ConvNet). A CapsNet model is proposed to solve the shortcomings of ConvNet and perform the test comparably accurately. The performance analysis of the network is done on MNIST digits and publicly available Devanagari Handwritten Character dataset and also on geometrically transformed (rotated, scaled, sheared) test datasets. A ConvNet model is also tested for the datasets and the performances of both the models are compared.**

The handwritten devanagari characters are recognized by the experimental CapsNet model with 99.69% accuracy and for the same dataset accuracy of ConvNet is 98.96%.

Keywords: Computer Vision, Handwritten character recognition, Convolutional Neural Network(CNN, ConvNet), Capsule Neural Network (CapsNet)

I. INTRODUCTION

Object recognition and Image classification has always been the center of computer vision problems. The current state of art in image classification and object recognition is the Convolutional Neural Networks(CNN). CNN has even outperformed human in object recognition and image classification problems. But the CNN is said to be doomed because

1) CNN cannot handle spatial relations between object parts
2) CNN needs to be trained for orientation and perspective change
3) CNN is vulnerable to perturbation attacks

Thus, the shortcomings of CNN motivated Geoffrey Hinton to propose Capsules[1], which are the nested set of neurons. This research explores the generalization capability of CapsNet on geometrically transformed images.

II. RESEARCH OBJECTIVE

The objectives of this research are

1) To recognize handwritten Devanagari characters using Capsule Network
2) To find and analyze the performance of Capsule Network over geometrically transformed (rotate, scale, shear) images.

III. DATASETS

- Devanagari Handwritten Character Dataset

  Introduces a new publicly available dataset, Devanagari Handwritten Character Dataset, of 92 thousand 28*28 images of 46 Devanagari characters out of which 10 are numerals and 36 are consonants.

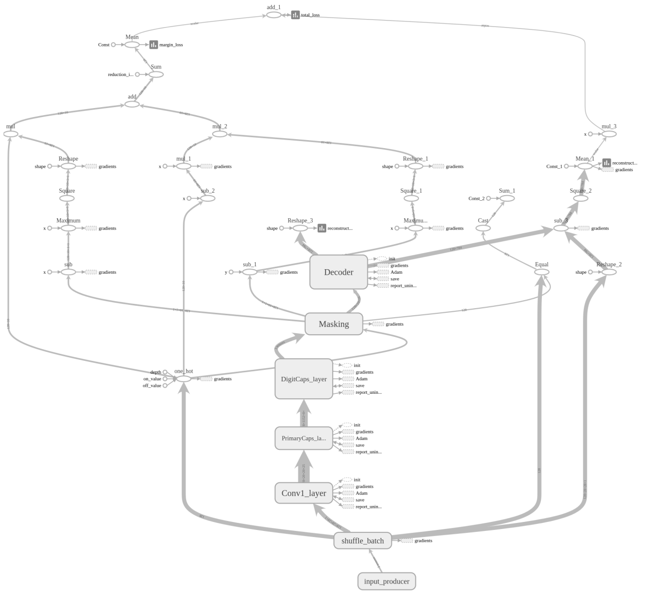

Fig. 1. Computational Graph of the experimental model as shown by tensorboard

- Modified National Institute of Standards and Technology (MNIST)

  MNIST is a popular and widely used machine learning dataset of handwritten digits consists of a training set of 60,000 examples, and a test set of 10,000 examples.

IV. PROPOSED MODEL

The tensorflow dataflow graph represents the computation in terms of the dependencies between individual operations[10]. Fig. 1 shows the dataflow graph of the experimental model as shown by the visualization library, tensorboard.

V. METHODOLOGY

Fig. 2 shows the steps carried out to complete this research work.

VI. EXPERIMENTS AND RESULTS

A CapsNet and a ConvNet were trained with MNIST and Devanagari Handwritten Character Dataset and tested with different geometric transformations.

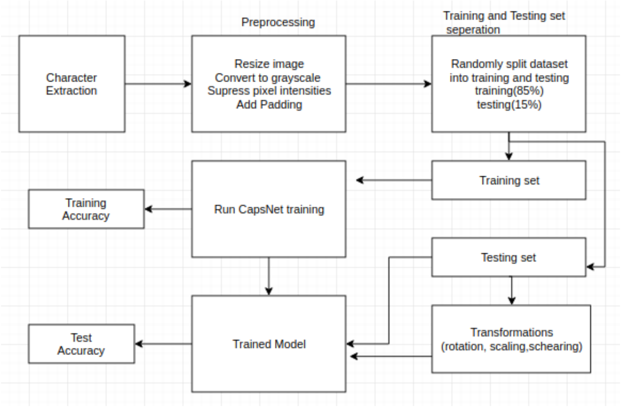

Fig. 2. Research Methodology

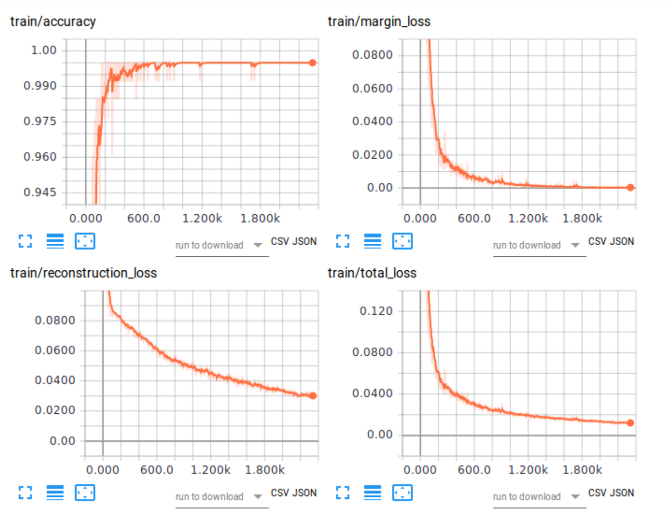

Fig. 3. Training Accuracy & Loss (20 epoch)

A. Training

The network was trained for 20epoch. Fig. 3. shows the graph of training process and Table. 1. shows the training accuracy on different epoch of training.

TABLE I
Test accuracy, Validation accuracy and Loss for different epochs

	01epoch	05epoch	10epoch	20epoch
training accuracy	0.9718	1.0	1.0	1.0
validation accuracy	0.9776	0.9866	0.9932	0.9977
loss	0.0754	0.0132	0.0187	0.0070

B. Testing

Both MNIST and Devanagari Handwritten Character datasets were tested on the CapsNet and ConvNet models. Table II, III, IV, V shows the results of tests on the trained experimental model on different datasets.

TABLE II
Comparative test accuracies of CapsNet & ConvNet on MNIST & Devanagari characters

test dataset	ConvNet		CapsNet	
	MNIST	Devanagari	MNIST	Devanagari
original	0.9804	0.9830	0.9896	0.9969
rotated(0-360)	0.4071	0.2973	0.431	0.3996
scaled(0.5-1.1)	0.5593	0.2716	0.564	0.3287
sheared(0-0.9)	0.1800	0.2376	0.223	0.3661

TABLE III
Comparative test accuracies of the experimental CapsNet & ConvNet model on MNIST & Devanagari characters for different angles of rotation

rotation angle	ConvNet		CapsNet	
	MNIST	Devanagari	MNIST	Devanagari
random(0-360)	0.4071	0.2973	0.431	0.3996
1-degree	0.9882	0.9883	0.9896	0.9963
10-degree	0.9756	0.9583	0.9826	0.9936
30-degree	0.8355	0.5989	0.8486	0.8076
45-degree	0.5097	0.3526	0.5136	0.4453
60-degree	0.195	0.2263	0.2486	0.2303
75-degree	0.067	0.1533	0.1695	0.1763

TABLE IV
Comparative Test accuracy of CapsNet & ConvNet on MNIST & Devanagari characters for different scale factors

scaled	ConvNet		CapsNet	
	MNIST	Devanagari	MNIST	Devanagari
random(0.5-1.1)	0.5593	0.2716	0.564	0.3287
1.11	0.8988	0.868	0.9053	0.9653
0.66	0.1445	0.1853	0.178	0.3996
0.5	0.0553	0.0286	0.085	0.0643

TABLE V
Comparative test accuracies of CapsNet and ConvNet model on MNIST & Devanagari characters for different shear values

shear value	ConvNet		CapsNet	
	MNIST	Devanagari	MNIST	Devanagari
random(0-0.9)	0.18	0.2376	0.223	0.3661
0.2	0.5338	0.6063	0.533	0.871
0.5	0.0841	0.1113	0.10	0.208
0.7	0.0831	0.0496	0.083	0.098

VII. Conclusion

Training accuracy of the experimental CapsNet model was 100% after 20epoch of training which evaluated the original dataset with 99.69% accuracy. For every test dataset we can see that the evaluation accuracy of the CapsNet model is slightly better than that of the ConvNet model.
Hence this research can conclude that CapsNet has slightly better generalization capability than that of ConvNet for geometrically transformed images.

VIII. Limitations and Future Works

Training the CapsNet model for 1 epoch took almost 45 minutes which is comparably very much than that of ConvNet. The training can be accelerated by using GPUs.

[3] describes a new architecture, Matrix Capsules with (Expectation Maximization)EM routing with different layers and EM Routing algorithm. The Routing by Agreement algorithm can be replaced by the EM Routing algorithm and performance could be analyzed. The work depicted on this thesis can be a reference for the facial recognition, object recognition tasks as well.

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Sentence Ranking and Answer Pinpointing in Online Discussion Forums Utilising User-generated Metrics and Highlights

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***Abstract*—One of the major challenges in searching on the internet has been that search engines and online forums have not been able to extract and pinpoint exact answer to people's query despite information being available on the internet. Extraction of to-the-point answers from articles, posts and blogs tend to improve search accuracy. Sentence Ranking helps to rank answers according to a score that represents positive remark for the relevance of sentence. User-generated metrics can be used to improve sentence ranking. Also, the text selected and saved as highlights by users can be used to extract the most important parts of the content. Answer pinpointing in simple forums can be achieved by allowing users to highlight parts of the text, store it in a database and analyse such highlights using sentence ranking engine followed by answer extraction to find the best chunk of texts. It can prove to be a milestone in providing exact and relevant answers as per the searchers' intent and can also facilitate improvement of question answering in discussion forums.**

***Index Terms*—sentence ranking, user-generated content, question answering, user-generated metric, user highlights, answer pinpointing, online discussion forum, engagement metric.**

I. Introduction

Active research is being conducted in the field of question answering (QA) and information retrieval. Intelligent agents and bots are already showing their presence in the global market and are being smarter each day. The results, however, have shown that the progress in this field is yet too far from fulfilling the expectations. The Internet has a massive amount of data but, diverse and unlabelled. That is why the search engines and assistants, in spite of having access to a massive amount of data, have not been able to give users the exact answers to the questions they have been searching for. Also, to address users' immediate information need, it is necessary to have a good information retrieval system. This can be done through the creation of an ideal question-answer system.

In search engines, widely searched questions such as "What is the height of the Everest?" are provided with exact answers. This, however, is not the case with other questions. Even when the answers to the questions searched for are available on the internet, they are not pinpointed. Identifying the precise answer within a long text has thus been a challenge in online discussion forums. Pinpointing the answer requires ranking of the sentences which may possibly contain the answer and extracting it. Different techniques and algorithms aid the process and are in use. Recent researches have shown that neural networks can be used to enhance question-answering systems thus providing users with better search experience.

II. Background

Answer Sentence Ranking and Answer Extraction are the two major challenges in question-answering required for the purpose.

A. Sentence Ranking

Answer sentence selection has always been a topic of interest to researchers in the field of question-answering systems. Answer sentence ranking involves assigning different answers to a question with a rank according to the relevance of the answers. The one that is ranked higher is the one that is more likely to have the answer contained in it (see Fig. 1).

A tag is a label attached to a post for purpose of identification or categorisation that can be several words long and reflects key points of the post. Tags can be either automatically generated from a passage or inserted by users themselves. Tags help to increase search efficiency by finding exact match rather than conventional techniques where strings are searched by matching sub-strings. Characteristics of tags often have a direct relationship with the users' answers. Sometimes hierarchies of tags can be used by nesting related tags into a collapsible list. Tags can also be helpful to answer sentence ranking.

Likewise, one of the most popular meta-data tags used in social platforms, such as Instagram, Facebook, Pinterest and Google+ is the hashtag that allows users to apply dynamic tagging for the purpose of the ease in the finding of posts with specific contents. Hashtags are focused more by viewers but they also serve as links to search queries.

According to Dwivedi and Singh[1], possible approaches for answer ranking are Linguistic Approach, Statistical Approach and Pattern Matching Approach.

1) Linguistic Approach for Answer Ranking: The linguistic approach relies on the use of Artificial Intelligence

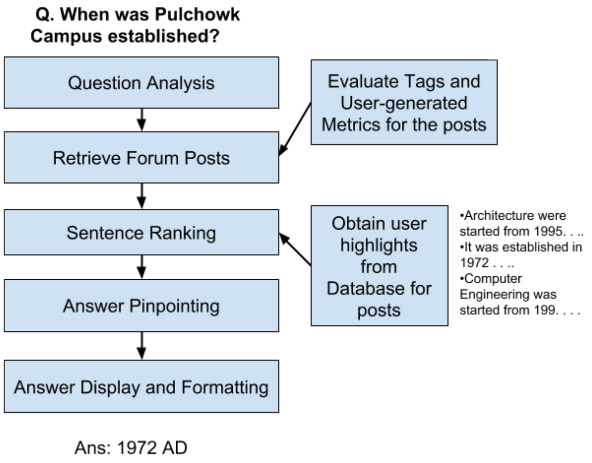

Q. When was Pulchowk Campus established?
Question Analysis
Retrieve Forum Posts
Sentence Ranking
Answer Pinpointing
Answer Display and Formatting
Evaluate Tags and User-generated Metrics for the posts
Obtain user highlights from Database for posts
•Architecture were started from 1995. . ..
•It was established in 1972 . . ..
•Computer Engineering was started from 199. . . .
Ans: 1972 AD

Fig. 1: QA based System Implementation Model

techniques integrating with Natural Language Processing techniques and knowledge base to form question-answering logic. Information organised in the form of production rules, logic, frames, templates, ontology and semantic networks are utilised during analysis of question-answer pair. Sometimes knowledge-based QA systems rely on a rule-based mechanism to identify question classification features.

2) Statistical Approach: This approach deals with a large amount of data and their heterogeneity and is independent of a query language. Support vector machine (SVM) classifiers, Bayesian classifiers, Maximum entropy models are some techniques that have been used for question classification purpose. Pattern matching approach uses text patterns or templates to identify answers.
3) Pattern Matching Approach: This approach uses text patterns or templates to identify answers. For example, the question, “When did world war II end?”, follows the pattern “When did <event name> end?” and its answer pattern will be like “<event name> ended on <date/time>”. Systems can be made to learn such text patterns from text passages rather than employing complicated linguistic knowledge or tools to text for retrieving answers.

B. Answer Extraction

The answers to questions posted in forums may or may not contain the exact answers to the questions in the thread. Answer extraction deals with extracting smaller parts (which may be in the form of words, phrases or sentences) from long posts for providing the readers with the precise answer to the question. Sentence ranking is followed by answer extraction where the answers are extracted. Sultan[2], in his paper, has explained the generic framework that is followed by most of the extraction algorithms. For any question, there are candidate answer sentences from each of which chunks of texts are identified. These chunks are, then, evaluated according to some criterion. The criterion depends on the method used. The best chunk is then identified. After we have located the best chunks from different sentences, equivalent chunks are grouped together and the quality of each group is computed. Finally, a chunk is extracted from the best group supposed to be the most precise answer to the given question.

C. Web 2.0 and Internet Revolution

The term ‘Web 2.0’ was invented by Darcy DiNucci in 1999 and got popularised at the O’Reilly Media Web 2.0 Conferences in late 2004[3]. Websites in Web 2.0 allowed user interactions and collaborations in a virtual community as creators of user-generated content. The idea behind Web 2.0 was very distinct at that time before which the web only allowed visitors from viewing the static content without significant interactions. The idea of Web 2.0 can be decomposed into three components: Rich Internet Application (RIA), Web-Oriented Architecture (WOA) and Social Web. Web 2.0 sites included various features and techniques including search, extensions and signal which Andrew McAfee referred by the acronym SLATES[4].

Like all other things, internet sites have also undergone both a revolution and an evolution. As the global push towards online presence and information sharing continues, websites and forum platforms have also emerged and bloomed. Currently, we have access to a diverse range of contents than ever and the trend continues. Only in 2016, around 96,000 petabytes of information was transferred which was double than that in 2012[5]. On the other hand, there are already over a billion websites all over the internet full of information over diverse range[6].

III. Related Works

As the web and the virtual digital assistant technologies are enhancing, various works have been done on almost all major aspects of answer extraction, sentence ranking and answer pinpointing.

A. Answer sentence selection

Echihabi and Marcu, 2003[7], have explained question-answering system as a pipeline of only two high level modules: An Information retrieval engine that obtains information system resources R relevant to an information that may contain answers to a given question Q1 and an answer identifier module which ranks each information resource for its relevancy with question Q1. For example, if a whole sentence S from resource R is accepted as the most likely answer, cosine similarity between S and Q1 can be used to calculate the likelihood of an answer. Researches have shown that such word-overlap method is practically not a good enough metric for answer selection. Enhanced Models of lexical semantic resources have improved the performance over systems which focuses only on syntactic analysis through dependency tree matching [8].

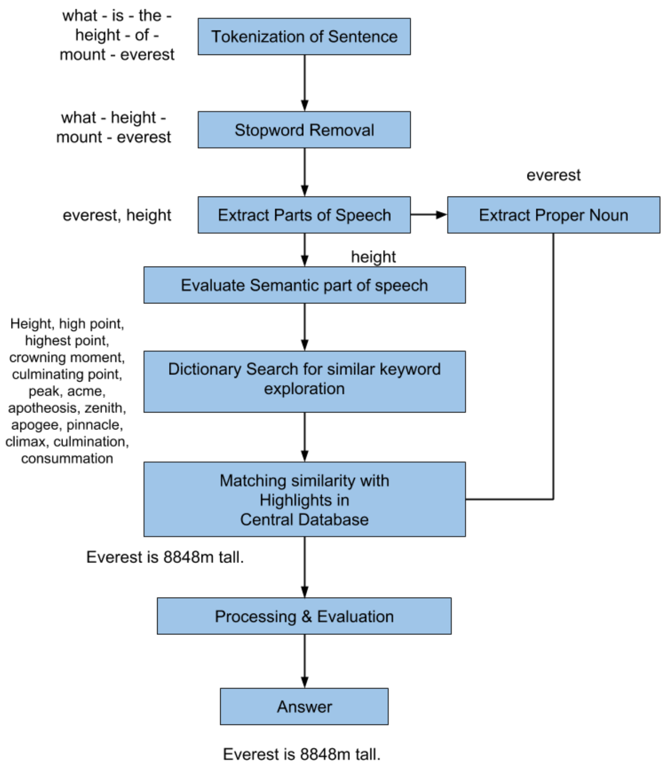

what - is - the - height - of - mount - everest
Tokenization of Sentence
what - height - mount - everest
Stopword Removal
everest, height
Extract Parts of Speech
everest
Extract Proper Noun
height
Evaluate Semantic part of speech
Height, high point, highest point, crowning moment, culminating point, peak, acme, apotheosis, zenith, apogee, pinnacle, climax, culmination, consummation
Dictionary Search for similar keyword exploration
Matching similarity with Highlights in Central Database
Everest is 8848m tall.
Processing & Evaluation
Answer
Everest is 8848m tall.

Fig. 2: Question-answering using Highlights from Central Database

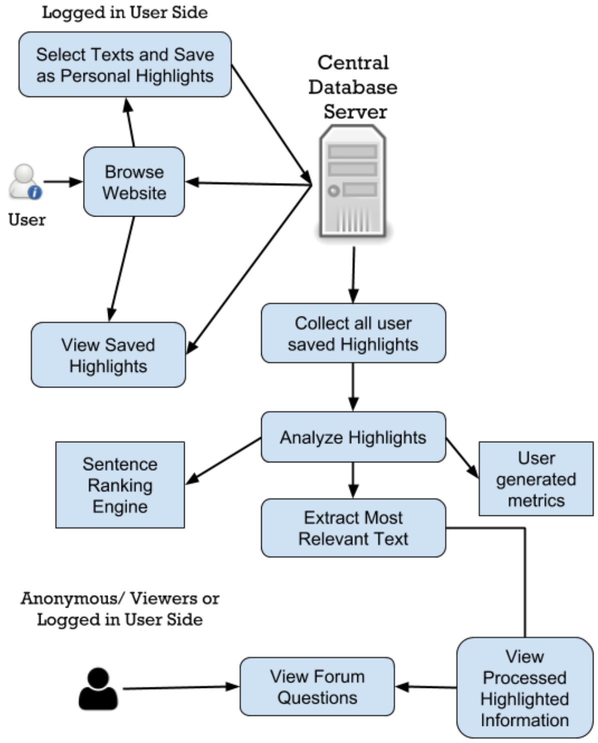

Logged in User Side
Select Texts and Save as Personal Highlights
Central Database Server
User
Browse Website
View Saved Highlights
Collect all user saved Highlights
Analyze Highlights
Sentence Ranking Engine
User generated metrics
Extract Most Relevant Text
Anonymous/ Viewers or Logged in User Side
View Forum Questions
View Processed Highlighted Information

Fig. 3: Implementation Model for Information Extraction from User Highlights

B. DNN for answering questions

Researchers have been using semantic-parser constructed using Inductive Logic Programming from the inception of question-answering systems[9].

Semantic similarity model using convolutional neural networks have been used in question-answering to decompose questions into entities (Eq) and relation patterns. The similarity of question entities (Eq) with entities in the knowledge base (Ekb) and the similarity of relation patterns and relations between them have been evaluated using convolutional neural network models[8].

Recently, researches have been done to enhance intelligent recommendation systems using user-generated contents to have a significant effect on decisions in providing rich and customised user experiences through neural networks and tensor factorisation models[10].

According to Lai, Bui and Li[11], existing deep learning methods for answer selection can be examined along two dimensions: (i) learning approaches and (ii) neural network architectures where learning approaches use point-wise, pair-wise and list-wise approaches to learn the ranking function $h\theta$. Siamese Architecture, Attentive Architecture, Compare-Aggregate Architecture are three main types of general architectures for measuring the relevance of a candidate sentence to a question.

IV. Methodology

Various methods like linguistic, statistical and pattern matching methods can be used for the ranking process. The possible answer sentence is segmented into words i.e tokenized. Then the stop-words are removed from the list of words. The proper noun is extracted and the semantic part of speech is analysed. The similar keyword for the semantics is matched with the highlights from the central database to generate more relevant results. Finally, after processing and evaluation, the answer is deducted (see Fig. 2).

While the answer extraction improves the search efficiency for answers, it can also be helpful in the validation of the information provided in answers. This is because in online discussion forums or any other question answering, where answers are provided by the people, the higher is the number of highlights for a particular answer (or a part of it), the more trustworthy the answer is.

A. User-generated contents (UGC)

User-generated contents involve all the contents which may be in the form of images, posts, comments, testimonials, etc. which are posted by users at online forums and social sites. Jos van Dijck, in his paper 'Users like you? Theorising agency in user-generated content' has stated that the meta-data harvested by Google from the UGC traffic is more valuable than the contents provided by users to its sites for advertising[12]. However, apart from advertising, the meta-data generated as a by-product of UGC can be a prime source of users' intent which can be used in the ranking of sentences for a relevant answer.

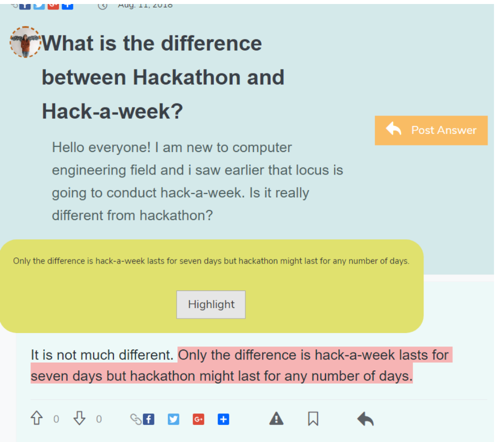
B. *Engagement metrics*

Engagement metrics include bounce rates for landing pages, the visit duration (i.e. the session length) of visitors, screen flow as well as the number of views, likes, shares, comments and clicks the posts have. These help in tracking the audience engagement, which in turn, provides the idea as to which posts are more accepted by the users. The visit duration gives knowledge of the time users spend on the pages (and the posts). Thus these metrics reveal a lot about user engagement which can be used in answer sentence ranking.

V. Implementation

Implementation of the described system can easily be done using some components of user engagement metrics and user-generated contents. Front-end web technologies like JavaScript and AJAX can be used to add features to forums. Browser-based plugins and add-ons can also be used to let users highlight the texts. Various methods, analytic tools and algorithms can be used for evaluating user-generated metrics which can also be used to provide rich user experience to the visitors (see Fig. 3).

A. *Text Selection*


Aug. 11, 2018

What is the difference between Hackathon and Hack-a-week?

Post Answer

Hello everyone! I am new to computer engineering field and i saw earlier that locus is going to conduct hack-a-week. Is it really different from hackathon?

Only the difference is hack-a-week lasts for seven days but hackathon might last for any number of days.

Highlight

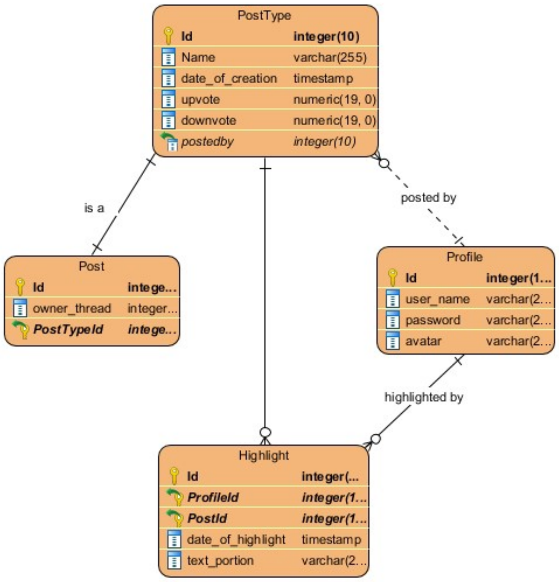
It is not much different. Only the difference is hack-a-week lasts for seven days but hackathon might last for any number of days.

0 0

Fig. 4: JavaScript Based Based Pop-up after text selection for Highlight in Forum

Whenever a logged-in user in forum/blog selects text, a pop-up is displayed (see Fig. 4). It facilitates users in saving the selected text i.e. in highlighting it. The highlight is saved by the user to be used as a private note. A user in the forum can't access another user's highlight library. However, such saved highlights can be accessed by sentence ranking engines as a heuristic for ranking purpose.

B. *Saving User-Highlight to Central Database server*



PostType	
Id	integer(10)
Name	varchar(255)
date_of_creation	timestamp
upvote	numeric(19, 0)
downvote	numeric(19, 0)
postedby	integer(10)

Post	
Id	intege...
owner_thread	integer...
PostTypeId	intege...

Profile	
Id	integer(1...
user_name	varchar(2...
password	varchar(2...
avatar	varchar(2...

Highlight	
Id	integer(...
ProfileId	integer(1...
PostId	integer(1...
date_of_highlight	timestamp
text_portion	varchar(2...

Fig. 5: Database Schema for User Highlights

In the central database server, the highlighted text along with the user who owns it is saved along with the date (see Fig. 5). The records of the database can be further used for the purpose of analysing the highlights.

C. *Analysing Highlights using Sentence Ranking Engine*

In different blogs and forum, there are several answers to a particular question. Out of those answers, there may be different highlights saved in a central database server. Using those highlights, each text is ranked to find the relevant answer. Tags are also useful in ranking the sentences. Some sentences are completely discarded for no relevance to the question.

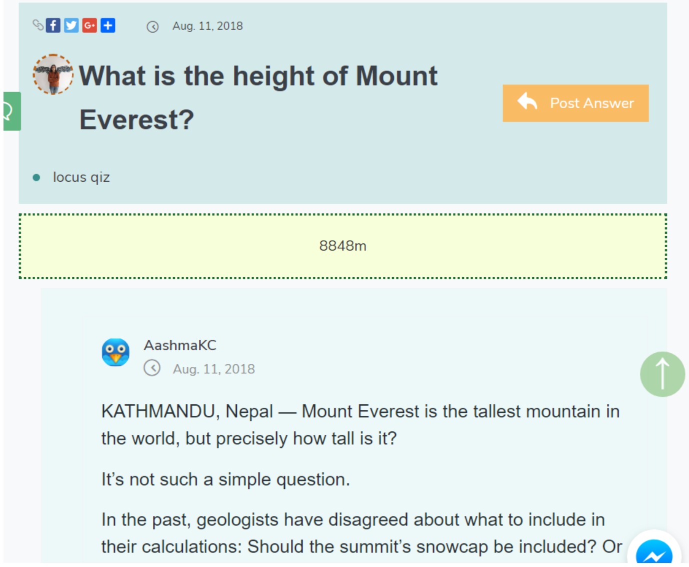
D. *Display relevant text for Blogs or Questions*

Finally, the sentence with the highest rank is regarded as the most relevant text and is considered to be the answer to the question. So, the pinpoint answer to the question is displayed to users as the most relevant text as analysed by the sentence ranking engine (see Fig. 6).

VI. Results

The development of information extraction and sentence raking was analysed. It was found that the user-generated metrics and highlights can be used to improve sentence-ranking and answer-pinpointing. Also, the use of neural networks for developing models was explored along with various linguistic, statistical and pattern matching methods to be used in question-answering and important-part-pinpointing.

The team had also worked on a web-based project, parallel to the research, that uses JavaScript based pop-up (after text selection) in a web-page to be saved as a private note. It can be accessed by the system to find out the most highlighted part of the web-page. Such information collected is used for showing most relevant information about the page to the visitors.



Aug. 11, 2018

What is the height of Mount Everest?

locus qiz

8848m

AashmaKC

Aug. 11, 2018

KATHMANDU, Nepal — Mount Everest is the tallest mountain in the world, but precisely how tall is it?

It's not such a simple question.

In the past, geologists have disagreed about what to include in their calculations: Should the summit's snowcap be included? Or

Fig. 6: Forum showing the relevant information about the post extracted from saved user Highlights.

VII. Conclusion

This article describes the possible uses of user-generated contents in sentence-ranking and answer-pinpointing in online websites to extract information. It explains different approaches that can be used for answer sentence-ranking and answer-extraction.

Despite the advantages of highlighting text, it has not been adopted by forums and websites for a long time. Although it has been commenced by a few websites such as the Medium, its use is not as ample as it needs to be. The question naturally arises as to why the feature of highlighting texts has not come into practice for a long time. This is because only after the advent of Web 2.0, the industry started focusing on client-side technologies including AJAX and JavaScript framework allowing for a rapid and interactive user experience. This made highlighting texts in web applications possible thus allowing websites to enable their users to enable rich user experience to highlight the part of text they want.

With the advent in technology, the intelligent systems/algorithms will be more intelligent and efficient in finding the user-demanded information from within the contents. We believe that user-generated metrics and data can be of great help for information-extraction.

VIII. Acknowledgement

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Nepali Document Clustering using K-Means, Mini-batch K-Means, and DBSCAN

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Abstract

Automated document clustering is the process of grouping documents into a small set of meaningful and coherent collections. This research evaluates K-Means, Mini-batch K-Means and Density-Based Spatial Clustering of Applications with Noise (DBSCAN) algorithms, in the context of Nepali documents, using four performance measures: Homogeneity, Completeness, V-Measure and Silhouette Coefficient. Features extraction is done using Term Frequency – Inverse Document Frequency (TFIDF). The empirical results show that Mini-batch K-Means performs better when using TFIDF. Similarly, in time-constrained environments, the clustering time of Mini-batch K-Means is better than the other two algorithms.

Keywords: Clustering, Machine Learning, Nepali Document Clustering, K-Means, Mini-Batch K-Means, DBSCAN, TFIDF

1 Introduction

A wide range of research has already been done in the field of clustering. It is an active field of research due to its significance in areas like data mining, text mining, information retrieval, statistics, machine learning, biology, marketing and so on ([1]). The problem of clustering can be very useful in the text domain, where the objects to be clustered can be of different granularities such as documents, paragraphs, sentences or terms. Clustering is especially useful for organizing documents to improve retrieval and support browsing ([2]).

In the context of Nepal, more and more Nepali documents are created and stored in both online and offline forms each day. Manually clustering them into meaningful clusters is both tedious and error-prone. So, automatically clustering them using computers is highly desirable. As very little research has been done in this area in the past ([3–5]), this study intends to explore three well-known algorithms in Nepali document clustering.

As Nepali is a complex language, the clustering algorithms need to be aware of specific features related to the language beforehand. This work uses TFIDF representing the features of the documents. It uses three algorithms K-Means, Mini-batch K-Means and DBSCAN to cluster the documents and then compares the accuracy and time taken to run the algorithms.

2 Literature Review

The idea of clustering was first used in anthropology by [6]. Later, it was popularized in the field of psychology by [7] and [8]. It became a major topic in the 1960s and 1970s when the monograph "Principles of Practice of Numerical Taxonomy", published by [9], motivated worldwide research on clustering methods.

Recently, clustering has also been used in browsing documents. One such study, done by [10], noted that document clustering has not been well received as an information retrieval tool. They objected to the facts that clustering is too slow for large corpora and clustering does not appreciably improve retrieval. They argued that these problems arise only when clustering is used in an attempt to improve conventional search techniques. They presented a document browsing technique that employs document clustering as its primary operation in that paper as well as a fast (linear time) clustering algorithm which support this interactive browsing paradigm.

[11] described several novel clustering methods which intersect the documents in a cluster to determine the set of words or phrases shared by all the documents in a cluster. They showed that word-intersection clustering produces superior clusters and does so faster than standard techniques. They also showed that their $O(n\ log\ n)$ time phrase-intersection clustering methods produce comparable clusters and do so more than two orders of magnitude faster than word-intersection.

Since then, clustering has been used in a large number of fields such as machine learning, pattern recognition, image analysis, information retrieval, bioinformatics, data compression, computer graphics, archaeology, psychology and marketing ([9, 12, 13]).

The term K-Means was first used by [14], for his sequential, "single-pass" algorithm for (asymptotically) minimizing the continuous sum-of-squares criterion. In the paper, he describes the algorithm as a process for partitioning an n-dimensional population into k sets on the basis of a sample. He notices that the process appears to give partitions which are reasonably efficient in the sense of within-class variance. He also mentions that the k-means procedure is easily programmed and is computationally economical so that it is feasible to process large samples on a digital computer.

Mini-batch K-Means was first presented by [15]. It was one of the two modifications to the popular K-Means clustering algorithm to address the extreme requirements for latency, scalability, and sparsity encountered in user-facing web applications. The Mini-batch method presented in the paper reduces computation cost by orders of magnitude compared to the classic batch algorithm while yielding significantly better solutions than online stochastic gradient descent.

DBSCAN, proposed by [16], relies on a density-based notion of clusters which is designed to discover clusters of arbitrary shape. They found that DBSCAN is significantly more effective in discovering clusters of arbitrary shape than the well-known algorithm CLARANS ([17]) and that DBSCAN significantly outperforms it in efficiency.

[3] presented a comparative analysis of three algorithms namely K-Means, Particle Swarm Optimization (PSO) and hybrid PSO+K-Means algorithm for clustering of Nepali text documents using WordNet. They represented text in synsets corresponding to a word and performed an experimental evaluation using intra-cluster similarity and inter-cluster similarity.

[4] published another paper that was used to create Nepali character dataset using semi-supervised clustering approach. Two algorithms Expectation–Maximization (EM) and K-Means were used to create the database using extracted features from both handwritten and scanned Nepali text.

[5] also proposed an algorithm which combines the advantage of a classical vector space model to cluster the semantic texts and ideas from fuzzy logic in 2014. It used the concept of advanced enhanced vector space model obtained by adding TFIDF with fuzzy membership value and perform the cosine operation to calculate the semantic distance between text.

3 Methodology

3.1 Dataset Preparation

The official written script for Nepali is Devanagari, which is an abugida (alphasyllabary) used commonly in Nepal, Bhutan, and India. This script is also shared by other languages like Sanskrit, Hindi, Marathi and so on, due to which it contains Unicode code points from U+0900 to U+097F ([18]) to encompass all their characters and symbols. Only a subset of these code points is used in current version of Nepali language ([19, 20]) and they can be further subdivided into 13 vowels, 36 consonants, 12 dependent vowel signs, 10 numerals and various other signs (**??**).

For the purpose of this study, the dataset was collected from various online Nepali News portals using a web crawler. The dataset was merged with some secondary data used in a recent Nepali News Classification study by [21]. Altogether, a dataset of 10,000 sample was created.

3.2 Preprocessing

The data in a raw corpus contains many unnecessary characters and words that do not contribute much to the clustering process. Filtering out these noisy data speeds up and simultaneously improves the result of cluster analysis ([21, 22]). The following preprocessing steps were used on the corpus:

1. **Document Sanitization:** This step removes all unnecessary characters and symbols using a whitelist. This includes punctuation marks, HTML tags, zero width joiners, zero width non-joiners etc.

2. **Tokenization:** This step breaks each individual document in the corpus into tokens that can be used directly by later steps.

3. **Stop Word Removal:** Stop words are the words which have a very high frequency in the corpus. They either do not contribute anything or their contribution is negligible in differentiating documents and hence are removed before stemming.

4. **Stemming:** Stemming is the process of removing affixes from words. Affixes may be either inflectional or derivational ([21]). In Nepali, the meaning of compound words created using derivational affixes are often very different from the root or stem words ([23]). So, this work will focus only on stemming inflectional affixes, which reduces the lexicons to root form without changing their overall meaning.

3.3 Text Representation

The text representation of Nepali documents has been done using TFIDF in this research.

The classic formula for TFIDF is:

$$w_{i,j} = tf_{i,j} \times \log\left(\frac{N}{df_i}\right) \tag{1}$$

where, $w_{i,j}$ is the weight for term i in document j, N is the number of documents in the corpus, $tf_{i,j}$ is the term frequency of term i in document j and df_i is the document frequency of term i in the corpus.

3.4 Clustering Algorithms

3.4.1 K-Means

The K-Means algorithm performs clustering by separating samples into k groups, each with equal variance while minimizing inertia. The number of clusters should be known before applying this algorithm. It scales well to a large number of samples and has been used across a large range of application areas in many different fields.

Mathematically, the K-Means algorithm divides a set S, of n samples, into k disjoint clusters C, each represented by a mean μ_i of the samples in the corresponding cluster. The means are commonly called the cluster "centroids". The centroid generally do not belong to X ([24]).

3.4.2 Mini-batch K-Means

The Mini-batch K-Means is a variant of the K-Means algorithm which uses Mini-batches to reduce the computation time, while still attempting to optimize the same objective function. Each Mini-batch is a random subset of the total samples. The Mini-batch version significantly reduces the amount of computation required to converge to a local solution. It also produces results that are generally only slightly worse than the K-Means algorithm ([15]).

3.4.3 DBSCAN

The DBSCAN algorithm is able to find clusters of any shape as it is guided by the principle that a cluster consists of areas of high density separated by areas of low density. There are two parameters to the algorithm, $MinPts$, and ε. Higher $MinPts$ or lower ε indicates higher density necessary to form a cluster ([16]).

3.5 Performance Evaluation Parameters

For the purposes of the following discussion, except for silhouette coefficient, a data set comprising N data points, and two partitions of these, a set of classes, $C = \{c_i | i = 1, ..., n\}$ and a set of clusters, $K =$

$\{k_i|i = 1, ..., m\}$ has been assumed. Let A be the contingency table produced by the clustering algorithm representing the clustering solution, such that $A = \{a_{ij}\}$ where a_{ij} is the number of data points that are members of class c_i and elements of cluster k_j.

3.5.1 Homogeneity

The result of a clustering operation satisfies homogeneity if each of the clusters contain data points from a single class only. The determination of how close a given clustering is to this ideal is done by examining the conditional entropy of the class distribution given the proposed clustering. In a perfectly homogeneous case, $H(C|K) = 0$. However this in not the case in almost all situations. Usually, the size of this value, in bits, is dependent on the size of the dataset and the distribution of class sizes. Hence, instead of taking the raw conditional entropy, this value is normalized by the maximum reduction in entropy the clustering information could provide, specifically, $H(C)$.

$H(C|K) = H(C)$ and is maximal when the clustering provides no new information. $H(C|K) = 0$ when each cluster contains only members of a single class and the clustering is perfectly homogeneous. In this degenerate case ($H(C|K) = 0$), when there is only a single class, homogeneity is defined as 1. So, adhering to the convention of 1 being desirable and 0 undesirable, homogeneity is defined as [25]:

$$h = \begin{cases} 1 & \text{if } H(C,K) = 0 \\ 1 - \frac{H(C|K)}{H(C)} & \text{else} \end{cases} \tag{2}$$

3.5.2 Completeness

Completeness is a metric symmetrical to homogeneity. The result of a clustering operation satisfies completeness if all the data points that are members of a given class are elements of the same cluster. In a perfectly complete clustering solution, distributions of cluster assignments within each class will be completely skewed to a single cluster. This degree of skew can be evaluated by calculating the conditional entropy of the proposed cluster distribution given the class of component data points, $H(K|C)$. In the perfectly complete case, $H(K|C) = 0$ and in the worst case scenario, each class is represented by every cluster with a distribution equal to the distribution of cluster sizes, i.e., $H(K|C) = H(K)$ and is maximal. In the degenerate case where $H(K) = 0$, when there is a single cluster, completeness is defined as 1. So, similar to homogeneity, the full definition of completeness is [25]:

$$c = \begin{cases} 1 & \text{if } H(K|C) = 0 \\ 1 - \frac{H(K|C)}{H(K)} & \text{else} \end{cases} \tag{3}$$

where,

$$H(K|C) = -\sum_{c=1}^{|C|}\sum_{k=1}^{|K|} \frac{a_{ck}}{N}\, log\left(\frac{a_{ck}}{\sum_{k=1}^{|K|} a_{ck}}\right)$$

$$H(K) = -\sum_{k=1}^{|K|} \frac{\sum_{c=1}^{|C|} a_{ck}}{n}\, log\left(\frac{\sum_{c=1}^{|C|} a_{ck}}{n}\right)$$

3.5.3 V-Measure

V-measure is the weighted harmonic mean of homogeneity and completeness,

$$V_\beta = \frac{(1+\beta)hc}{(\beta h) + c} \tag{4}$$

If $\beta > 1$ completeness is weighted more strongly in the calculation. Conversely, if $\beta < 1$, homogeneity is weighted more strongly. There is no reason to believe that the data used in this dissertation is skewed towards homogeneity or completeness, so β has been set to 1. Therefore, the eq. (4) simplifies to:

$$V = \frac{2hc}{h + c} \tag{5}$$

The computations of homogeneity, completeness and V-measure are completely independent of the number of classes, the number of clusters, the size of the data set and the clustering algorithm used. Thus these measures can be applied to any clustering analysis irrespective of number of data points (n-invariance), number of classes or number of clusters [25].

3.5.4 Silhouette Coefficient

Silhouette coefficient provides a graphical display for partitioning techniques. Each cluster is represented by a so-called silhouette, which is based on the comparison of its tightness and separation. This silhouette shows which objects lie well within their cluster, and which ones are merely somewhere in between clusters. The entire clustering is displayed by combining the silhouettes into a single plot, allowing an appreciation of the relative quality of the clusters and an overview of the data configuration. The average silhouette width provides an evaluation of clustering validity, and might be used to select an "appropriate" number of clusters.

The silhouette value is a measure of how similar an object is to its own cluster (cohesion) compared to other clusters (separation). The silhouette ranges from -1 to $+1$, where a high value indicates that the object is well matched to its own cluster and poorly matched to neighboring clusters. If most objects have a high value, then the clustering configuration is appropriate. If many points have a low or negative value, then the clustering configuration may have too many or too few clusters.

Given a data point i and clusters k let $a(i)$ be the average distance between i and all other data within the same cluster. $a(i)$ can then be interpreted as a measure of how well i is assigned to its cluster (smaller values are better). The average dissimilarity of point i a cluster c can then be defined as the average of the distance from i to all points in c.

Let $b(i)$ be the lowest average distance of i to all points in any other cluster, of which i is not a member. The cluster with this lowest average dissimilarity is defined as the "neighbouring cluster" of i as it is the next best fit cluster for point i. Silhouette coefficient of point i can now be defined as [26]:

$$s(i) = \begin{cases} 1 - \frac{a(i)}{b(i)}, & \text{if } a(i) < b(i) \\ 0, & \text{if } a(i) = b(i) \\ \frac{b(i)}{a(i)} - 1, & \text{if } a(i) > b(i) \end{cases} \tag{6}$$

which can be rewritten concisely as:

$$s(i) = \frac{b(i) - a(i)}{\max\{a(i), b(i)\}} \tag{7}$$

It is also possible to consider the overall average silhouette width for the entire plot, which is simply the average of the $s(i)$ for all objects i in the whole data set. In general, each value of k will yield a different overall average silhouette width $s(k)$. One way to choose k "appropriately" is to select that value of k for which $s(k)$ is a large as possible [26, 27].

Theoretically, no cluster validity index has a clear advantage over others in every case. However, the silhouette coefficient has performed well over other indices in many comparative experiments [27–30].

4 Experimental Setup

The clustering and evaluation system pipeline for Nepali documents used in this study is shown in fig. 2. It consists of preprocessing, text-representation, machine learning (clustering) and evaluation phases. Parameters like k, ε, and $MinPts$ were determined before applying the algorithms for optimal results.

5 Result and Analysis

The dataset mentioned in section 3.1 was clustered using three algorithms DBSCAN, K-Means and Mini-batch K-Means with various sample data sizes and their performance were studied using four measures: Homogeneity, Completeness, V-Measure, and Silhouette Coefficient. Differences in cluster quality when using TFIDF. Similarly, the time taken by the algorithms was also studied using both text representation schemes.

5.1 Performance Analysis

Table 1 lists the result of clustering the Nepali dataset using different data sizes. Text representation was done using TFIDF.

Figure 3 shows the plots of the clustering algorithms v/s performance measures for table 1. Mini-batch K-Means has the best performance and DBSCAN has the worst. The performance of K-Means is nearly identical to Mini-batch version for higher sample sizes.

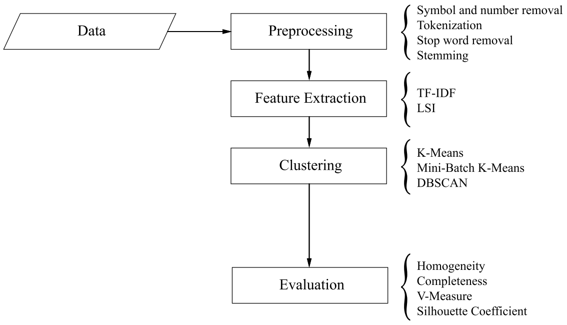
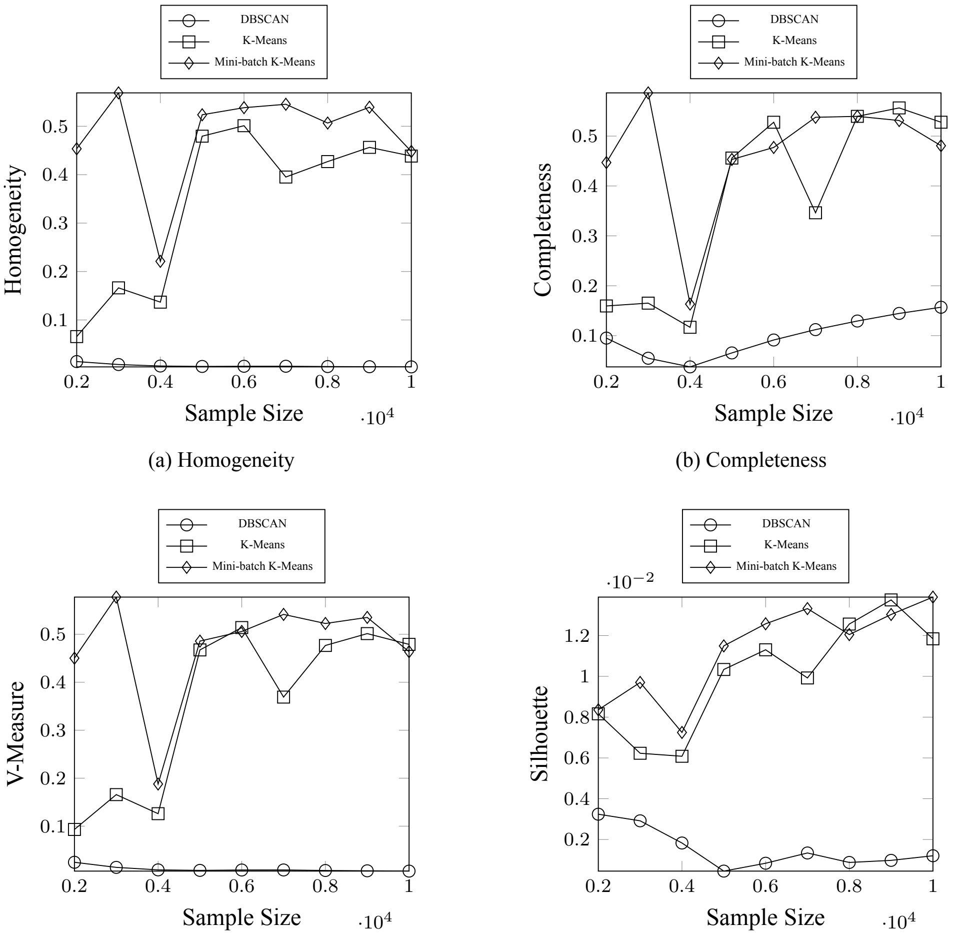


Figure 2: System Architecture



(a) Homogeneity

(b) Completeness

(c) V-Measure

(d) Silhouette

Figure 3: Performance Analysis with TFIDF

Algorithm	Size	Homogeneity	Completeness	V-Measure	Silhouette
DBSCAN	2,000	0.014162557	0.095062318	0.024652360	0.003240279
	3,000	0.008039397	0.054708011	0.014018728	0.002916194
	4,000	0.004998860	0.037372858	0.008818225	0.001828447
	5,000	0.004111333	0.065374395	0.007736147	0.000450257
	6,000	0.004478619	0.091272191	0.008538274	0.000835649
	7,000	0.004490954	0.112061915	0.008635821	0.001339375
	8,000	0.003865849	0.129309259	0.007507260	0.000874452
	9,000	0.003525922	0.144541874	0.006883919	0.000976385
	10,000	**0.003190042**	**0.156913349**	**0.006252962**	**0.001202579**
K-Means	2,000	0.065725926	0.159497783	0.093090905	0.008163300
	3,000	0.166349805	0.165164577	0.165755072	0.006228649
	4,000	0.136843898	0.116724418	0.125985964	0.006081243
	5,000	0.479450862	0.455990192	0.467426332	0.010336318
	6,000	0.501097067	0.527766597	0.514086177	0.011302530
	7,000	0.395121842	0.346275902	0.369089799	0.009921182
	8,000	0.427014022	0.539584375	0.476744209	0.012563696
	9,000	0.456360194	0.556505987	0.501482200	0.013747476
	10,000	**0.438415457**	**0.527807275**	**0.478976244**	**0.011840634**
Mini-batch K-Means	2,000	0.453432557	0.446961315	0.450173681	0.008359614
	3,000	0.568853662	0.586650900	0.577615223	0.009700666
	4,000	0.221093048	0.163240458	0.187812563	0.007248560
	5,000	0.523651710	0.453139567	0.485850590	0.011493876
	6,000	0.538269372	0.477199390	0.505898016	0.012577101
	7,000	0.545322140	0.537703477	0.541486011	0.013322621
	8,000	0.506561918	0.539595857	0.522557340	0.012047895
	9,000	0.539257283	0.531231006	0.535214055	0.013033515
	10,000	**0.447876592**	**0.480701863**	**0.463709041**	**0.013886573**

Table 1: Performance Analysis with TFIDF

5.2 Time Analysis

Table 2 lists the time taken by the algorithms, in seconds, using TFIDF. Figure 4 shows the corresponding plots. The figure shows that K-Means is the slowest algorithm and Mini-batch K-Means the fastest. The performance of DBSCAN is similar to Mini-batch K-Means from fig. 4a. However, their difference is completely overshadowed by K-Means, so they are separately plotted (without K-Means) in fig. 4b to highlight the differences.

6 Conclusion and Recommendations

Separating a large number of documents into similar and meaningful clusters using computers has a wide range of applications. Extensive study has been done in this field for English language but study in clustering documents for the Nepali language is still lacking. This study is an attempt to reduce the gap in this area.

The summary of cluster quality analysis, after applying K-Means, Mini-batch K-Means, and DBSCAN, is listed in table 3. Mini-batch K-Means performs better than the remaining two algorithms when using TFIDF in text representation. DBSCAN performs worst in almost all cases.

Similarly, the summary of completion times for the algorithms is listed in table 4. Mini-batch K-Means is the best algorithm in all cases whereas K-Means is the worst when using TFIDF.

This research limits its study to a maximum of 10,000 data samples. This is mainly due to the fact that DBSCAN does not behave nicely when sample sizes are very large. It consumes too much memory in such cases and much of processing time is spent using virtual memory instead of doing useful calculations. Future studies can focus on how to remove this bottleneck. Similarly, it is also possible to compare the performance of other algorithms with larger data samples.

Algorithm	Size	Time
DBSCAN	2,000	0.294145107
	3,000	0.628072023
	4,000	1.148311853
	5,000	1.841221094
	6,000	2.374995232
	7,000	3.137669325
	8,000	4.065223932
	9,000	5.593692303
	10,000	**8.453108072**
K-Means	2,000	7.479647875
	3,000	8.999480963
	4,000	12.999316931
	5,000	7.039831161
	6,000	7.380022049
	7,000	32.342036009
	8,000	20.883139133
	9,000	20.475090027
	10,000	**44.317399025**
Mini-batch K-Means	2,000	0.171869040
	3,000	0.160945892
	4,000	0.230267048
	5,000	0.278146982
	6,000	0.376816988
	7,000	0.439945221
	8,000	0.406978130
	9,000	0.615887880
	10,000	**1.282078981**

Table 2: Time Analysis with TFIDF

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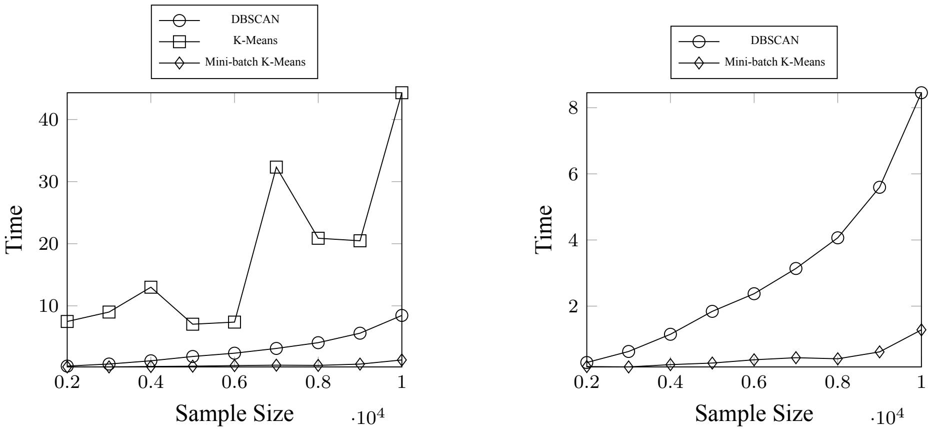

(a) DBSCAN, K-Means, Mini-batch K-Means

(b) DBSCAN, Mini-batch K-Means

Figure 4: Time Analysis with TFIDF

	TFIDF
Homogeneity	Mini-batch K-Means
Completeness	Mini-batch K-Means
V-Measure	Mini-batch K-Means
Silhouette	Mini-batch K-Means

(a) Best

	TFIDF
Homogeneity	DBSCAN
Completeness	DBSCAN
V-Measure	DBSCAN
Silhouette	DBSCAN

(b) Worst

Table 3: Performance Measures Summary

	TFIDF
Best	Mini-batch K-Means
Worst	K-Means

Table 4: Time Summary

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Performance Analysis Between Haar and Daubechies Discrete Wavelet Transform in Digital Watermarking

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***Abstract*— In this paper, the cover image is embedded with watermark image and from the watermarked image and the watermark image has been extracted by using haar and daubechies discrete wavelet transform based digital watermarking by using MATLAB Simulation software and also performance of these watermarking has been evaluated using different performance metrics they are mean square error (MSE), peak signal to noise ratio (PSNR), structural similarity index measure (SSIM) and correlation coefficient (CRC). In the simulation result, we found that daubechies wavelet transform give better performance over haar wavelet transform in terms of PSNR, MSE, SSIM and CRC.**

Keywords*— *haar discrete wavelet transform, daubechies discrete wavelet transform, watermark image.

I. INTRODUCTION

With advancements in digital communication technology and the growth of computer power and storage, the difficulties in ensuring individuals' privacy become increasingly challenging. The degrees to which individuals appreciate privacy differ from one person to another. Various methods have been investigated and developed to protect personal privacy [1].

Watermarking is a technology that provides data security, authentication and integrity and also provides copyright protection for digital media. Watermarking process mainly consists of two modules, watermark embedding module and watermark extraction and detection module. The main focus of watermarking technology is to embed secret information or signal into digital images, video and audio etc. After embedding the information is detected and extracted and extracted information reveals real identity of media or owner [2]. Digital watermarking is the act of hiding a message related to a digital signal (i.e. an image, song, and video) within the signal itself. It is a concept closely related to steganography, in that they both hide a message inside a digital signal. However, what separates them is their goal. Watermarking tries to hide a message related to the actual content of the digital signal, while in steganography the digital signal has no relation to the message, and it is merely used as a cover to hide its existence [3].

Wavelet based image watermarking is gaining more popularity because of its similarity with the human visual system, and various digital watermarking techniques with haar wavelet transform. It is necessary to provide security along with resistant to geometric distortion and noise also better PSNR. Block diagram of digital watermarking shown in figure 1.

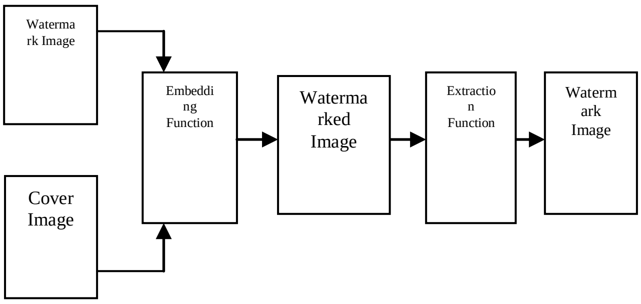

Fig. 1. Basic Block Diagram of Digital Watermarking

This paper is organized as follows, description of haar and daubechies discrete wavelet transform is presented in Section II and simulation results are described in Section III. Finally, conclusion is stated in Section IV.

II. HAAR AND DAUBECHIES DISCRETE WAVELET TRANSFORM

There are various techniques in implementing digital watermarking. These techniques are commonly categorized in terms of working domain i.e. spatial domain or transform domain. In spatial domain, pixel luminance and chrominance values are modified to embed the watermark for example Least Significant Bit (LSB), correlation based and patchwork techniques. While in transform domain, the media content undergoes mathematical transformation before watermark embedding is done for example using Discrete Fourier Transform (DFT), Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT)[4]. However, DWT has been used more frequently in digital image watermarking due to its time/frequency decomposition characteristics, which resemble to the theoretical models of the human visual system.

Wavelet Domain is a promising domain for watermark embedding. Wavelet refers to small waves. Discrete wavelet transformation is based on small waves of limited duration and varying frequency. This is a frequency domain technique in which firstly cover image is transformed into frequency domain and then its frequency coefficients are modified in accordance with the transformed coefficients of the watermark and watermarked image is obtained which is very much robust. DWT decomposed image hierarchically, providing both spatial and frequency description of the image. It decomposes an image in basically three spatial directions i.e. horizontal, vertical and diagonal in result separating into four different components namely LL, LH, HL and HH. Here first letter refers to applying either low pass frequency operation or high pass frequency operations to the rows and the second refers to the filter applied to the columns of the cover image. LL level is the lowest resolution level which consist of the approximation part of the cover image and rest three levels i.e., LH, HL, HH give the detailed information of the cover image. DWT decomposition of image is as shown in figure 2.

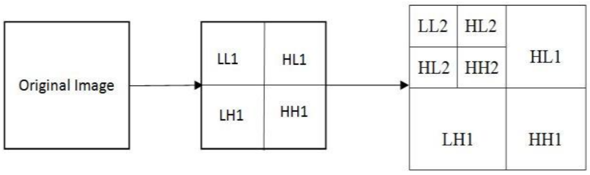

Fig. 2. DWT Decomposition of the Image

A. Haar Discrete Wavelet Transform

Haar is the simplest and very fast wavelet transform. Haar matrix is sequentially ordered. Inma thematics, the Haar wavelet is a sequence of rescaled —square-shaped functions. The wavelet theorems are most popular methods of image processing, de-noising and compression. Considering that the Haar functions are the simplest wavelets, these forms are used in many methods of discrete image transforms and processing. The Haar wavelet transform has a number of advantages such as it is conceptually fast, simple, memory efficient, since it can be calculated in place without a temporary array.

The Haar wavelet also has limitations. In generating each of averages for the next level and each set of coefficients, the Haar transform performs an average and difference on a pair of values. Then the algorithm shifts over by two values and calculates another average and difference on the next pair. The high frequency coefficient spectrum should reflect all high frequency changes. The Haar window is only two elements wide. If a big change takes place from an even value to an odd value, the change will not be reflected in the high frequency coefficients.

In the process of watermark embedding, a watermark image is embedded in the cover image. In order to embed a watermark in an image Haar wavelet is used as mother wavelet.

B. Daubechies Discrete Wavelet Transform

Daubechies wavelets are the most popular wavelets. They represent the foundations of wavelet signal processing and are used in various applications. These are also called Maxflat wavelets as their frequency responses have maximum flatness at frequencies 0 and π. The Daubechies wavelet transforms are defined in the same way as the Haar wavelet transform by computing running averages and differences via scalar products with scaling signals and wavelets the only difference between them consists in how these scaling signals and wavelets are defined. For the Daubechies wavelet transforms, the scaling signals and wavelets have slightly longer supports, i.e., they produce averages and differences using just a few more values from the signal. This slight change, however, provides a tremendous improvement in the capabilities of these new transforms. The names of the Daubechies family wavelets are written dbN, where N is the order, and db the "surname" of the wavelet. db1 is same as Haar wavelet, generally these are considered as same wavelet.

In the process of watermark embedding, an watermark image is embedded in the cover image. In order to embed a watermark in an image Daubechies wavelet is used as mother wavelet. The watermark embedding and extraction process using Daubechies wavelet transform is as illustrated in following block diagram 3.

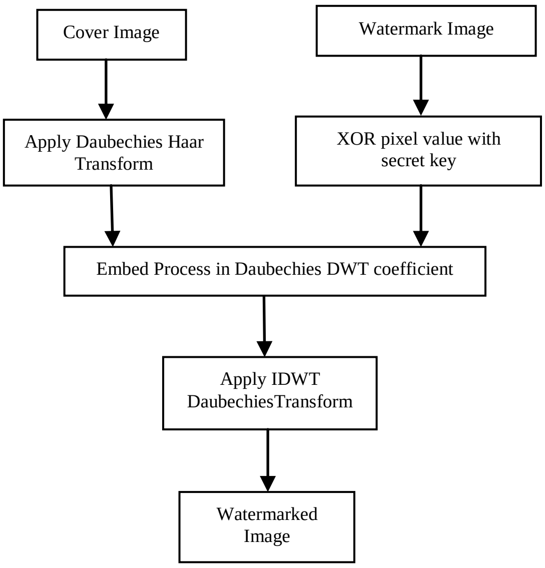
Cover Image
Watermark Image
Apply Daubechies Haar Transform
XOR pixel value with secret key
Embed Process in Daubechies DWT coefficient
Apply IDWT DaubechiesTransform
Watermarked Image

Fig. 3. Embedding Process in Daubechies Wavelet Transform

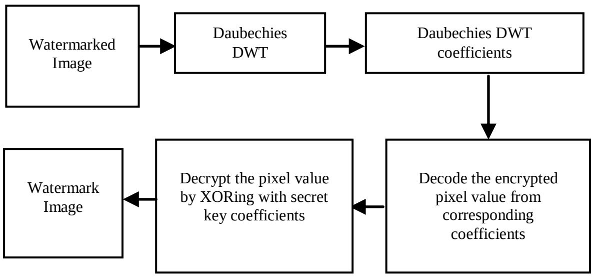
Watermarked Image
Daubechies DWT
Daubechies DWT coefficients
Decode the encrypted pixel value from corresponding coefficients
Decrypt the pixel value by XORing with secret key coefficients
Watermark Image

Fig. 4. Extracting Process in Daubechies Wavelet Transform

III. SIMULATION RESULT

For the implementation of the proposed work, i.e. to study the comparative analysis of Haar and Daubechies DWT, RGB color image of size 512x512 were used as cover image and 128x128, 64*64 image are used as watermark image and implemented on MATLAB 2013a. Here, as the watermark image size must be 25% less than that of Cover image, thus watermark image of image size 128x128 and 64x64 are used as watermark image. The standard RGB cover images considered are Lena, Peppers, Baboon, Canvas, Pollen etc. and Watermark images are Android icon, Flag of Nepal, NCIT logo etc. as shown below.

The experiments are performed on MATLAB 2013a platform on various cover images with the number of watermark image for both Haar and Daubechies DWT based digital watermarking. The details regarding experimental study is as described below:

With Android Icon as watermark image.

When LENNA is considered as cover image and Android Icon as watermark image (128*128), Daubechies DWT gives the following result.

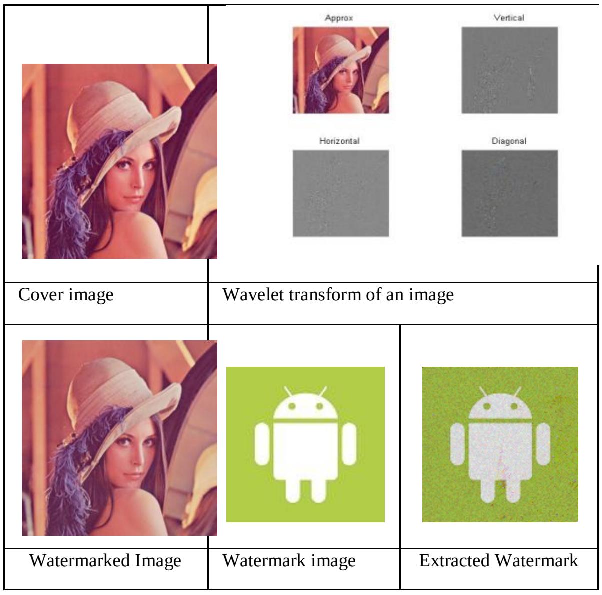

Fig. 5. Daubechies DWT of Lenna with Andriod icon as watermark

It was found that,

For Watermark image, MSE = 899.5375
PSNR = 18.5906

Similarly, for Cover and watermarked image,
MSE = 95.3803 PSNR = 28.3362
SSIM = 0.8545 CRC = 0.8545

And when LENNA is considered as cover image and ANDROID ICON as watermark image, Haar DWT gives the following result.

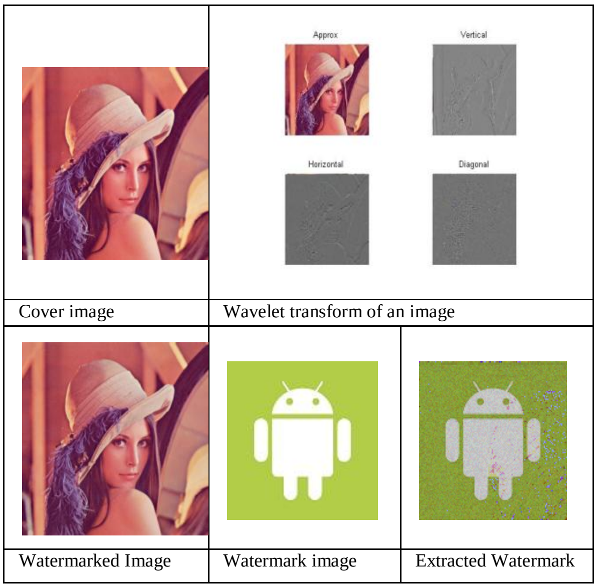

Fig. 6. Haar DWT of Lenna with Andriod icon as watermark

It was found that,

For Watermark image, MSE = 2.2980e+03
PSNR = 14.5173

Similarly, for Cover and watermarked image,
MSE = 384.0539 PSNR = 22.2869
SSIM = 0.7683 CRC = 0.7683

When NCIT is considered as watermark image (Watermark Image size: 128*128), Daubechies and Haar DWT gives the following result.

TABLE I. CALCULATED PERFORMANCE PARAMETER WHEN NCIT IS A WATERMARK IMAGE

Cover Image	Haar DWT			
	MSE	PSNR	SSIM	CRC
Lenna	527.4238	20.9092	0.7290	0.7290
Baboon	717.1212	19.5749	0.5552	0.5552
Pepper	306.0197	23.2733	0.6578	0.6578
Canvas	1.0080e+03	18.0960	0.5419	0.5419
Pollen	1.0502e+03	17.9179	0.7065	0.7065
WiFi	3.2052e+03	13.0722	0.4979	0.4978
House	2.3608e+03	14.4002	0.4953	0.4953
Linkedin	4.3588e+03	11.7372	0.4449	0.4449
Icon	1.0885e+03	17.7624	0.5680	0.5680
Chrome	3.1099e+03	13.2033	0.4564	0.4563
Color	1.0131e+03	18.0745	0.5623	0.5623
Process Icon	3.5346e+03	12.6474	0.4503	0.4503
Pens	826.6590	18.9575	0.5622	0.5621
Penguin	729.5404	19.5003	0.8597	0.8597
Flowers	486.4910	21.2601	0.7826	0.7825

Cover Image	Daubechies DWT			
	MSE	PSNR	SSIM	CRC
Lenna	179.4586	25.5912	0.8074	0.8074
Baboon	599.5849	20.3523	0.6199	0.6199
Pepper	199.2694	25.1364	0.7108	0.7107
Canvas	375.5991	22.3836	0.7384	0.7383
Pollen	1.0389e+03	17.9652	0.7435	0.7435
WiFi	1.7360e+03	15.7354	0.5078	0.5077
House	1.9460e+03	15.2395	0.5432	0.5431
Linkedin	2.9618e+03	13.4153	0.5170	0.5170
Icon	862.4516	18.7735	0.6371	0.6370
Chrome	2.9415e+03	13.4451	0.5062	0.5062
Color	993.6883	18.1583	0.5686	0.5686
Process Icon	2.4955e+03	14.1592	0.5206	0.5205
pens	578.4330	20.5083	0.6864	0.6864
pinguin	581.2461	20.4872	0.8993	0.8992
flowers	292.1611	23.4746	0.8610	0.8610

Table I, shows the MSE, PSNR value for Cover image and Watermarked image and SSIM, CRC for Watermark and Extracted Watermark Image when NCIT is used as watermark image. It shows that less value of MSE and thus more the PSNR for Daubechies DWT as compared to Haar DWT. Also higher value of SSIM and CRC shows that extracted watermark image is similar and compatible to original watermark image.

Also, the comparative study of PSNR and SSIM value for Watermark and Extracted Watermark image for Daubechies and Haar DWT is illustrated in figure 7 and 8 respectively.

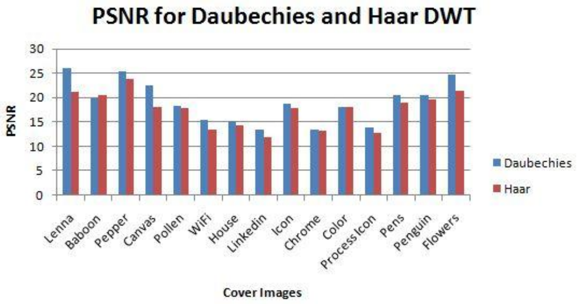

Fig. 7. Bar Diagram showing PSNR and SSIM value for Daubechies DWT with NCIT as Watermark image

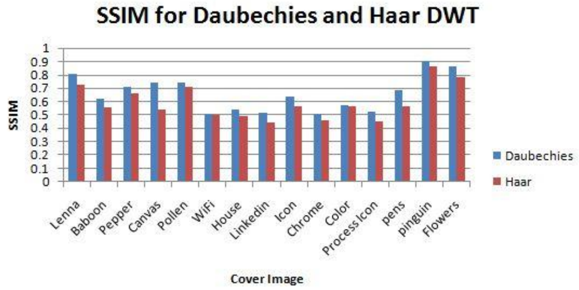

Fig. 8. Bar Diagram showing PSNR and SSIM value for Haar DWT with NCIT as Watermark image

When NCIT is considered as watermark image (Watermark Image size: 64*64), Daubechies and Haar DWT gives the following result.

TABLE II. CALCULATED PERFORMANCE PARAMETER WHEN NCIT IS A WATERMARK IMAGE

Cover Image	Haar DWT			
	MSE	PSNR	SSIM	CRC
Lenna	521.3383	20.9596	0.8598	0.8595
Baboon	678.0034	19.8185	0.5124	0.5123
Pepper	301.3346	23.3403	0.6667	0.6665
Canvas	1.0047e+03	18.1106	0.5360	0.5359
Pollen	1.0435e+03	17.9460	0.8810	0.8807
WiFi	2.9802e+03	13.3883	0.5425	0.5424
House	2.3808e+03	14.3635	0.8495	0.8492
Linkedin	4.1136e+03	11.9886	0.4582	0.4581
Icon	1.0833e+03	17.7833	0.5861	0.5860
Chrome	3.1015e+03	13.2151	0.4622	0.4621
Color	995.1558	18.1519	0.5659	0.5658
Process Icon	3.3696e+03	12.8551	0.4653	0.4652
Pens	822.8506	18.9776	0.8274	0.8272
Penguin	716.6878	19.5775	0.9939	0.9936
Flowers	479.1923	21.3257	0.8983	0.8981

Cover Image	Daubechies DWT			
	MSE	PSNR	SSIM	CRC
Lenna	172.3496	25.7667	0.8794	0.8791
Baboon	589.2058	20.4281	0.5856	0.5855
Pepper	189.3973	25.3571	0.7277	0.7275
Canvas	369.3508	22.4564	0.7941	0.7939
Pollen	909.0486	18.5449	0.8531	0.8529
WiFi	1.7734e+03	15.6427	0.5430	0.5429
House	1.9423e+03	15.2476	0.6429	0.6428
Linkedin	2.8850e+03	13.5293	0.6891	0.6890
Icon	856.5244	18.8034	0.8556	0.8554
Chrome	2.9371e+03	13.4516	0.5201	0.5200
Color	989.6663	18.1759	0.5682	0.5681
Process Icon	2.4889e+03	14.1708	0.5459	0.5457
Pens	573.0132	20.5492	0.8672	0.8670
Penguin	584.0002	20.4667	0.9187	0.9184
Flowers	304.5672	23.2940	0.8808	0.8805

Table II shows the MSE, PSNR value for Cover image and Watermarked image and SSIM, CRC for Watermark and Extracted Watermark Image when Flag of Nepal is used as watermark image. It shows that less value of MSE and thus more the PSNR for Daubechies DWT as compared to Haar DWT. Also higher value of SSIM and CRC shows that extracted watermark image is similar and compatible to original watermark image.

Also, the comparative study of PSNR and SSIM value for Watermark and Extracted Watermark image for Daubechies and Haar DWT is shown in figure 9 and 10.

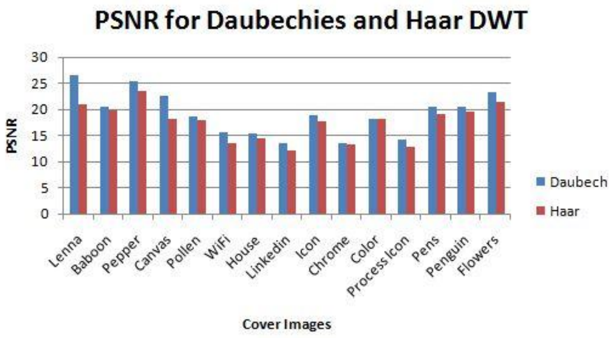

Fig. 9. Bar Diagram showing PSNR and SSIM value for Daubechies DWT with NCIT as Watermark image

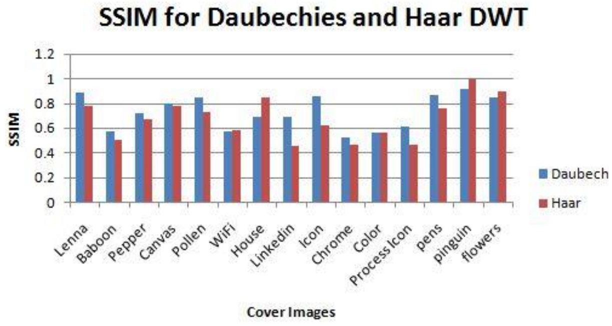

Fig. 10. Bar Diagram showing PSNR and SSIM value for Haar DWT with Robot as Watermark image

IV. CONCLUSION

This paper, mainly focused on invisible watermarking that provides a comprehensive and robust algorithm that embeds and extracts watermark image effectively. The Wavelet transform of various Cover images with different watermark image has been performed and to evaluate the performance of the Haar and Daubechies DWT based digital watermarking, performance metrics: MSE, PSNR, SSIM and CRC were calculated. The above experiments show that Daubechies DWT gives less MSE and thus more PSNR compared to Haar DWT. With the higher value of PSNR that defines the imperceptibility so we can say that the cover image and watermarked image are visually same. In terms of SSIM and CRC, Daubechies DWT have larger value, shows the high similarity between the original watermark and extracted watermark than that of Haar DWT. By human visual system it seems that Daubechies gave best result. Also it has been observed that performance metrics for 64*64 is better than 128*128 watermark image which shows that less the image size better the performance.

Thus it can be concluded that performance of Daubechies DWT is better than Haar DWT in digital watermarking.

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Performance Analysis of Electricity Demand with Meteorological Parameters for Japan

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***Abstract*—The quality of short term electricity demand forecasting is essential for all the energy market players for operation and trading activities. Electricity demand is significantly affected by non linear factors such as climatic condition, calendar and other seasonality have been widely reported in literature. This paper considers parsimonious forecasting models to explain the importance of meteorological parameters for the hourly electricity demand forecasting. Many researchers include only temperature as a major weather factor because it directly influences electricity demand, however other meteorological factors such as relative humidity, wind speed etc. are rarely included in literature. Therefore, the main purpose of this study is to investigate the impact of meteorological variability such as relative humidity, wind speed, solar radiation etc. for short term demand forecasting and analyzed it quantitatively. We demonstrate three different multiple linear models including auto-regressive moving average ARMA (2,6) models with and without some exogenous weather variables to compare the performances for Hokkaido Prefecture, Japan. We applied Bayesian approach to estimate the weight of each parameters with Gibbs sampling and results show overall improvement of mean absolute percentage error (MAPE) performance by 0.015%.**

I. Introduction

Short term electricity demand forecasting is important for all stakeholder of electricity- such as market operator, electricity generators, electricity retailers and ultimately for general people. For market operator, forecasting is crucial for scheduling and dispatch of generators capacity. For electricity generators, strategic choice involved in bidding and re-bidding of capacity depends on demand forecast[3]. For, electricity retailer, demand forecasting affects the decisions about the balance between hedging spot acquisition of electricity, and finally these actions helps for general people due to consistent energy supplies without black out and possibly minimum cost.

Various models are discussed in literature and pay attention for better performance. Electricity demand in Japan has strong time correlation with lagged dependent variable such as Ohtsuka Y. et al. [8], and therefore there are several papers that relate with ARMA time series structure. Ohtsuka Y. et al. have proposed Bayesian estimation procedures for univariate ARMA and got good performance as well. Since each model has its own strength and weakness, we have developed multiple equation model accounting correlated error as hybrid model. As distinct from previous studies, we employ two stage estimation of multiple linear regression MLR ARMA(2,6) model. First stage, we get point estimation values of parameters using ordinary least square (OLS) technique and refine these estimation using Bayesian technique in second stage.

To develop model several factors that directly or indirectly influence on electricity demand have to take in account. For example- weather, calendar, and historical demand data. Impact of weather variables on electric power demand in England, Australia, Jordan and many more regions are found in literature, but their focus is on the affect of temperature. Failure of power supply in 1995 due to excessive hot, and corresponding increase of electricity demand in Malaysia. Such increment of demand is possible if temperature lowers significantly. Countries having cold regions have the peak demand in the summer are usually lower compared to the peak demands of winter. This indicates that human activities during winter season is higher. Various weather variables can be considered for demand forecasting: temperature and humidity are the most commonly used, but wind, radiation and cloud cover are often excluded. The affect of meteorological factors such as temperature, humidity, solar radiation, precipitation, and wind speed varies according to the season and hence varies electricity demand significantly. However, most of the paper exclude other factors and include only temperature for their analysis.

Among various approaches for predicting future data, we can generalize into two types of estimates. i) point estimate- single valued forecast, and ii) probabilistic estimate- where each parameters are treated as random variable and several possible values for the future demand is predicted. The main advantage of probabilistic forecast is that it contains additional information in terms of uncertainty. This paper employ two stage for estimation. In first stage, the point estimated values obtained from OLS is considered as prior information for Bayesian and in next stage, these parameters are used as random variable for Markov Chain Monte Carlo (MCMC) and obtained the final values in terms of distributions for probabilistic forecast. Finally, forecasting the next day demand is in terms of mean, median and 60 percentile value.

II. Methodology

A. Description of data

We have played with the hourly electricity demand data from Jan 1, 2013 until December 31, 2015 for Hokkaido Prefecture provided by Hokkaido Electric Power Company

(HEPCO) and same period of meteorological data set from Japan Meteorological Agency (JMA). Some missing data for snowfall, and cloud are filled up with interpolation of data.

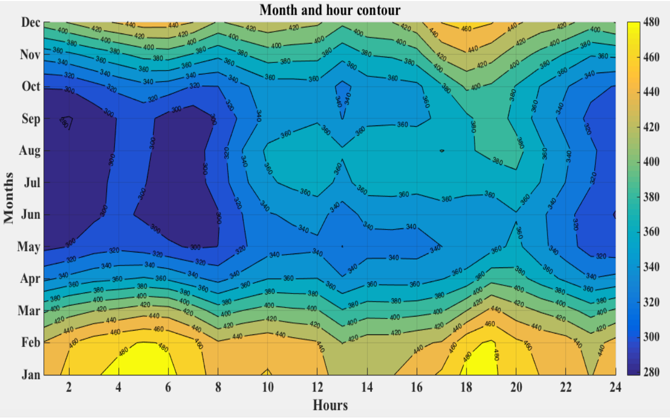

Figure 1: Trend of electricity demand profile: average data 2013-2015 (×10 MW)

Figure 1 demonstrates the average electricity demand profile of past two years for each months and hours. Contour map indicates the maximum demands upto 4800MW during morning (approx. 4 to 6 AM) and evening (approx. 6 PM to 7 PM) at winter season, specially in December and January. Since, Hokkaido Prefecture suffers from very cold climate during winter season around -20°C, people use electricity for warming purpose such as room heating, building heating, water heating etc. Also variation on pricing and necessity of people cause excessive demand during morning and evening time. The lowest demand on the similar time period are found in summer season, specially May to September. This is exactly the opposite effect and exhibits seasonal variation.

Table 1. Correlation between weather variables and electricity demand

Weather variable	Winter (Jan)	Summer (Aug)
1. Temperature	-0.3495	0.5302
2. Rainfall	0.0727	-0.0078
3. Relative humidity	0.1385	-0.4348
4. Solar radiation	-0.2321	0.4141
5. Snowfall	0.1013	NaN

Since our interest is to analyze the affect of meteorological parameter, the table above shows the variables most significantly correlated with electrical demand are temperature, solar radiation having both negative correlation during winter season while it is positive during summer. Similarly, relative humidity and precipitation shows positive correlation during winter and opposite in summer. However, Solar radiation, and relative humidity during summer shows approximately equal and opposite correlation results minimization of their individual affect and strong correlation of temperature remains dominant factor for electricity demand during summer.

B. *Related works*

In literature, many authors develop univariate time series model without any exogenous variables with competitive forecasting performance. For example, Taylor [9] employ a double seasonal exponential smoothing for half hour data to predict very good result with mean absolute percentage error (MAPE) of 1.25 to 2%. However, only historical demand data set may not sufficiently address the cause of effect on demand because temperature variation is also an important factor that directly influence electricity demand. After 2003,climate change significantly affect the variation on demand such as modification of annual daily load curve, shifting of the peak demand occurrence from evening to morning in Jordan [7]. In Europe, extremely high temperatures during summer of 2003 creating significantly greater electricity demand. Therefore, it is worth to specifically examine the influence of each meteorological parameters for electricity demand.

Some multivariate weather parameters- like temperature, precipitation, wind speed, cloud cover, humidity are employed for modeling electricity consumption load [4][5]. They also mentioned that the use of additional weather variables such as precipitation, wind speed, humidity and cloud coverage should yield even better results. That means the performance is improved and consistent due to such meteorological variables. Friedrich L. et al. [6] investigate the results for Abu Dhabi city electricity load using multiple weather variable for 24 hour to 48 hour prediction horizon and got very promising result of 1.5% MAPE for 24-hour and 48-hour horizon. Apadula et al. [1] analyze weather, and calendar variables effects on monthly electricity demand using MLR model for Italy. Including good meteorological variable estimates highly improve monthly demand forecast with MAPE around 1.3%. However, they haven't analyzed the performance including and excluding individual meteorological parameters.

Another important factor found in literature is day types. Dordonant et al. [5], Chapagain and Kittipiyakul [2], forecast the electricity load considering a normal day, and make adjustments with other dummy variable for treating as weekend or other special days which is also taken into account during modeling. But, our intention here in this paper is to analyze the improvement of performance when we include such weather variables. So far we are not getting any quantitative comparison among the weather variables, such as what is the improvement of performance if we include meteorological variables for example- wind speed, humidity, cloud coverage, precipitation. Therefore this is our interest to analyze it quantitatively.

C. *Prototype Modeling*

In this paper we compare the forecasting results based on a hour ahead prediction between three models named as model A, B, and C. These models are developed as multiple linear regression (MLR) with AR(2) model inspired by the seminal paper of Ramanathan et al. [**?**], multiple regression model with separate equations for each hour of the day approached for California electricity market. We estimate the demand for the first hour of the day with one equation and the second for the second hour of the day from next equation and so on. Therefore, we need 24 individual equations for the complete prediction of demand in one day and prototype model is-

$$\begin{aligned} Demand_{h,d} = Deterministic_{h,d} + Meteorology_{h,d} + \\ HistDemand_{h,d} + v_{h,d} \end{aligned} \tag{1}$$

where h indicates the hour of the day, and d indicates the daily observations and $v_{h,d}$ contains the correlated error term with some order of lag data. We use some special technique to select the appropriate order of q called Bayesian Information Criteria (BIC).

$$v_{h,d} = \sum_{i=1}^{q} \rho_i \epsilon_{h,d-i} + \epsilon_{h,d} \tag{2}$$

and, $\epsilon_{h,d} = N(0, \sigma^2)$.

$Deterministic_{h,d}$ variables refer predictable variables such as days of week, months, and years. Daily load profile shows the higher demand during the business week (Monday to Friday) than that of weekend (Saturday and Sunday) or public holidays. Such effect can be address with dummies. For example- For the case of all days of week, we can consider Saturday as reference dummy so that other days can be compare with respect to that day. Procedure hold same for months dummies and seasons dummies. And the model $Deterministic_{h,d}$ is modeled with 25 variables.

$Meteorology_{h,d}$ variables are the another factor that effect the demand of electricity. Some pre-processing of temperature is done finding some correlation between temperature and demand, which implies that $17.1°C$ as the reference point where there is no effect of temperature for demand. We include some other meteorological variables such as relative humidity, wind speed, precipitation(rain or snowfall), solar radiation are also accounted for formulations. Main objective of this paper is focused on their affects for electricity demand and model $Meteorology_{h,d}$ consists 34 variables.

For $HistDemand_{h,d}$, we studied the variation of historical electricity demand pattern. We conduct Ljung-Box Q-test for BIC test after analyzing the pattern of residuals. Since, auto-regressive (AR) component captures the pattern of load in hour $h = i$ for any given day is a good indication that load will be higher in hour $h = i$ on the following day(s), $HistDemand_{h,d}$ is modeled as-AR(2) and MA(6) representing the appropriate model of cyclicality for off-peak and peak hours with 13 variables including constant term.

Therefore, model A is constructed with 74 variables including 6 correlated variables. Still demand is continuously varies due to random kind of disturbances. For example, unknown working hours of large steel mills, shutdown of industrial activities, days with extreme weather or sudden change in weather are the promising factors that affect on demand. Although, we are trying to address extreme weather or sudden weather change by inserting hourly and daily deviation terms, but unscheduled holidays (eg- 28 Dec 2014 to 3rd Jan 2015) is still a limitation in our study.

As our interest is to analyze the effect of other meteorological factors on the demand forecasting, now we develop next model called model B. Where we exclude some meteorological variables from Model A such as rain, snow, wind, radiation, humidity, cloud and their interactions (12 variables). Therefore, model B will consist 56 exogenous variables excluding 6 correlated coefficients, for prediction of demand. Similarly, 16 more variables having very low weight on their coefficients are removed from model B for model C.

The covariates for model A, B, and C can be arranged in column vector form and are estimated using OLS. These point values are used as prior values for Bayesian rule and Markov Chain Monte Carlo (MCMC) is constructed to find the distribution of the parameters for better forecast.

III. Results and discussions

We have used three years of data set upto 2015 through 2012, where complete 2 years (730 days) of moving windows is used as training data set to predict the out sample demand for the year of 2015. The multiple equations modeled here is estimated for each hour with separate equations having its own covariants. Therefore, each hour of the day, they have a different weight of parameter value.

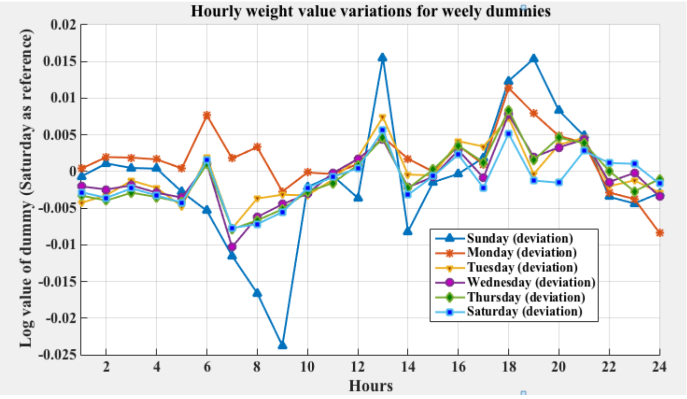

Figure 2: Hourly analysis of coefficient for week dummies

To discuss day type dummies in detail, we have plot the coefficients values in figure 2. Since, we represent dummy variables Sunday to Friday, considering Saturday as a base level. The largest coefficient values are seen to occur on Monday because of previous day's demand, which are substantially lower than Monday demand, is being used to predict Monday forecast $(AR(2)effect : demand_{h,d-1}, demand_{h,d-2})$. The smallest coefficient specially during morning time (exactly same time of sharply increment of demand during weekdays) significantly decreases to generate lower weekends loads. Coefficients for different weekdays are found almost similar patterns indicating similar effects though out 24 hours, but during morning and night hours, coefficients are negative indicating decrease of demand than that of day hours specially evening 18 to 20 hour.

In figure 3, forecasted electricity demand for first week of January, 2015 is plotted and compared with actual demand. Since, we have implemented mean, median and 60 percentile forecast from the distribution of predicted data, which is the beauty of Bayesian estimation. For future prediction, such

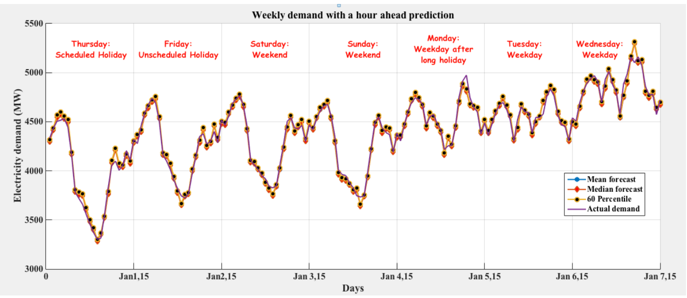

Figure 3: Weekly demand variation for the first week of Jan 2015, and this week consists a lot of variations on demand.

information are quite helpful to express demand prediction in terms of uncertainty. This first week consists various types of day types such as scheduled public holiday, unscheduled holidays, weekends and weekdays. Overall MAPE for this week is 0.82%, but still it is over estimated on Jan 1, due to non holiday effect of 31 Dec, under estimated on Jan 5, and 7 due to significant rise of peak on that day compared with the peaks of previous day. We have forecast the electricity demand for complete year 2015, with Bayesian approach with MAPE 0.69% and 0.15% variation. In literature, MAPE, and Root Mean Squared Error (RMSE) are widely used for performance analysis purpose.

Figure 4 compares the performance of model A to other models B, and C. Positive value indicates that there is some improvement on our forecasting due to the meteorological variables such as- wind speed, humidity, cloud coverage, precipitation. This was the main objective of this paper. Finally, we can clearly observe that on each months comparison, model A shows dominant MAPE improvement compare to other models B, and C through out the year except some summer months July and August. Interestingly, both model B and C provide better result. The variation of electricity demand on summer may be highly depends on temperature and both models B and C are quite enough for these two months. Because, in table 1. temperature shows the dominant correlation for demand during summer. In overall, performance can be improve by 0.015%, if we include other meteorological variables in our model formulation.

IV. Conclusion

In this paper we developed three models based on literature about multiple equation demand forecasting model. During modeling, we pays particular attention to the weather variables that effects electricity demand and try to analyze quantitatively. We have analyzed these models based on their forecasting performance for complete one year out-sample prediction. Since, models were categorized based on all weather parameter include or not, they have a bit variation on their performances. More specifically, comparing with model B and C, model A that include all available weather parameters can improve the overall performance by at least 0.015%. Interestingly, during summer months (July and August) both model B and C looks better. One complexity for prediction during summer season is due to its high variation of demand. Sudden changes of temperature due to rainfall or wind speed also cause immediate fluctuations on demand. But, model B and C are succeed to address such a variation of demand. This indicates that optimization of exogenous variable is also necessary to improve performance.

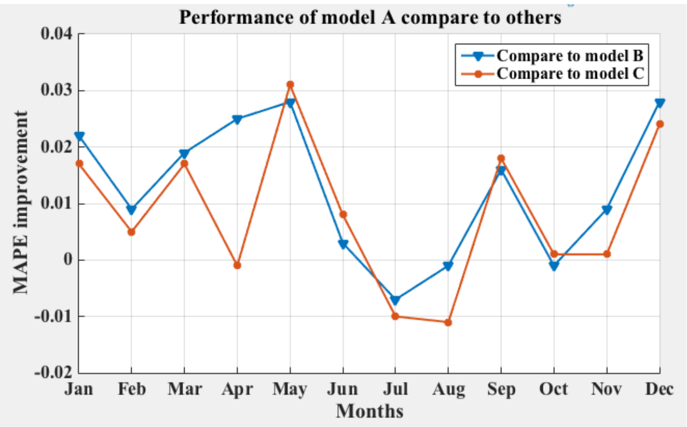

Figure 4: Performance improvement of model A with respect to other models

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A Nepali Rule Based Stemmer and its performance on different NLP applications

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Abstract—**Stemming is an integral part of Natural Language Processing (NLP). It's a preprocessing step in almost every NLP application. Arguably, the most important usage of stemming is in Information Retrieval (IR). While there are lots of work done on stemming in languages like English, Nepali stemming has only a few works. This study focuses on creating a Rule Based stemmer for Nepali text. Specifically, it is an affix stripping system that identifies two different class of suffixes in Nepali grammar and strips them separately. Only a single negativity prefix न is identified and stripped. This study focuses on a number of techniques like exception word identification, morphological normalization and word transformation to increase stemming performance. The stemmer is tested intrinsically using Paice's method and extrinsically on a basic tf-idf based IR system and an elementary news topic classifier using Multinomial Naive Bayes Classifier. The difference in performance of these systems with and without using the stemmer is analysed.**

Index Terms—**Nepali, Stemming, Over-Stemming, Under-Stemming, IR, tf-idf, Paice method, News Topic Classification**

I. Introduction

Stemming refers to the reduction of a given word into its stem which need not be the morphological root of the word. This is done to reduce the inflection of any particular word into a base form. For example: cats is the inflected form of cat and stemming strips the plurality suffix -s from cats to give cat.

Various NLP applications use stemming as a preprocessing step, for example: POS Tagging, Machine Translation, Document Clustering etc but arguably the most important role of word stemming is in Information Retrieval (IR). IR is an immensely common and important application of Natural Language Processing. It essentially refers to the retrieval of a particular document from a collection of documents.

There are two major problems while stemming: over-stemming and under-stemming. Over-stemming is when two separate inflected words are reduced to a same word stem. This is a false-positive in IR, since it leads the IR system to fetch documents which might not contain the search query. Similarly, under-stemming is when two same inflections of a word are not reduced to the same word stem. This is false-negative. It leads to an IR system not finding documents having a related word inflection.

Stemming is mostly done in three ways:

- Rule Based Stemming
- Statistical Stemming
- Hybrid Stemming

Rule based stemming approaches generally refer to affix stripping where a list of affixes are maintained and are stripped to stem a word. Similarly, statistical stemming refers to the usage of statistical models like HMMs and n-grams to stem a word. Hybrid stemming tends to combine aspects of both rule based stemming and statistical stemming in hopes of improving stemming performance. The focus of this work is on rule based method.

II. Related Works

Stemming is not an unfamiliar topic. Including the renowned Porter stemmer, many works exist for stemming words in English. In Nepali, however, there are only a few works. Bal et al. wrote a morphological analyzer and stemmer for Nepali language [1]. Sitaula proposed a hybrid nepali stemming algorithm which uses affix stripping in conjunction with a string similarity function and reports a recall rate of 72.1% on 1200 words [2]. He has taken into consideration a total of 150 suffixes and around 35 prefixes. Paul et al. describes an affix removal stemming algorithm for Nepali text. Their work has a database of 120 suffixes and 25 prefixes and a root lexicon of over 1000 words and reports an overall accuracy of 90.48% [3]. Shrestha et al. classifies suffixes into three categories and stem them according to different criterias [4]. They take into account 128 suffix rules and report an accuracy of 88.78% on 5000 words.

There are also some works in languages which are morphologically similar to Nepali. A hindi stemmer was devised by Ramanathan et al. [5] where they first use a transliteration scheme to transliterate Devanagari to English. They have maintained a suffix list which is used to strip the word by using the process of longest match. Upon testing the algorithm in 35977 words, 4.6% words were found to be under-stemmed while 13.8% were found to be over-stemmed. An Urdu stemmer is also written by Kansal et al. [6] which uses the rule based approach to stem Urdu words. They report 85.14% accuracy on more than 20,000 words.

III. Challenges

The fact that Nepali is an inherently complex language makes it inaccessible to many analysis. Various derivational and inflectional techniques exist in Nepali grammar which creates plethora of frequently used words in everyday life. For instance, inflection alone is categorized as being of ten types. These inflections can alter a word's structure based on gender, cardinality, respect, tense and its aspects. Moreover, inflections are also based on moods, voice, causality and negation [7]. This makes it non-trivial to devise a proper stemming algorithm for Nepali language.

There is also a need to identify whether a linguistic entity attached at the end of the word is a suffix attaching itself to a base word or is actually a part of the word itself. For instance, in the word काले the entity ले is actually the part of the word itself whereas in the word कालेले the rightmost ले is a post-positional suffix. It is imperative to accurately identify when and when not to strip a given suffix because unnecessary stripping leads to over-stemming.

Another challenge in suffix stripping is the difference in writing. For example, both of the word form साङ्केतिक and साङ्केतीक are used interchangeably in informal writing. Unless an assumption about strictness of the grammar rules, there is a need to include both of the suffixes ◌िक and ◌ीक. Not only that, several suffixes can be joined together as in उनीहरुको which contains two postpositions (हरु and को) compounded together. To deal with these scenarios, there is a need to repeatedly apply the stripping rules. However, this increases the chances of over-stemming.

IV. Methodology

A. Morphological Normalization

Among the vowels present in Nepali language, the vowel pairs <इ, ई> and <उ, ऊ> in both their dependant and in dependant forms are often confused while writing. Same is the case with some of the consonant groups like <व, ब>. To make the stemmer more robust to these common grammatical errors, a morphological normalization scheme was introduced where the often confused vowels and consonants are normalized into a single entity. Concretely, all occurrence of the vowel ई are replaced with इ and so on while stemming the words. A more detailed normalization scheme is outlined below.

B. Prefix Stripping

Though there are many prefixes in Nepali, they have not been stripped as a part of this work. This is mainly because the prefixes derive a new word from a root instead of inflecting it. For instance, the words like उपकार, प्रकार, अधिकार, परिकार etc all are words derived from the application of the prefixes उप, प्र, अधि, परि respectively to the same root कार. All of these words are actually totally unrelated to each other so stripping prefixes would mean that they would overstem.

TABLE I
Morphological Normalization Rules

Vowel / Consonant	Normalized To
इ	ई
◌ी	◌ि
ऊ	उ
◌ू	◌ु
व	ब
श	स
ष	स
◌ँ	*Nil (all occurances removed)*

An exception to this rule is the negativity prefix न. It usually occurs before verbs and negates their sense. For example, the verb जानु (to go) can be inflected as नजानु (to not go) by the application of this prefix. This work only considers this single prefix for stripping.

C. Suffix Stripping

The suffixes in Nepali language have been classified into two classes in this work:

- Type I suffix
- Type II suffix

Type I suffixes mainly consists of post-positions and other agglutinative suffixes. Some example of these suffixes are: मा, बाट, ले, लाई, द्वारा, लागि, निम्ति etc. There are 85 type I suffixes identified in this work.

Type II suffixes, on the other hand, primarily consist of case markers and other bound suffixes. Some of the suffixes also occur in both free and bound form, for example ◌ेका and एका are linguistically the same but differ in that the former has the dependant vowel ◌े and the second has the independent vowel ए. Some examples of type II suffixes are: छे, ने, छ्यौ, एको, इक etc. A total of 161 of these suffixes were identified.

1) Stripping type I suffix: Stripping these suffixes is a non-trivial process. This can be attributed to two major facts:

To begin with, identification of these suffix is challenging. As was discussed earlier, some of these suffixes occur as a part of word itself. For instance, the word नेहरु is the name of a reputed Indian politician and not the suffix हरु attached to the root ने. There are many more examples of such exception words. Before stripping type I suffixes, an extensive exception word list has to be created and checked against to prevent over-stemming. A total of 181 of these exceptions words were identified by manually eyeballing a corpus derived from various online Nepali news sites. The corpus is described in section V-A.

Another challenge in stripping type I suffix is that these suffixes can be chained together i.e. the word उनीहरुलाई is a word created by chaining two different type I suffixes i.e. हरु and लाई. This requires repetitive stripping of the suffixes while checking the intermediate results against the exception word list.

2) Stripping type II suffixes: Stemming these suffixes is particularly tricky due to the inherent structure of Nepali Morphology. For example, consider the suffix इक. It is known to change the morphology of nouns in the following way:

सङ्गीत + इक = साङ्गीतिक
समाज + इक = सामाजिक

I.e. change of the dependent vowels (अ to आ) at the start of the word.

To take these factors into consideration, we introduce a word transformation rule. In simple terms, if the word contains the इक prefix, the dependant vowel at the start of the word is changed accordingly. The vowel आ becomes अ, vowel औ becomes उ and the vowel ऐ becomes इ . Using this transformative rule, the word नैतिक would be transformed to the word नितिक . It is important to observe that this map does not map a word to its stem, rather only to an intermediate word, which will be then further processed to produce the correct stem. The intermediate word might not be grammatically correct one. The rationale being that the word नितिक and the word नीति would conflate to the same once they are morphologically normalized and then stemmed.

The stemming algorithm in itself is quite simple. In fact, after taking into account the variations in word morphology by addition of suffixes, the rest of the process is the repeated stripping of the suffixes in a longest suffix first approach. This stripping is done until further stripping is not possible. In the event that any particular stripping rule decreases the word size to below a set threshold, that rule is discarded. This is done to prevent over-stemming of the word. The threshold value for this project was taken to be 2 by observing the error rates as per the testing method described in section V-B.

V. Performance Evaluation

A. Data

To test the stemming rules and evaluate the over/under stemming errors, a corpus was constructed. This corpus was derived from various online news portals such as Setopati, Nagariknews, eKantipur etc. The corpus contained articles from various different areas including news, sports, politics, literature etc. Corpus contained a total of 4387 news articles with the total word count of 1181343 and total unique word count of 118056. Each news article, on average, contained 269 total words and 181 unique words.

B. Intrinsic Evaluation - Paice's Method

Paice method [8] for evaluation of stemmers is based on under-stemming and over-stemming errors. In this method, a concept group is first defined where multiple word inflations of a single word-concept are grouped together. Similarly, a stemmer group is defined where words that produce same stem are grouped together. Using these two word groups, four performance indices are calculated and subsequent calculation of over-stemming index (*OI*) and under-stemming index (*UI*) is done. These indices and the method to calculate them are defined in [8].

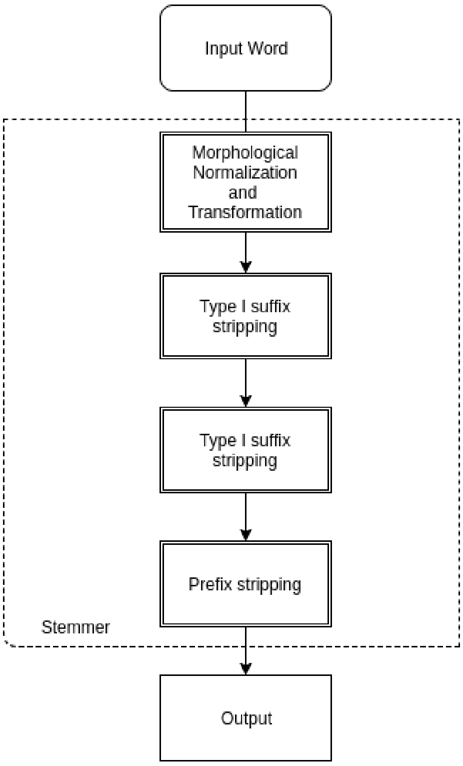

Fig. 1. Block diagram of the stemmer.

For evaluating the stemmer according to Paice method, 497 concept groups were defined. Each concept groups contained at least two related words with the maximum being thirty-nine words. A total of 1813 words constituted the concept groups. Some examples of the groups are as follows:

- तपाईँ, तपाई, तपाईँको, तपाईंहरू, तपाईँले, तपाईको, तपाईले, तपाईंहरु
- हुनुपर्नें, हुनु, हुनुपर्छ, हुनुहुन्छ, हुनुहुन्थ्यो
- मानिस, मानिसको, मानिसहरु, मानिसलाई, मानिसले, मानिसमा, मानिसहरुको, मानिसहरुले

These words were derived from the top 10,000 most frequent words occurring in the corpus described in section V-A. The results obtained after running Paice method of evaluation on the stemmer using these concept groups are shown in table II.

Using these indices, the *OI* was found to be 0.2% and the *UI* was found to be 5.27%. This shows that the stemmer has high understemming error in contrast to over-stemming error implying that the stemmer is a *light stemmer* i.e. it has a tendency to not strip suffixes aggressively.

TABLE II
PAICE METHOD RESULTS

Metric	Value
Global Desired Merge Total (GDMT)	8274
Global Unachieved Merge Total (GUMT)	436
Global Desired Non-Merge Total (GDNT)	2742411
Global Wrongly Merged Total (GWMT)	4729

C. Extrinsic Evaluation

A most accurate and pragmatic test for any Stemmer is to actually implement a NLP application based on that Stemmer and then check for the performance of that application. For the purpose of this thesis, two different applications were designed. One of them being a crude IR system, which was developed using the Stemmer and then tested on a prepared dataset upon a subset of the corpus described in V-A. Another application was an elementary News Topic Classifier for seven different news topics.

1) Information Retrieval Test: Modern IR systems employ various measures like query expansion (where a simple input query is reconstructed to multiple queries for getting a wider coverage) to sophisticated relevancy algorithm like pagerank. For the purpose of this thesis, however, only a simple IR system has been developed where both documents and queries are modeled using the bag of words model and the ranking is done by using tf-idf metric which has been shown to give good results for document retrieval [9].

For the purpose of this test, total 100 documents were sampled from the corpus in 4.1. Then, 14 queries were constructed for retrieval. These queries contained one to three words and were constructed manually using the gathered documents. Some of the queries are shown below:

- पोखरीमा विष
- साझा बस
- कतार राजदुत
- अखिल क्रान्तिकारी

Using the TF-IDF ranking scheme, two independent information retrieval experiment were carried out for each query. The first experiment was done without stemming the documents and queries while the second experiment was done on the stemmed document and queries. The topmost result i.e. the document with the highest relevance score for the given query for both experiments were taken and three native Nepalese human judges were asked to assess the relevance of the retrieved document on the scale of one to five; one being the least relevant while five being most. If the query failed to return any document in any experiment, the relevance was taken to be zero.

The difference in average relevance score of the retrieved document with stemming and without stemming was calculated for each query and the differences were averaged at the end. The average gain in the relevance was found to be 0.93 i.e. 18.6%. The results of the experiment are summarized in fig. 2.

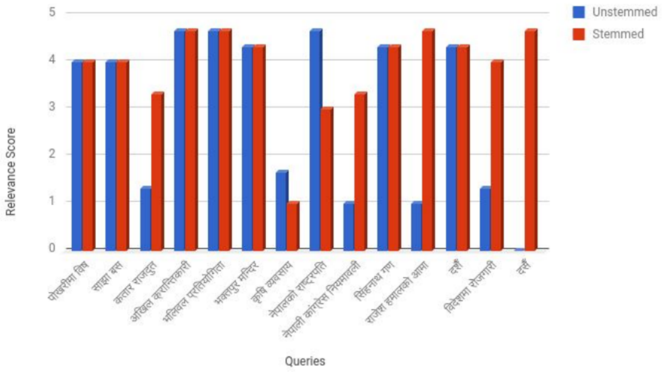

Fig. 2. Stemmed vs Non-Stemmed Relevance in IR experiment.

2) News Topic Classification: For the purpose of this particular application, a total of 1400 news articles belonging to seven categories like politics, economy, sports, literature, technology, global, and society were extracted from a Nepali news site nagariknews.com. Each topic contained 200 documents i.e. a uniform representation. A 70-30 split of training and test data was then done and a Multinomial Naive Bayes with Laplace smoothing was used for the subsequent classification.

A corpus wise stop word removal scheme was used i.e. terms appearing in more than half of the documents were removed and the tf-idf scheme [9] was used to construct a feature vector. The results for both stemmed and non-stemmed version of the classification is as follows:

TABLE III
METRICS FOR STEMMED VS NON-STEMMED

Scheme	Vocabulary Size	f1-score
Stemmed	3217	0.79
Non-stemmed	5754	0.77

The F1 metric in Table III is a micro-averaged metric and since micro averaging in multiclass classification yields identical precision, recall, and f1; the precision and recall metrics are excluded from the table. The table clearly shows that in addition to significantly reducing the vocabulary size of the feature vector, stemmed classification also clearly outperforms the non-stemmed classification in terms of F1 score.

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Agent Based Control of Multiple Power Sources

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***Abstract*—The reliabilty of a power source can be increased by using multiple types of sources with different attributes. Properties, such as environment friendliness of a solar power system, are preferable over attributes such as negative impacts and cost of diesel generating plants and utility grids. When using such a multi-source system, a common challange is to use maximum or all of the power produced by the most preferred source. Conventional technique of simply connecting the outputs of the power sources cannot assure of the maximum utilization. The agent based approach developed in this paper maximizes the utilization of the most preferred source and minimizes the use of the least preferred one**

***Index Terms*—Agent System, Bounded Knapsack Problem, Divide and Conquer Approach**

I. Introduction

Telecom sites providing voice and data services need to operate without interruption on 24-7 basis. Site down of even a small time period causes loss of important communication and dissatisfaction on customer side and negative impact in the revenue and good will of operators.

A point of failure of a telecom site is often the power supply. So, it is common to use more than one source of power in the sites. The goal of such a practice is to increase reliability and robustness of the power supply for un-interruptible operation.

The power systems employed in the telecom sites are heterogeneous in nature varying in attributes such as purchase and installation price, operating cost, impact on the environment etc. Some of the systems, because of the qualities, are more preferable over others. And the trend is to use renewable energy such as solar and wind power. But the intermittency of these sources make the output power unsteady and unreliable. So, these sources are be combined with existing power sources such utility grid electricity and diesel generator. But the way they are connected for the output, which is the combined power they supply, the desired source is not used at the desired level.

II. Literature Review

The intermitency of renewable sources such as PV modules and wind turbines do not allow users to depend upon them [1] and requires their integration with some steady sources such as battery systems or the utility grid. While a steady power can be derived from such a combination, no single source outperforms others in all the metrics and the advantage of a hybrid system is evident as discussed in [2] . A hierarchical organization and operation of charging sources, conventional battery, fuel cell and capacitors as described in [2] has capacity to store energy due to the battery as well as can quickly supply large currents due to the capacitor.

The goal of such a system may be one or all of the following:

- Balance demand – supply during peak demand hours.
- Cost balance by preferring use of a low cost energy source.
- Emphasize on use of greener technology.

[2] employs measurement systems that aid in control of multiple switches that interconnect energy sources and load.

[1] proposes a system architecture and control algorithm to minimize the use of grid electricity as far as possible emphasizing use of energy stored in the battery or from the renewable sources to minimize grid costs at individual buildings and eliminate demands during peak hours. The algorithm works in the context of Time Of Use (TOU) pricing but without Net Metering. The cost reduction reported is 2.7X. The output power of different sources and the demand are predicted using complex mathematical equations and fed to the algorithm which outputs the amount of energy to use from the grid and the energy to charge or that can be discharged from the battery.

Similarly, the use of neural network and fuzzy logic controller for adaptive scheme for energy management in stand-alone hybrid power system with photo voltaic (PV) modules, wind turbine (WT), Proton Exchange Membrane Fuel Cell (PEMFC) as energy sources and Lithium-ion battery as energy storage is discussed in [3]. The energy management system uses artificial neural network to achieve Maximum Power Point (MPP) for different types of PV panels and the FLC to distribute energy among the hybrid system entities, manage charge and discharge current flow for performance optimization and to regulate the temperature of the PEMFC. The controller is designed with hierarchical architecture and uses mathematical models to estimate the power being delivered by the sources based upon the current values of the associated parameters.

Microcontroller equipped with FPGA is used as a controller for a power management system in [4]. The power system consists of battery storage system, PEMFC, PV modules and a low voltage ac node and emphasis is given in controlling the SOC which is estimated using an algorithm that takes parameters such as battery current-time integration, open circuit voltage, electrolyte temperature, discharge rate and minimization of startup and shutdown of the PEMFC.

A Multi-Agent System (MAS) based energy management system presented in [5] can self regulate a heterogeneous set of power sources and loads organized as a coherent group of entities, called a micro-grid, in order to optimize several criteria such as cost and efficiency. The components in the micro-grid: sources, loads and storage system are modeled as individual agent. The co ordination, required for the transfer of energy from one agent to another, among the agents is realized by Contract Net Protocol (CNP).

In [6], authors discuss a Stand-Alone Micro-grid at High Altitude controlled and coordinated by multi-agent system. A heterogeneous system of agents representing load, generators, controllers that participate in virtual bidding in order to generate a schedule for operation of energy sources and energy reserves is described in [6]. Each component and its related task are represented by separate agents. There are 7 different types of agents to generate schedule, error compensation, an agent for each type of energy source, storage, load forecasting. The schedule agent provides load profile, clearing price, power dispatch scheme and accepts bid prices from energy source agents. The bid price is representation of operating conditions and demand profile. It involves a lot of message exchanges during the bidding process. Real time differences between model predicted and actual power generation and load profile may arise during operation and is compensated by operation agents using reserve sources.

An emphasis is given to decentralized architecture over a central one in [7]. The microgrid named as Autonomous Polygeneration Microgrid, consists of energy sources such Photo Voltaic, Wind Turbines, Proton Exchange Membrane Fuel Cell, consumers like household appliances, hybrid scooter, desalination plant and energy storage devices like deep cycle batteries, water and hydrogen storage tank. [7] discusses 5 types of agents: one for each renewable energy sources, battery, desalination, electrolyzer and fuel cell. These agents interact with their respective environments and other agents through sensors and communication interfaces and set the operating points the entity they are associated with. The input variables and control variables are mapped into node/concepts of a FCM. A particular FCM is selected according to the input concepts and an operating condition is set based upon the selected cognitive map. It is claimed in [7] that the decentralized approach using multi agent lowers risk of total system failure and reduced implementation cost as compared to centralized systems.

Ant Colony Optimization (ACO) is a nature inspired method to tackle problems of combinatorial optimization. The authors in [8] present ACO meta-heuristics, a generalized method of problem solving imitating the ants in the nature which can be adapted to different problem scenarios with problem specific modifications. Algorithms based upon ACO meta-heuristics have been successfully applied to the well known travelling salesman problem (TSP) and in telecommunications network routing. The algorithm is implemented by using objects called agents or artificial ants that incrementally solve a problem. The artificial ants are relatively very simple, act on local information and interact indirectly through modifications in the environment, the process being called stigmergy. The result is emergence of a collective behavior. They exist in quite a large number with little effect due to failure of some individuals which gives the property of system robustness.

The features of the ants in ant colony optimization such as simplicity, processing of local information, indirect communication, and fault tolerance can be incorporated into agents in multi agent based system to solve the stated problem.

III. Methodology

A. Problem Context

In the fixed parallel connection based multi power source system, the current contributed by nth source out of j power sources is given by

$$\mathrm{I_n} = \frac{\mathrm{I_{on}}}{\mathrm{I_{o0}} + \mathrm{I_{o1}} + ... + \mathrm{I_{0j-1}}} \times \mathrm{l} \tag{1}$$

where

$\mathrm{I_{on}}$: total current/power capacity of nth power source.

l : total instantaneous load current/power

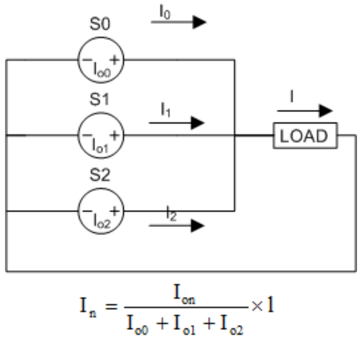


Figure 1: Parallel connection of three power sources

All the power generated by the preferable source cannot be used in this case.

B. Problem Formulation

The power problem can be represented as bounded knapsack problem in the following way:

$\mathrm{w_j}$: amount of power from source j that can be taken at a time.

$\mathrm{c_j}$: cost and impact of an unit of power from source j

$\mathrm{b_j}$: bound or available amount of power in source j

l : total load demand to be fulfilled, the size of the knapsack

The goal is to select

$\mathrm{x_j}$: number representing the quantity of power taken/drawn from source j. Power is drawn in unit quantity of value $\mathrm{w_j}$. Total power taken/drawn is expressed as $\mathrm{x_j w_j}$

to minimize the cost and impact which is given as

$$\text{total cost} = \sum_{\mathrm{j=0}}^{\mathrm{N_s-1}} \mathrm{c_j x_j w_j}$$

with the constraint

$$\sum_{j=0}^{N_s-1} w_j x_j \leq l$$

where,
$0 \leq x_j \leq b_j$, $j \,\epsilon\, [0, N_s]$, N_s is the number of types of power sources.
The load demand should be exactly met, so the constraint should be

$$\sum_{j=0}^{N_s-1} w_j x_j = l$$

C. Solution Approach

The approach of divide and conquer algorithm is used to solve the problem. So the knapsack, l in our case, is divided into smaller knapsacks. Each smaller knapsack is filled with the most preferable item as far as possible. Any smaller knapsack can be filled with power from any source. So, to reduce size mismatches in our solution, the size of all the portions are made equal, let the size be w.

$$w_0 = w_1 = w_2 = w_{N_s-1} = w$$

For simplicity, we consider a constant load. So l doesn't change. Since all the smaller portions of l are equal in size and each one is exactly fulfilled by using amount of power equal to w, we can have

$$w\ N_A = l$$

where N_A is the number of smaller portions of l. Then we can have relation for N_A as

$$N_A = \frac{l}{w}$$

The availability of power in preferable sources keeps changing. For an arbitrary value of w, it is likely that the available power may not be in exact multiple of w. In order to use most of the available power, the value of w must be chosen carefully. Two conditions may occur

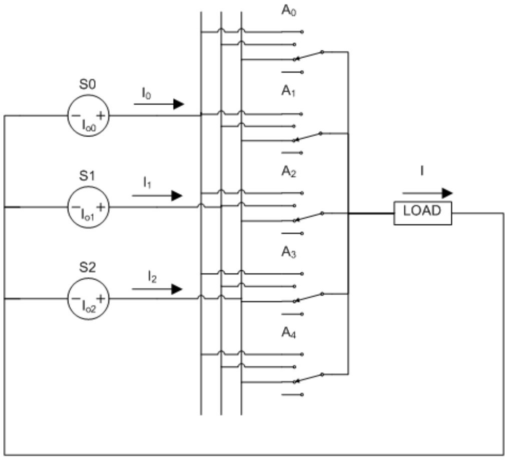
1) after taking power of quantity $(x_j\, w)$ from source j, there may be a surplus amount
2) the available power may be less than $(x_j\, w)$ and $((x_j - 1)\ w)$ may have to be taken leaving some surplus amount

If b_j is the present available power, in the above described cases, there is unused power which is given as

$$\text{unused power} = b_j - x_j\, w$$

The maximum unused power cannot be greater than w, because as soon as the unused power equals w, it will be used to fill a smaller knapsack, total power taken from that source will be

$$((x_j + 1)\ w)$$



$$I_n = \frac{1}{N_{AC}} \times N_{ACSn}$$

N_{AC} : no of agents connected
N_{ACSn} : no of agents connected to S_n

Figure 2: Multi-agent based solution concept

So, it can be inferred that the unused power can be reduced by reducing the value of w or increasing the number of smaller portions.

D. Algorithm Development

The first step is to determine the load, l, the system is required to fulfill and the acceptable error of unused power, w. And compute the number of smaller knapsacks N_A.

Each smaller portion of l is be filled with power from the most preferable source, if that is not available, then the next preferred source and so on. An agent is employed to fill each smaller portion of l. Each agent can choose to connect to any available power source. Figure 2 illustrates the concept of the solution. The connection is now dynamic.

Initially, each agent is connected to the least preferable source.

Because of the nature of the physical circuit, all the connected agents draw equal power from the source, the sum of which is equal to the load demand l.

Each agent checks the available power sources in descending order of preference starting at the most preferred one. When it makes a new connection, it compares the power it can draw from this new connection to the power it was drawing previously.

If the new value of power is greater than or equal to the previous value, it keeps the new connection.

Else, if the new value is smaller than the previous value, it leaves the connection and goes on to try other remaining sources.

If no source can satisfy the condition, the least preferable source will, because it is designed with enough capacity that can suffice the maximum load.

At any time, the load is fulfilled by combining the power each agent is drawing from the sources.

E. Algorithm

```
//Using l and w, compute number of agents required
$\mathrm{N_A} = \frac{\mathrm{l}}{\mathrm{w}}$
//INITIALIZATION for each agent
for $(\mathrm{a\_count} = 0 \text{ to } \mathrm{N_A} - 1)$ {
    $\mathrm{ics} = \mathrm{N_S} - 1$
}
//REPEAT for each agent
for $(\mathrm{a\_count} = 0 \text{ to } \mathrm{N_A} - 1)$ {
    read $\mathrm{pbd1_{a\_count}}$
    if $(\mathrm{pbd1_{a\_count}} \neq 0)${
        for(power source index s_count = 0 to $(\mathrm{N_S} - 1)${
        ics = s_count
        read $\mathrm{pbd2_{a\_count}}$
        if $(\mathrm{pbd2_{a\_count}} \geq \mathrm{pbd1_{a\_count}})${
            $\mathrm{pbd1_{a\_count}}$ = $\mathrm{pbd2_{a\_count}}$
            break loop
            }
        }
    }
}
$\mathrm{l} = \sum_{\mathrm{n}=0}^{\mathrm{n}=\mathrm{N_A}-1} \mathrm{pbd1_n}$
```

F. Experimentation

The agent based system is expected to deliver a higher utilization of preferred power source than fixed parallel connection based system. So, using Processing, a program was developed to implement the two systems and compute the utilizations of the sources in both the cases. For fixed parallel connection based system, the utilization of available power from source j is computed as

$$\mathrm{ut_{Sj\_p}} = \frac{\text{power drawn by load from source } \mathrm{S_j}}{\text{total power available in source} \mathrm{S_j}}$$

In the agent based system, w is chosen and the number of agents is computed as

$$\mathrm{N_A} = \frac{\mathrm{l_m}}{\mathrm{w_m}}$$

Each agent makes contribution of w power. The utilization of available power for a source j is computed as

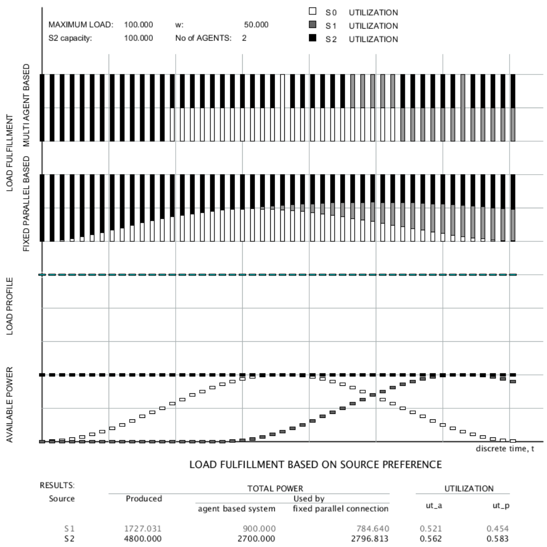
$$\mathrm{ut_{Sj\_a}} = \frac{\text{power drawn by connected agents from source } \mathrm{S_j}}{\text{total power available in source } \mathrm{S_j}}$$

For both cases, the available power was simulated using various waveforms that closely match the real world scenario. A load profile with constant demand was fed into the simulation.

IV. Results and Discussion

A. Results

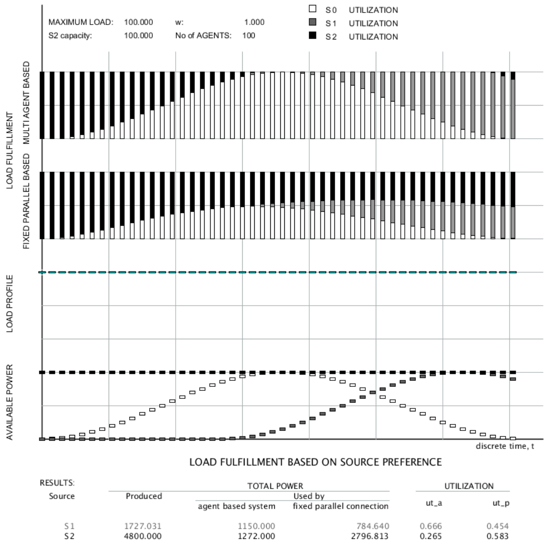
Three sources are considered, S0, S1 and S2, with S0 being the most preferred source. Figures 3 and 4 show simulation results for w=50 / $\mathrm{N_A}$ = 2 and w=1 / $\mathrm{N_A}$ = 100 for constant load. Each graph consists of waveforms for generated power for each of the source, the load profile and time sampling of the utilizations of the sources.



RESULTS:

Source	TOTAL POWER			UTILIZATION	
	Produced	Used by			
		agent based system	fixed parallel connection	ut_a	ut_p
S1	1727.031	900.000	784.640	0.521	0.454
S2	4800.000	2700.000	2796.813	0.562	0.583

Figure 3: Source utilization for w=50 / $\mathrm{N_A}$ = 2 with constant load profile



RESULTS:

Source	TOTAL POWER			UTILIZATION	
	Produced	Used by			
		agent based system	fixed parallel connection	ut_a	ut_p
S1	1727.031	1150.000	784.640	0.666	0.454
S2	4800.000	1272.000	2796.813	0.265	0.583

Figure 4: Source utilization for w=1 / $\mathrm{N_A}$ = 100 with constant load profile

The utilizations of 3 sources, as generated by the simulations for various values of w and $\mathrm{N_A}$ are tabulated in table I.

B. Discussion

The following conclusions can be made from the observations:

1) In cases, except for $\mathrm{w_m}$= 100 and 50 , the utilization of S0 achieved by the agent based system is higher,99%, than that obtained without any control mechanism which is simple fixed parallel based connection, only 50%.
2) Utilization of the most desired system increases as the value of $\mathrm{w_m}$ decreases or $\mathrm{N_A}$ increases.

The agent based system tries to closely follow the energy production and uses it as much as possible.

Table I: Comparison between utilization achieved by multi-agent based system and simple fixed parallel connection for constant load profile

			$\mathrm{ut}_{\mathrm{S0}}$		$\mathrm{ut}_{\mathrm{S1}}$		$\mathrm{ut}_{\mathrm{S2}}$	
SN	w	$\mathrm{N_A}$	_a	_p	_a	_p	_a	_p
1	100	1	0.042	0.508	0.058	0.454	0.958	0.583
2	50	2	0.500	0.508	0.521	0.454	0.562	0.583
3	20	5	0.808	0.508	0.718	0.454	0.338	0.583
4	15	6	0.847	0.508	0.724	0.454	0.316	0.583
5	10	10	0.900	0.508	0.712	0.454	0.294	0.583
6	8	12	0.931	0.508	0.695	0.454	0.285	0.583
7	5	20	0.954	0.508	0.686	0.454	0.276	0.583
8	3	33	0.971	0.508	0.677	0.454	0.271	0.583
9	2	50	0.980	0.508	0.671	0.454	0.269	0.583
10	1	100	0.991	0.508	0.666	0.454	0.265	0.583

Compared to the works the developed algorithm has the following advantages:

1) The algorithm requires no external data such weather predictions and estimations are required and depends upon local information only.
2) No single agent is a central component. They are homogeneous in nature and break down of one does not bring down the system.
3) A separate communication infrastructure is not required, agents decide upon a connection based upon the value of current they are drawing.

V. Conclusion And Recommendation

A. Conclusion

The method developed in this work increases the use of desired source the most to optimize factors such as cost and environmental impact. The problem is modeled as bounded knapsack problem model which is tackled by divide and conquer approach. An agent tries to optimally solve each sub problem. Using the multi-agent system, with parameters $\mathrm{N_A}$ = 100, w = 1, utilization increases to 99% which is only 50.8% in fixed parallel connection. The choice of the parameter w can affect the performance of the system. For w = 100, that is $\mathrm{N_A}$ = 1, the utilization is only 4%. While smaller value of w improves the utilization performance, the increase in the number of agents increase the cost.

B. Recommendation

This work considers constant load. Also, the power management systems in the papers discussed in literature review also had some form of energy storage systems to compensate the intermittency of the renewable energy source. So, as an improvement in the present work, a varying load profile, a more practical case, can be studied and the agent structure and behavior can be changed to accommodate the storage systems. This would store the energy produced by the most preferred source during low load and use it during high demand and low energy production by the most preferred source.

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Impact of Pico-hydropower plants on Rural Development (Gotikhel)

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ABSTRACT

With the assumption of, the development and promotion of Pico-hydro can eradicate poverty and uplift the social standard of people living especially in remote hills and mountains of the country. Introducing Pico-hydro will provide them access to TVs, radio, computer, and cottage industries etc., which definitely improve their living standard. This paper shows the social, economic and political advancement due to Pico-hydro in Gotikhel. Here to identify the impact of Pico-hydro in Gotikhel different historical data are collected for the qualitative and quantitative analysis, social, economic, political, impact in past and present are studied. And the study will cover KII and questionnaire method to study the households and its impact on their living standard. The importance of the study is to accumulate the information about the small-hydro communities. Similarly, to increase the interest of research on Pico or small hydro projects. The study will cover the sufficient range of literature review of Pico-hydro and Gotikhel from socio, economic and political development of Gotikhel.

Keywords: Pico-hydro, Environment, Vijuli Adda, Penstock, Micro-hydropower plant (MHP)

1. Introduction:

Hydropower is the term referring to electricity generated by hydropower, the production of electrical power through the use of the gradational force of falling or flowing water. It is now not a new knowledge that flowing water creates energy that can be captured and turned into electricity called hydropower.

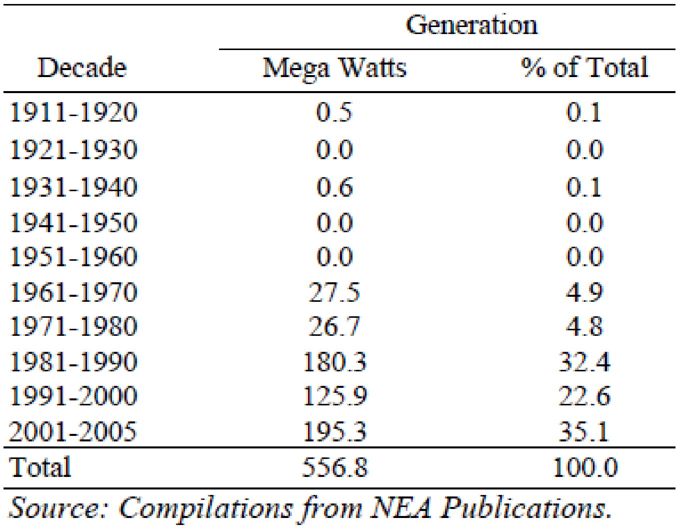
Hydropower can be generated in a range of sizes from a few hundred watts to over 10 GW. Small scale hydropower plants (up to 1000KW) play an immense role in meeting the energy needs and do not require huge investment and market requirements. Micro hydro or Pico hydro system (up to 100KW) operates by diverting part of the river flow through a penstock (or pipe) and a turbine, while drives a generator to produce electricity. Then water is again left in the river flow. Small scale hydro-plants are mostly run of the river system which allows the river flow to continue. In these plants, complex mechanical governing system is not required, which reduces costs and maintenance requirements.

2. Hydropower Status in Nepal (Literature Review)

Nepal is rich in water resource. Nepal has long range of mountains which leads to continuous flow of water in the river throughout the year. Nepal has one of the highest per-capita hydropower potentials in world. The estimated theoretical power potential is approximately 83,000 MW. However, the economically feasible potential has been estimated at approximately 43,000MW. A first hydropower plant 500KW was established in 1911 around more than 100 years ago.

Historically, the electricity sector in Nepal had been looked after by an electricity office known as, “Shree Chandra Jyoti Prakash Vijuli Adda” since the bikram sambat 1968 Jestha 9 (1911 AD). This office continued to exist for a long time even after demolition of rana regime; but it was named “ shree Tin Juddha Chandra Prakash Jyoti” after installation of a second hydropower plant in 1991B.S at sundarijal. It is only in year 2014/15 B.S the office carried the name “Electricity Department”. The present Department of Electricity Development (DoED) is the renamed organization of EDC since February 7, 2000 AD [7].

Decade wise Development of Hydropower is given in Table below.



	Generation	
Decade	Mega Watts	% of Total
1911-1920	0.5	0.1
1921-1930	0.0	0.0
1931-1940	0.6	0.1
1941-1950	0.0	0.0
1951-1960	0.0	0.0
1961-1970	27.5	4.9
1971-1980	26.7	4.8
1981-1990	180.3	32.4
1991-2000	125.9	22.6
2001-2005	195.3	35.1
Total	556.8	100.0

Source: Compilations from NEA Publications.

Figure (1): Decade wise Development of hydropower [6].

3. Possibility of small hydro in Nepal

According to Nepal Micro-Hydropower Association; the first micro hydropower plant of 5KW capacity was installed in Godavari, Kathmandu with the Swiss assistance in 1962 A.D. Since then around 3300 MHPs has been installed in the country. These mini/micro/Pico hydropower plants are generating close to 30000 KW of installed capacity to provide electricity for about 35000 households approximately.

At present due to availability of national grid, villages/communities are found to be attracted towards national grid rather than small hydro power in their locality. Local government should make such policies that people get attracted towards micro/Pico hydropower for investment. Instead, village and communities should be produce electricity through small-hydropower and connect their electricity to national grid, they will get money against sales of electricity. Government should bring schemes for this.

4. Merits of Small-hydropower in context of Nepal

- Once the plant is installed the cost for running the plant are very low and if the plant is well maintained it can work for many decades.
- Continuous operation day and night and under any wind conditions (not like solar or wind turbine) and every day, seasonal changes however can be anticipated (more water during winter and spring season, less water during this summer).

5. Limitations

- A necessary condition to install a micro-hydro plant is obviously to have available reliable water stream within a few hundred feet from the location of the residence on the land that belongs to the homeowner.
- One must be very careful not to harm the environment, leave the scenery as beautiful as it was, don't harm wildlife birds and fish as well as the local trees and shrubs.

6. Sample Study of Gotikhel Pico-hydropower plant

Gotikhel is a village and former village Development committee that is now a part of Mahankal Rural Municipality in Province no. 3 of Central Nepal. The Pico-hydropower plant is located at a distance of 40.2 KM from Satdobato Junction via Satdobato-Tikabhairab road.

7. Methodology

Questionnaires were made for operator, manager, manufactures and other related person to get an actual status of Pico-hydro plant.

8. Result and Discussions

Schemes	Capacity(kw)	Major technical Problem
Mahakal Bahuudyasya Ghatya Vijuali Utphadan Samuha (माहाकाल बहुउधेश्य घट्टे बिजुली उत्पादन समूह)	16 KW	➢ Intake washed off ➢ Land slide of canal ➢ Valve leakage ➢ Load unbalance ➢ Generator over heated

This Pico-hydro power plant was established on 2051(Aswin 6) B.S. The point person for this project was Mr. Keshab Prashad Ghimire. The project head engineer for this MHP was Er. Akalman Nakarmi (Mechanical Engineer studied in Switzerland). During that time their total cost of this project was about 23 lakhs. They have used 8 inch Diameter, 815 meter long pipe to carry water for penstock. Thus generated electricity was distributed to 152 households.

Story is different after the National grids have been reached to village. The entire household sifted towards the national grid in 2066 B.S. As grid power is continuous and free from technical issues with public. As there was maintenance and load unbalance problem in Pico-hydropower plant. Now this Pico-hydro is run by Mr. Keshab Ghimire himself and has started a small Rice mill utilizing the Pico electric power. It has given employment to 1 skill manpower.

However, this Pico-hydro has brought huge socio-economic and political impact to the village. This hydro connected to the village with outer world and raised lots of hope to the people living there.

Here in the below, before and after impact of Pico-hydro is shown along with socio-economic and political dimensions.

Dimensions	**Before**	**After**	**Remarks**
Social			
	Households used to use kerosene and fire woods. Lack of source of information. Less working hours.	Households got connected with electric energy. Access to information through Radio, television etc. Increase in working hours.	Less use of kerosene and fire woods after Pico hydro power. Society becomes more aware. People got involved early morning to late evening.
Economic			
	Orthodox agriculture. Dependent on household activities.	Equipped with modern agricultural techniques. They used to feed vegetables to cattle. Pico-hydro provided instant job for 4 people.	Impact of agricultural programs of radio, television etc. Started selling vegetables to near market. Pico hydro created job opportunity to 4 people.
Political			
	Literacy rate was below Were just the voters	Literacy rate increases. Now their representative is a ward chairperson (Ganga ram Timilsina)	Awareness towards education. Forward in political leadership.

Discussion: Sample study of Gotikhel shows that Pico-hydro had a significant impact on the development of Gotikhel. It is found that consumption of firewood had decrease. After that the children are found not to be engaged in wood collection for firewood. Similarly it was found that student have got more time to study during night. People in the society now have access to outer world through Information Communication and

Technology (ICT). Now people are also found to be engaged in other political and development activities. Thus, this study concludes that the MHP has positive impact on socio-economic and political development of rural communities.

9. Conclusions

Due to steep gradient and mountainous topography, Nepal is blessed with the abundant hydro resources. Having a theoretical potential of nearly about 90,000MW hydropower at least 42,000 MW is technically and economically feasible. Due to high mountains, Nepal has all seasons flowing river which is fortune for hydro-electric production.

If Nepal could emphasis on hydropower development it can uplift the living standard of people. Nepal has varying terrain due to which different small river flows at high current. If the rivers are equipped with micro or Pico hydropower then it can add a big economic progress in the nation’s development. Similarly, it can bring huge socio-economic and political upliftment in rural areas. After the production of micro or Pico hydro power; national grids electricity can be utilized for the pollution free industrial development.

Hence, Local government and central government should bring some scheme to invest local people on Pico or micro hydropower. This will not only bring socio-economic and political development in rural area but also becomes a big supporting economic factor for the nation.

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An Analysis of Heart Disease Prediction using Different Data Mining Techniques

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Abstract - **Data mining is one of the important fields of research whose significant goal is to find a useful pattern of data from large data sets. After analysing, the discovered pattern can be used to make decisions on a different field like healthcare industry. With the increase in worldwide population and evolution of different new diseases along with old diseases, healthcare industry produces numerous amounts of data on a regular basis. Heart disease is a word that collectively represents different medical disorder related to the heart and directly affects the heart. On treatment or during research, the healthcare industry collects numbers of data related to heart disease which contains hidden information that can be important in making decisions. With data mining techniques it is possible to analyse those data from different aspects to create a relationship among them. This paper works on the utilization of various decision tree algorithms of data mining in order to predict heart diseases.**

Keywords: Heart Disease, Naïve Bayes, Neural Networks, Decision Tree

I. INTRODUCTION

Data mining is one of the most crucial, powerful and motivating fields of research which involves extraction of helpful, meaningful and interesting information from a collection of data. It can also be introduced as the process of knowledge discovery from already existing information. The main concern behind the concept of data mining is finding hidden relationships among the data present in different area like business, scientific and medical to allow experts of those areas to make predictions for future use. Hence, the main goal of data mining is Extraction and Predictions. Data mining involves different techniques like classification, clustering, and association. Regarding medical research, it is one of very appropriate approach as it assists the medical researcher to predict and detect diseases by gaining knowledge from patient's database.

II. HEART DISEASE

The heart is one of the most important parts of our body. Improper operation of the heart will affect the other body parts of human such as brain, kidney etc. It supports life by its function of supplying blood throughout the body. Without proper working of the heart it’s impossible for any creature to live its life.

The term, Heart disease describes the disorders or malfunctioning of the heart. There are different forms of heart disease like heart attack, heart failure, Cardiomyopathies and so on. Despite the genetic problems, there are many factors which arise these types of disease like unhealthy lifestyle, lack of exercise, high cholesterol, high sugar level, and stress.

III. DATAMINING TECHNIQUES USED FOR PREDICTIONS

3.1. Decision Tree

Decision Tree is one of the popular machine learning algorithms which is more powerful for classification and regression problems. The main reason behind its popularity is that it imitates the level according to which human thinks, hence makes easier to understand. In a decision tree each node represents an attribute, each link represents a rule and each leaf represents an outcome.

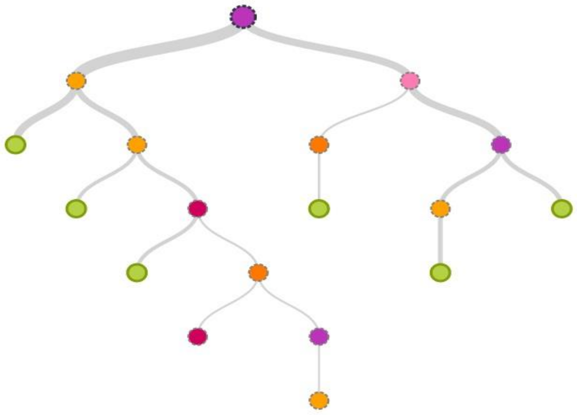

Figure 1 - Decision Tree

According to the description of the data, decision tree divides the given set of data into smaller data sets so that we get a set of data points that can be categorized in a specific set. This method uses number of algorithms to build a decision tree.

ID3

Developed by Ross Quinlan, it is an algorithm used to develop a decision tree from a given number of the data. The tree thus developed helps in making a decision.

C4.5

It was also developed by Ross Quinlan, and also known as an extended form of ID3, thus invented to develop a decision tree. The decision tree thus generated can be used for classification so it's often named as a statistical classifier.

C5.0

It is an extended form of C4.5 and similar to the previous version C4.5 it can be often used for classification. The only difference lies in the size of the tree and computation time.

J4.8

J4.8 is simply a C4.5 algorithm for generating a decision tree which can further be used in classification.

3.2. Neural Networks

Neural Networks in Artificial Intelligence is an information processing paradigm, inspired by the biological nervous system. The main idea behind neural networks is that it learns to perform tasks by considering examples.

Neural Networks are composed of highly interconnected processing elements known as Neurons.

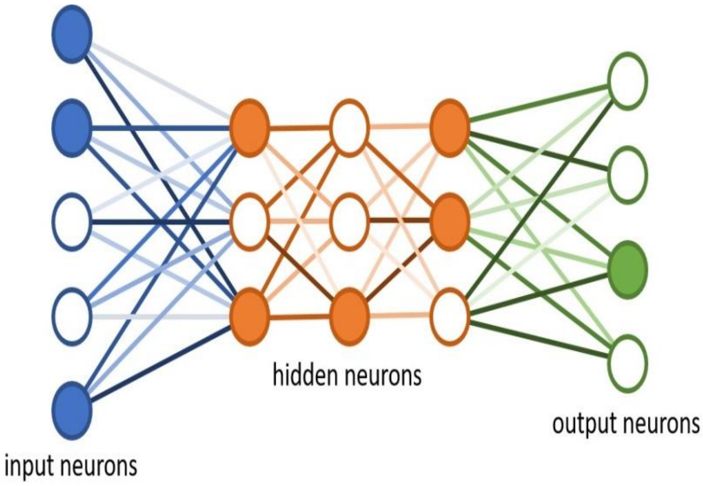

Figure 2- Neural Network

These Neurons receive input, change its internal state and produce output according to the input.

The main focus behind developing this concept is that it can be used to extract patterns that are almost impossible to detect by human beings or other any technique.

3.3. Naive Bayes

Naive Bayes is one of the simple and effective machine learning classifiers which is based on the Bayesian theorem. It is designed to get more accuracy when the input size is high. This algorithm assumes that the value of a particular feature doesn't depends of the value of any other feature on the given set of data.

Let's consider a hypothesis H and let E be the evidence. Now, according to the Bayes' Theorem the probability of H before getting E and the probability of H after getting E is:

$$P(H/E) = \frac{P(E/H)}{P(E)} P(H)$$

IV. LITERATURE REVIEW

Numerous researches have been done and numbers of algorithms were implemented in heart disease prediction by a number of authors. Different data mining algorithms were carried out on different data consisting of a different number of attributes. As per their work, they got their result but the accuracy on the prediction varies according to the attributes taken and method used. In this paper, we aim to analyse different data mining technique which has been used to predict heart disease.

P. Atul Kumar [1] has proposed the prediction using 14 attributes. the training data set and test data taken by him was 200 and 103 respectively. Tangara [8], used 3000 data instances with 14 attributes too. the data set was divided into two parts as 70% and 30% as training data and test data which was implemented [9] on these algorithms and the result of these algorithm were recorded.

K. Thenmozhi [3] proposed a prediction model for the Heart disease using 15 attributes [5]. The attributes taken in this model were age, sex, chest pain, resting blood pressure, serum cholesterol, resting electrographic, Fasting blood sugar, Maximum heart rate achieved, Exercise induced again, ST depression induced by exercise relative to, Slope of the peak exercise, Number of major vessels coloured by fluoroscopy, Defect type, obesity, and smoking. For the prediction of the heart disease, Naive Bayes, Decision Tree and Neural Networks techniques were used in this model.

M. Lavanya [4] proposed a prediction model for heart disease in the year 2016. The data were taken from South Africa. They proposed the model with 11 attributes. The attributes taken were a patient identification number, gender, cardiogram, age, chest pain, blood pressure level, heart rate, cholesterol, smoking, alcohol consumption, and blood sugar level. J48 decision tree, Naive Bayes and Artificial Neural Networks technique were used in the prediction technique.

B. Nidhi [7] has used 13 attributes and then reduced the attributes into 6 and implemented the different algorithms for their result.
The different results have been summarized in the table below.

Techniques Used	**Accuracy (%) Different number of Attributes**				
	6	11	13	14	15
Decision Tree	96.6	91.85	94.44	52.33	90.74
Naive Bayes	99.2	85.92	96.66	52	99.62
ANN	85.53	99.25	99.23	45.67	100

Table 1: Comparison of accuracy with Attributes

V. CONCLUSION

On analysing the data, we got from different papers we can see that Neural Networks techniques provide high accuracy on comparison with Decision tree and Naive Bayes. The number and type of attributes taken were different so we can say that accuracy depends on what and how many attributes were taken.

On comparing these facts. The attributes taken are more common and some differs. Those which differs may have affected the efficiency. The papers have not clearly stated the effect of single attribute to classifier result so the difference on these attributes may have changed the results from one another.

Similarly, the amount of data taken to train the system and the amount of data used for testing makes the difference in the accuracy and results of predicting the heart disease.

Hence, we can conclude that for the classification, the selection of proper attributes is the major concern. There may be many other attributes like family history, job class etc. which can directly effect the occurrence of heart diseases. So, by this study we can suggest that effect of single attribute and other highly affecting attributes can be involved in the classification for the better results. Similarly, we can also say that the number of data sets taken to train the system will always vary the accuracy. The more the training data, the more will be the accuracy in classification.

Thus, by this study, we can conclude that, Artificial Neural Network is best in classification technique with large data set for training the system and with appropriate set of attributes.

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Vision Based Motorcycle Monitoring at Intersection of Nepal Roads

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Abstract—**Computer vision plays important role in Intelligent Transportation System (ITS) for traffic management and surveillance. This paper implements existing vision-based detection and tracking algorithms to detect and track motorcycles. While few research has been carried out for vehicle detection, but no research has been carried as far known for tracking vehicle in Nepal roads at intersections.GMM and Haar Cascade Classifier method are used for detection.Results show that contextual combination in bike detection gets 89% for sensitivity, 60 % for precision and 0.72 for F1-score. Low precision is due to high false positive in detection of every frame in video. The optical flow tracking with Haar detections rejects false positive which was high detected in detection process. This tracking improves all performance metrics: Sensitivity, precision, F1-score and accuracy. While tracking with optical flow gets 86.96% for sensitivity, 95.23 % for precision, 83.3 % for accuracy.**

Keywords: GMM, Haar, Intelligent Transport System, Optical Flow,Tracking

I. Introduction

Video surveillance helps to monitor activities, behavior in an environment to identify, control all activities in an automated way. With the help of video surveillance different suspicious, behavioral activities may be controlled. With restructuring and developing city as smart city, Intelligent Transportation System (ITS) plays a major role. Great advancement and growth in technology is being reflecting in transportation system (road section) which helps to plan, design intersection at major highways.Traditionally spot sensors as loop detectors were used but traffic monitoring system using computer vision makes possible to provide flow, speed, vehicle classification and detection of abnormalities at the same time[1].

Due to continuous development in computer vision algorithms, a machine can understand and evaluate situation at surveillance. This finds large application in traffic monitoring. This helps transportation personnel and decision makers to plan for transportation engineering in growing city having smart city concept. Traffic intersections are well-known targets for monitoring because intersections are characterized by their complex nature where different vehicles, pedestrians interact. Accidents at intersections are extremely dangerous. Cars, two-wheelers are particularly exposed to accidents at intersections[2]. Regardless of geometry of intersections or the meteorological conditions, human decision remain most critical factors. Active sensors like RADAR, LIDAR and passive sensors like camera are used for traffic monitoring. In Nepal, there is no clear distinct lane separation in major highways.

In developing countries like Nepal, heterogenous traffic consist of vehicles with varying dynamics and space requirements sharing the same road space. But in developed countries (United States, Europe), the homogenous traffic flow is formulated.for motorized two-wheel and four-wheel road traffic. Regarding unsignalized intersections, the traffic behavior patterns in developing countries is different than that of developed countries. The intersections at Nepal highways are blocked by drivers trying to “cut the corners” and don’t tend to wait for gaps. Gap acceptance behavior is uncommon at unsignalized intersections (even signalized intersections) in Nepal. For example, a motorcyclist judges whether the gap between motorcycle and other vehicle is acceptable to progress. Another motorcyclist in same situation would have a different width acceptance. People loosely follow lane discipline but more efficient use of road space in heterogenous traffic.

This paper employs contextual combination of GMM and Haar detection algorithms on motorcycles and motorcycle is tracked after being detected at intersection of roads by optical flow.

II. Literature Review

Detecting vehicles, pedestrian finds great application in traffic monitoring at intersections of highway. Appearance model like Histogram of Oriented Gradient (HOG), Haar, Local Binary Patterns (LBP) are detection methods that depends on database with positive and negative images. HOG was used in first for human detection[3].HOG descriptor assumes that the local object appearance and shape within an image is described by distribution edge directions. Then extracted features are feed to Support Vector Machine (SVM) to classify bike and non-bike type. Positive database contains object to be detected and negative database contains object not to be detected[3].The images with high resolution can be easily extracted from a low-resolution image. Motion based model exist for detection of vehicle. Traditional approach uses mean and median of previous frame and which gets blurring with time.

Gaussian Mixture Model (GMM) is one of the most popular motion detecting method which is robust over lighting change[4]. GMM method is detection method that compares between foreground object and background object. This algorithm is used to perform the background subtraction process because it is reliable towards light variances and repetitive object detection.Each pixel in an image is mixture of Gaussians. Based on variance of each of the Gaussians, pixel is classified as background or not.If pixels don't fit distribution of Gaussian pixel classified as foreground object.

Tracking vehicle in surveillance video is challenging task due to varying illumination, shadows. Many methods have proposed for tracking the vehicle. Tracking estimates the trajectory of object of interest frame to frame in a video. In computer vision, object detected in one frame of video is independent of object detection in the consecutive frame. It's important to relate previous frame with current frame with same object detected in current frame.[5] used for Kalman filter for tracking multi-object. Lukas-Kanade[6] tracker estimates the motion vectors in each frame of video sequences. By thresholding the motion vectors, model creates binary feature image containing blobs of moving objects and track vehicles in the region of interest (ROI). Optical flow is robust and fast over Kalman filter and small motion of particular pixel can be obtained.

III. Methodology

The system detects and tracks the motorcyclist on intersections of highways with data obtained from video surveillance. This system gives an overview how detection and tracking of vehicle at signalized (unsignalized intersections) are associated. The Figure 1 is a graphical view of this approach for traffic monitoring in videos. Videos collected from intersection in Nepalese highways will be used to detect the motorcyclist using motion as well as appearance features. To get the trajectory of the motorcycles over time optical flow is used.

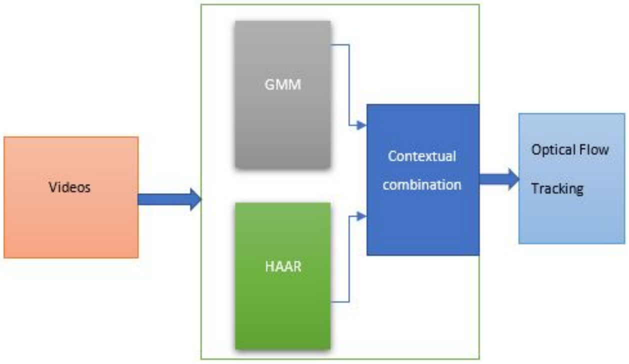

Figure 1: System Overview

A. Description of Data

For this study, video was downloaded from internet recorded of average 3-4 minutes at Trichandra -Kamaladi road intersection of 30 frames per seconds. The data set was collected on July 8, 2015 around 6:00 PM by CCTV. People drive by paying less attention to upcoming vehicles while merging in highways. Training data for positive samples and negative samples is obtained by cropping from videos and other publicly available datasets (ImageNet, PascalVOC 2008, Caltech dataset).

B. Motorcyclist Detection

Gaussian Mixture Model is one of the most popular schemes for background subtraction because it adapts to complex environment. It has ability to handle slow illumination changes, water-light reflection, slow and periodic object motion[7].GMM is a density model that consists of several Gaussian component functions. Each pixel in an image frame is modeled as K Gaussian distribution. Each pixel in the frame will be compared with model formed with GMM. Each Gaussian model represents a different pixel color. Pixels with similarity values under the standard deviation and highest weight factor were considered as background, while higher standard deviation and lower weight factor considered as foreground[8]. For each image frame, each pixel is matched with K Gaussian distribution model. The probability that the current pixel fits a particular Gaussian distribution from the mixture is:

$$P(x_t) = \sum_{i=0}^{K} w_{i,t} * \eta(X_t, \mu_{i,t}, \sum i, t) \tag{1}$$

where $w_{i,t}$ is the i^{th} Gaussian in the mixture at time t. A pixel match with one of Gaussian distribution model if it is included in 2.5 standard deviation range. If pixel has value beyond 2.5 deviation standard, then the pixel is declared as unfit to the Gaussian distribution model.

$$\mu_k - 2.5 * \sigma_k < X_t < \mu_k + 2.5 * \sigma_k \tag{2}$$

C. Cascaded Haar Classifier

The purpose of this step is to find reduced ROI of motorbike after background subtraction with Gaussian Mixture Model. Haar features are kind of descriptors that calculates the edges and lines of the object[9]. To ensure the balance between higher detection rate and false positive rate, cascade classifier is ensured to maximize the possibility of including all target objects. Haar- Like is a rectangular simple feature used as an input feature for cascaded classifier. When applying filters to region of interest of the image, the pixels sum under white areas are subtracted from the pixel sums under the black area. Weight of white and black area can be considered as "1" and "-1" respectively.

The concept of integral image is used for calculating Haar-like feature by Viola &Jones recognized which Haar-like feature among the other Haar-Likes is in each image. Integral image helps to calculate Haar-like feature.First, integral image is calculated after GMM then learning algorithm selects rectangular feature which separates positive and negative samples. Such Haar-like feature found by calculating difference in pixel intensities between the bright area to dark area using integral image. The area is considered as feature of object if the difference is greater than the threshold. Samples that are labelled correctly will be used to train for next stage. At

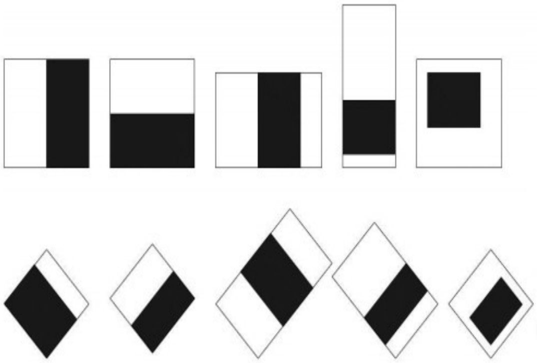

Figure 2: Different Kinds of filters based on Haar-Like Features [10]

the end after a number of stages, strong cascade classifier is developed. Cascaded classifier improves the processing speed. At first, using Viola Jones algorithm in motorcyclist detection, cascade file is trained separately by OpenCV and XML is provided. Haar feature is trained with 990 positive and 5000 negative samples of image dataset and XML files. This helps to classify motorcyclist from non-motorcyclist type.

D. Contextual Combination

Both GMM and Haar-like features work in entirely different principles as motion-based vs appearance based. Such as article[4][8]found motion to be more suitable for detecting traffic than appearance, however, in our case a motorcyclist might come to state of rest while merging where motion detection might failed to detect those vehicles in rest so we are using the appearance features. When both of them are acting, we draw a reliable bounding box for detecting motorcyclist using haar and GMM.

E. Motorcyclist Tracking

Tracking estimates the trajectory of object of interest throughout the video. GMM and Haar features used for detection, and vehicles (motorcycles) is tracked on the detection information available in this system. When an object is tracked which was detected in previous frame, the appearance of object is a lot known. Tracking an object uses information while detection starts from scratch. For this Lucas-Kanade optical flow method is used which detects whether new bike or previous being tracked bike. New BikeID is assigned to every new detected bike and tracker is deleted after the bike leaves the frame.

IV. Results and discussions

Detection algorithm and tracking algorithm is applied to test video. At first test video is applied to Gaussian Mixture Model which separates foreground from frame of video. Then Haar algorithm is used to extract features from GMM processed frame. After applying contextual combination of detection algorithms, multiple bikes are detected.

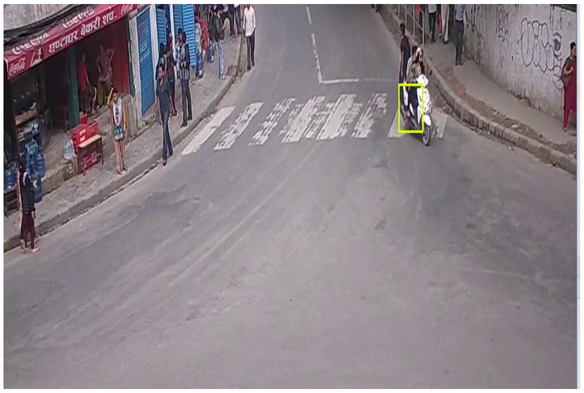

Figure 3: Detecting motorbike after applying Haar algorithm

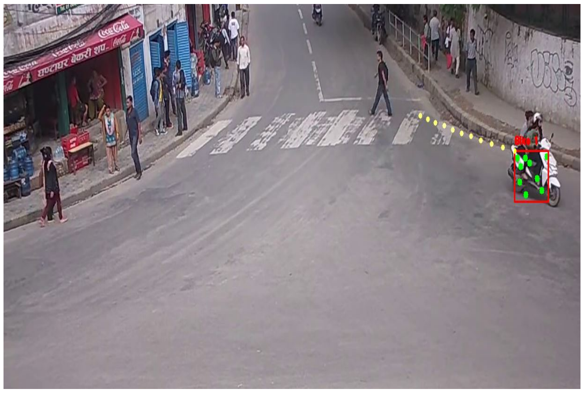

Figure 4: Motorbike ID 1 Tracking Result

In figure 4, yellow dot line shows the trajectory of bike ID 1 while tracking.Motorbike tracking determines the ability of the system in tracking after detection. This tracking follows after the result of detection. When there are multiple motorbikes present in frame of video , then it tracks those motorbikes assigning unique bike ID.

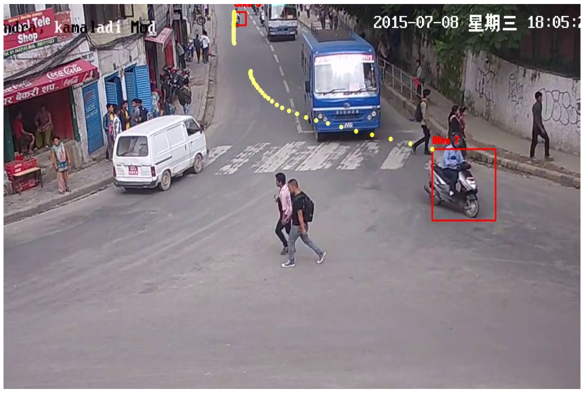

Figure 5: Two Motorbikes being tracked

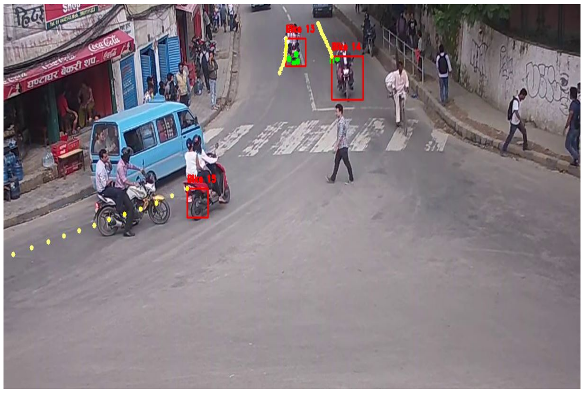

Figure 6: Another example of Multiple Motorbikes being tracked

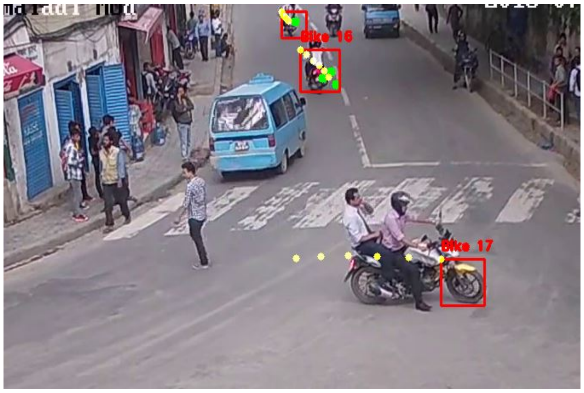

Figure 7: Bike detected and tracked - previously not tracked

Bike which is in motion near by blue microbus is not detected at this frame but it is detected and tracked in other frames Figure 7. Bike should be detected as it enters the frame but this system detects and tracks bike in some other point rather than entry point. So in tracking figures, yellow dot lines of trajectory of bike begins at other point than entry point. If a bike's tracking doesn't begin at entry point of frame, it is detected and tracked at other frames of a video.

To evaluate the classifiers performance, recall, precision and accuracy were used. True Positive (TP), number of images correctly classified as motorcycles; false positives (FP), the number of images wrongly classified as motorcycles; false negative(FN), the number of images wrongly classified as non-motorcycles and true negative(TN), the number of images correctly classified as non-motorcycle.

$$Recall = \frac{TP}{TP+FN} \tag{3}$$

$$Precision = \frac{TP}{TP+FP} \tag{4}$$

$$Accuracy = \frac{TP+TN}{TP+FP+FN+TN} \tag{5}$$

$$F1 = \; 2 * \frac{Precision * Recall}{Precision + Recall} \tag{6}$$

Table I: Result of Bike Detection

True Positive(TP)	True Negative(TN)	False Positive(FP)	FN
24	0	16	3

Recall (Sensitivity) = 0.89
Precision = 0.6
F1-Score = 0.72
False positive detections is high in algorithm. Such false positives is minimized while tracking such detection by optical flow.

Table II: Bike Tracking Testing Result

Tracked	True Positive(TP)	True Negative(TN)	False Positive(FP)	FN
21	20	0	1	3

Recall (Sensitivity)= 86.96%
Precision = 95.23%
F1-Score= 0.91
Accuracy = 83.3 %
The accuracy of bike tracking obtained is 83.3%. The bike that is detected and tracked at the frame is counted. The calculation of motorcycle occurs if the motorcycle is detected as new object rather than the motorcycle similar to existing bike on the previous frame.

V. Conclusion

In this paper, video at intersections of road is provided surveillance level view of motorbikes for different computer vision algorithms. Adaboost cascaded Haar classifier using Haar features is implemented with background detection. Incorporating optical flow tracking on contextual combination of HAAR and GMM not only increases the sensitivity, precision, F1-score but also increases accuracy than Haar detection. Since high false positive in Haar detection only, object detection is checked at every 30 frames for tracking purpose. While doing this approach,very few bikes are missed in detection. Optical flow was found to be better at rejecting noisy detections.

Finally a method is demonstrated to a surveillance scene using contextual combination of detection and optical flow tracking results.

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A Methodological Approach For Analysis, Design And Deployment Of Data Warehousing And Business Intelligence

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ABSTRACT

Leading organizations are using a set of theories and technologies that converts raw data into useful information for the business use. They are seeking new, smarter ways to improve performance, grow revenue, develop stronger customer relationships and increase workforce effectiveness – and they expect individuals in every role to contribute to these outcomes. Business intelligence is a key factor in achieving such results because it supports informed decision making at every level, enabling managers, executives and knowledge workers to take the most effective action in a given situation. This paper not only explores the underlying issues and the development of information technology that provide business intelligence ,it also provides an actionable insight on how to plan, build, and deploy business intelligence and data warehousing solutions.

KEYWORDS: Business Intelligence, Data Warehouse, DBMS, ETL, OLTP, OLAP

1. INTRODUCTION:

The principal reason why businesses need to create Data Warehouses is that their corporate data assets are fragmented across multiple, disparate applications systems, running on different technical platforms in different physical locations. This situation does not enable good decision making. When data redundancy exists in multiple databases, data quality often deteriorates. Poor business intelligence results in poor strategic and tactical decision making. Individual business units within an enterprise are designated as "owners" of operational applications and databases. These "organizational silos" sometimes don't understand the strategic importance of having well integrated, non-redundant corporate data. Consequently, they frequently purchase or build operational systems that do not integrate well with existing systems in the business. Due to globalization, mergers and outsourcing trends, the need to integrate operational data from external organizations has arisen. The sharing of customer and sales data among business partners can, for example, increase business intelligence for all business partners.

The challenge for Data Warehousing is to be able to quickly consolidate, cleanse and integrate data from multiple, disparate databases that run on different technical platforms in different geographical locations.

2. BI CONCEPT:

The concept of Business Intelligence (BI) is brought up by Gartner Group since 1996. It is defined as the application of a set of methodologies and technologies, such as J2EE, DOTNET, Web Services, XML, data warehouse, OLAP, Data Mining, representation technologies, etc, to improve enterprise operation effectiveness, support management/decision to achieve competitive advantages. Business Intelligence by today is never a new technology instead of an integrated solution for companies, within which the business requirement is definitely the key factor that drives technology innovation. How to identify and creatively address key business issues is therefore always the major challenge of a BI application to achieve real business impact. (Golfarelli et.al, 2004) defined BI that includes effective data warehouse and also a reactive component capable of monitoring the time critical operational processes to allow tactical and operational decision-makers to tune their actions according to the company strategy.(Gangadharan and Swamy, 2004) define BI as the result of in-depth analysis of detailed business data, including database and application technologies, as well as analysis practices. (Gangadharan and Swamy, 2004) widen the definition of BI as technically much broader tools, that includes potentially encompassing knowledge management, enterprise resource planning, decision support systems and data mining. BI includes several software for Extraction, Transformation and Loading (ETL), data warehousing, database query and reporting, (Berson et.al, 2002; Curt Hall, 1999) multidimensional/on-line analytical processing (OLAP) data analysis, data mining and visualization. The capabilities of BI include decision support, online analytical processing, statistical analysis, forecasting, and data mining.

3. BI COMPONENTS:

3.1. Advanced Analytics:

It is referred to as data mining, forecasting or predictive analytics, this takes advantage of statistical analysis techniques to predict or provide certainty measures on facts.

3.2. Corporate Performance Management (Portals, Scorecards, Dashboards):

This general category usually provides a container for several pieces to plug into so that the aggregate tells a story. For example, a balanced scorecard that displays port lets for financial metrics combined with say organizational learning and growth metrics.

3.3. Conformed Dimension:

A conformed dimension is a set of data attributes that have been physically implemented in multiple database tables using the same structure, attributes, domain values, definitions and concepts in each implementation.

Unlike in operational systems where data redundancy is normally avoided, data replication is expected in the Data Warehouse world. To provide fast access and intuitive "drill down" capabilities of data originating from multiple operational systems, it is often necessary to replicate dimensional data in Data Warehouses and in Data Marts. Un-conformed dimensions imply the existence of logical and/or physical inconsistencies that should be avoided.

3.4. Data Warehouse and data marts:

The data warehouse is the significant component of business intelligence. It is subject oriented, integrated. The data warehouse supports the physical propagation of data by handling the numerous enterprise records for integration, cleansing, aggregation and query tasks. It can also contain the operational data which can be defined as an updateable set of integrated data used for enterprise wide tactical decision-making of a particular subject area. It contains live data, not snapshots, and retains minimal history. Data sources can be operational databases, historical data, external data for example, from market research companies or from the Internet), or information from the already existing data warehouse environment. The data sources can be relational databases or any other data structure that supports the line of business applications. They also can reside on many different platforms and can contain structured information, such as tables or spreadsheets, or unstructured information, such as plaintext files or pictures and other multimedia information. A data mart as described by (Inmon, 1999) is a collection of subject areas organized for decision support based on the needs of a given department. Finance has their data mart, marketing has theirs, and sales have theirs and so on. And the data mart for marketing only faintly resembles anyone else's data mart. Perhaps most importantly, (Inmon, 1999) the individual departments own the hardware, software, data and programs that constitute the data mart. Each department has its own interpretation of what a data mart should look like and each department's data mart is peculiar to and specific to its own needs. Similar to data warehouses, data marts contain operational data that helps business experts to strategize based on analyses of past trends and experiences. The key difference is that the creation of a data mart is predicated on am specific, predefined need for a certain grouping and configuration of select data. There can be multiple data marts inside an enterprise. A data mart can support a particular business function, business process or business unit. A data mart as described by (Inmon, 1999) is a collection of subject areas organized for decision support based on the needs of a given department. Finance has their data mart, marketing has theirs, and sales have theirs and so on. And the data mart for marketing only faintly resembles anyone else's data mart. BI tools are widely accepted as a new middleware between transactional applications and decision support applications, thereby decoupling systems tailored to an efficient handling of business transactions from systems tailored to an efficient support of business decisions.

3.5. Data Sources:

Data sources can be operational databases, historical data, external data for example, from market research companies or from the Internet), or information from the already existing data warehouse environment. The data sources can be relational databases or any other data structure that supports the line of business applications. They also can reside on many different platforms and can contain structured information, such as tables or spreadsheets, or unstructured information, such as plaintext files or pictures and other multimedia information.

3.6. Information Databases:

3.6.1. OLAP (On-line analytical processing):

It refers to the way in which business users can slice and dice their way through data using sophisticated tools that allow for the navigation of dimensions such as time or hierarchies. Online Analytical Processing or OLAP provides multidimensional, summarized views of business data and is used for reporting, analysis, modeling and planning for optimizing the business. OLAP techniques and tools can be used to work with data warehouses or data marts designed for sophisticated enterprise intelligence systems. These systems process queries required to discover trends and analyze critical factors. Reporting software generates aggregated views of data to keep the management informed about the state of their business. Other BI tools are used to store and analyze data, such as data mining and data warehouses; decision support systems and forecasting; document warehouses and document management; knowledge management; mapping, information visualization, and dash boarding; management information systems, geographic information systems; Trend Analysis; Software as a Service (SaaS).

3.6.1.1. Data Cubes:

The main component of these systems is a OLAP cube. A cube consists in combining data warehouse’s structures like facts and dimensions. Those are organized as schemas: star schema, snowflake schema and fact constellation. The merging of all the cubes creates a multidimensional data warehouse.

3.6.2. OLTP (On-line transaction processing):

Online Transaction Processing is a information system type that prioritizes transaction processing, dealing with operational data. This kind of computer systems are identified by the large number of transactions they support, making them the best to address online application. The main applications of this method are all kind of transactional systems like databases, commercial, hospital applications and so on.

3.7. Real time BI:

It allows for the real time distribution of metrics through email, messaging systems and/or interactive displays.

4. Data Warehouse

This component of our data warehouse architecture (DWA) is used to supply quality data to the many different data marts in a flexible, consistent and cohesive manner. It is a *'landing zone'* for inbound data sources and an organizational and re-structuring area for implementing data, information and statistical modeling. This is where business rules which measure and enforce data quality standards for data collection in the source systems are tested and evaluated against appropriate data quality business rules/standards which are required to perform the data, information and statistical modeling described previously.

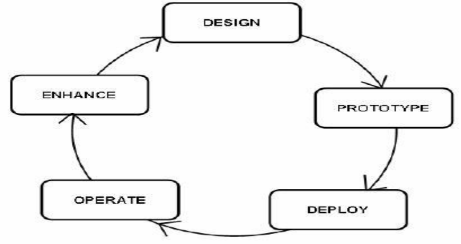

Figure: DW Development Lifecycle

Inbound data that does not meet data warehouse data quality business rules is not loaded into the data warehouse (for example, if a hierarchy is incomplete). While it is desirable for rejected and corrected records to occur in the operational system, if this is not possible then start dates for when the data can begin to be collected into the data warehouse may need to be adjusted in order to accommodate necessary source systems data entry "re work". Existing systems and procedures may need modification in order to permanently accommodate required data warehouse data quality measures. Severe situations may occur in which new data entry collection transactions or entire systems will need to be either built or acquired. We have found that a powerful and flexible extraction, transformation and loading (ETL) process is to use Structured Query Language (SQL) views on host database management systems (DBMS) in conjunction with a good ETL tool such as SAS ETL Studio. This tool enables us to perform the following tasks:

•The extraction of data from operational data stores

•The transformation of this data

•The loading of the extracted data into the data warehouse or data mart.

When the data source is a "non-DBMS" data set it may be advantageous to pre-convert this into a SAS data set to standardize data warehouse metadata definitions. Then it may be captured by SAS ETL Studio and included in the data warehouse along with any DBMS source tables using consistent metadata terms. SAS data sets, non-SAS data sets, and any DBMS table will provide the SAS ETL tool with all of the necessary metadata required to facilitate productive extraction, transformation and loading (ETL) work. Having the ability to utilize standard structured query language (SQL) views on host DBMS systems and within SAS is a great advantage for ETL processing. The views can serve as data quality filters without having to write any procedural code. The option exists to "*materialize"* these views on the host systems or leave them *"un-materialized"* on the hosts and *"materialize"* them on the target data structure defined in the SAS ETL process. These choices may be applied differentially depending upon whether you are working with "current only" or "time series" data. Different deployment configurations may be chosen based upon performance issues or cost considerations. The flexibility of choosing different deployment options based upon these factors is a considerable advantage.

4.1. Data Mart:

A Data Mart is a subset of data from a Data Warehouse. Data Marts are built for specific user groups. They contain a subset of rows and columns that are of interest to the particular audience. By providing decision makers with only a subset of the data from the Data Warehouse, privacy, performance and clarity objectives can be attained. There are different types of Data Marts. A Data Mart can be a physically separate data store from the Corporate Data Warehouse or it can be a logical "view" of rows and columns from the Warehouse.

4.2. Data Dimension:

A Data Dimension is a set of data attributes pertaining to something of interest to a business. Dimensions are things like "customers", "products", "stores" and "time". For users of Data Warehouses, data dimensions are entry points to numeric facts (e.g. sale, profit, revenue) that a business wishes to monitor. For example, a business might want to know how may blue widgets were sold at a specific store in Los Angeles last month. A data dimension can be hierarchical. For example, "days" can be grouped into "months", "months" into "quarters" and quarters into "fiscal years" or "calendar years". This allows fact data to be easily aggregated, summarized and presented.

4.3. Data Warehousing:

Data Warehousing encompasses a series of tools, technologies and processes that are used to extract data from a series of operational systems, cleanse and integrate that data and make it available to end users via a set of Data Marts and Data Warehousing Tools.

4.3.1. ETL (Extract Transform Load) Technology:

ETL technology is used to extract data from source databases, transform and cleanse the data and load it into a target database. ETL is an important component in the set Data Warehousing technologies.

The principal difference between ETL and conventional methods of moving data is its ease-of-use. A user friendly graphical interfaces is available to quickly map tables and columns between the source and target databases. This is much faster than having to write and maintain conventional computer programs. ETL also provides functionality to transform data values. For example, a source system might store months of the year as "01", "02"... "12" whereas another system might use a different convention (e.g. "Jan", "Feb"... "Dec"). ETL facilitates transformation of data values which is very important when data is being consolidated from multiple systems.

ETL technology can migrate data from different types of data structures (e.g. databases, flat files) and across different platforms (e.g. mainframe, server). It is also able to identify "delta" changes as they occur. This allows ETL tools to copy only changed data, rather than having to do full data refreshes that can take much time and degrade system performance. Consequently, ETL can copied operational databases into Data Warehouses environments in real-time or near real-time.

4.4. System Design:

One of the main aims of the data warehouse is to extract data from different OLTP or flat files sources and consolidate them in a single repository for easy access and make best of use of the data. The two processes of data warehouse are data load and access. The design of the system was very robust in order for the aim to be achieved. The loading of the data warehouse was done through the use of ETL (Extract, Transformation and Load) process.

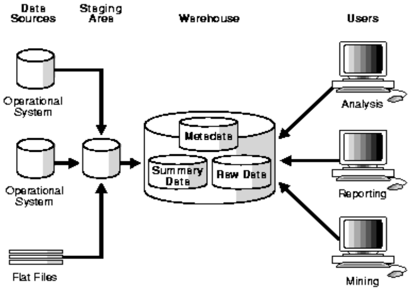

Figure: Data Warehouse Architecture Design

Above is the architectural design for the data warehouse and business intelligence using a staging area. A staging area simplifies building summaries and general warehouse management.

4.5. Dimensional Model or Star Schema:

A Dimensional Model is a database structure that is optimized for online queries and Data Warehousing tools. It is comprised of "fact" and "dimension" tables. A "fact" is a numeric value that a business wishes to count or sum. A "dimension" is essentially an entry point for getting at the facts. Dimensions are things of interest to the business. Dimensional Models are designed for reading, summarizing and analyzing numeric information, whereas Relational Models are optimized for adding and maintaining data using real-time operational systems.

4.5.1. Fact Table:

A Fact Table in a dimensional model consists of one or more numeric facts of importance to a business. Examples of facts are as follows:

1. the number of products sold
2. the value of products sold
3. the number of products produced
4. the number of service calls received

Businesses have a need to monitor these "facts" closely and to sum them using different "dimensions". For example, a business might find the following information useful:

1. the value of products sold this quarter versus last quarter
2. the value of products sold by store
3. the value of products sold by channel (e.g. phone, Internet, in-store shopping)
4. the value of products sold by product (e.g. blue widgets, red widgets)

Businesses will often need to sum facts by multiple dimensions:

1. the value of products sold store, by product type and by day of week
2. the value of products sold by product and by channel

In addition to numeric facts, fact table contain the "keys" of each of the dimensions that related to that fact (e.g. Customer Number, Product ID, Store Number). Details about the dimensions (e.g. customer name, customer address) are stored in the dimension table (i.e. customer).

4.6. Relational Model:

A Relational Database is a set of database tables that are related using keys from other database tables. A relational model can be "normalized" or "de-normalized. When a relational model is normalized, redundant data is removed from tables and additional tables are implemented. Most operational applications today use relational databases. As a business evolves, columns can be added to tables and new tables can be added to the database. Relational databases are stable, flexible and work well for online transaction processing. Due to the relatively high volume of tables, complex computer programs are needed to navigate the tables to obtain meaningful information. The need to "join" multiple tables can also create performance issues. Consequently, relational databases are often not ideal for online queries and for reporting, particularly when the volume of data in the database is large.

Most Data Warehousing applications, therefore, are built using dimensional models.

4.7. Meta Data:

Meta data is simply data about data. It includes a definition of each field in the Data Warehouse and the corresponding domain values. Meta data describes where the data came from and how it was transformed or cleansed during the data integration process. Because warehouse data can originate from multiple sources and is used for critical decision making, it is important that data definitions be clear and accessible to all Data Warehouse users.

5. ANALYSIS-DESIGN-DEPLOYMENT TOOLS:

The tools discussed here are front-end tools that are available to transform data in a Data Warehouse into actionable business intelligence. The use of appropriate Data Warehousing tools can help ensure that the right information gets to the right person via the right channel at the right time.

5.1. Automated Alerts:

Custom built and purchased application systems can be implemented to examine data in a Data Warehouse and initiate system generated alerts when predefined thresholds are reached, or when expected results are not attained. Alerts can be sent via an email, phone message or an electronic workflow item to the appropriate decision maker. The rules for triggering automated alerts can easily be adjusted as business requirements change.

5.2. Data Mining Tools:

Data Mining Tools are analytical engines that use data in a Data Warehouse to discover underlying correlations. Data Mining Tools are used by analysts to gain business intelligence by identifying and observing trends, problems and anomalies. Because the business environment is so dynamic, it is often difficult for businesses to quickly identify emerging patterns or trends. Data Mining Tools help businesses identify problems and opportunities promptly and then make quick and appropriate decisions with the new business intelligence.

5.3. Excel Spreadsheets:

These are frequently used in Data Warehousing applications to access and present data from Data Marts. Spreadsheets are powerful, flexible and relatively inexpensive tools that many decision makers are comfortable using. Before Data Warehousing became popular, decision makers often had difficulty getting access to corporate data. It was necessary to populate spreadsheets from multiple disparate data sources and manually integrate the data. This process was both time consuming and error-prone.

The use of Excel Spreadsheets to present and analyze data from Data Warehouses is an inexpensive and flexible method for sharing business intelligence.

5.4. OLAP Tools:

These are used to analyze multi-dimensional data and allow users to identify observe trends and then to "drill-down" to discover the details behind those trends. As the name implies, OLAP tools are "online" and are used for "analytics". Many firms are addressing their information needs by replacing their static, paper-based legacy reports with online access to corporate information via OLAP Tools.

5.5. Dashboards:

Performance Dashboards are targeted at senior decision makers who need to know at a glance, how the business is performing against its measurable goals and objectives. The performance measures shown on Dashboards are based on the firm's key performance indicators (KPIs). KPIs can involve financial, marketing, production, customer, growth and other important metrics.

6. Data Warehouse & BI solution BENIFITS:

Once a data warehouse is in place and populated with data, it will become a part of a BI solution that will deliver benefits to business users in many ways:

- ***End user creation of reports*****:** The creation of reports directly by end users is much easier to accomplish in a BI environment. They can also create much more useful reports because of the power and capability of BI tools compared to a source application. And moving the creation of reports to a BI system increases consistency and accuracy and usually reduces cost.
- ***Ad-hoc reporting and analysis*****:** Since the data warehouse eliminates the need for BI tools to compete with the transactional source systems, users can analyze data faster and generate reports more easily, and slice-and-dice in ways they could never do before. The Microsoft BI toolset vastly improves the ability to analyze data.
- ***Dynamic presentation through dashboards*****:** Managers want access to an interactive display of up-to-date critical management data. That is accomplished via dashboards, which are sophisticated displays that show information in creative and highly graphical forms, much like the instrument panel on an automobile.
- ***Drill-down capability*****:** Users can drill down into the details underlying the summaries on dashboards and reports. The allows users to slice and dice to find underlying problems.
- ***Support for regulations*****:** Sarbanes-Oxley and other related regulations have requirements that transactional systems are sometimes not able to support. With a data warehouse, the necessary data can be retained as long as the law requires
- ***Metadata creation*****:** Descriptions of the data can be stored with the data warehouse to make it a lot easier for users to understand the data in the warehouse. This will make report creation much simpler for the end-user

- ***Support for operational processes*****:** A data warehouse can help support business needs, such as the ability to consolidate financial results within a complex company that uses different software for different divisions
- ***Data mining*****:** Once you have built out a data warehouse, there are data mining tools that you can use to help find hidden patterns using automatic methodologies. While reporting tools can tell you where you have been, data mining tools can tell you where you are going.
- ***Security*****:** A data warehouse makes it much easier to provide secure access to those that have a legitimate need to specific data and to exclude others.
- ***Analytical tool support*****:** There are many vendors who have analytical tools (i.e. QlikView, Tableau) that allow business units to slice and dice the data and create reports and dashboards. These tools will all work best when extracting data from a data warehouse.

This long list of benefits is what makes BI based on a data warehouse an essential management tools for companies.

7. IMPORTANCE:

A goal of every business is to make better business decisions than their competitors. That is where business intelligence (BI) comes in. BI turns the massive amount of data from operational systems into a format that is easy to understand, current, and correct so decisions can be made on the data. You can then analyze current and long-term trends, be instantly alerted to opportunities and problems, and receive continuous feedback on the effectiveness of your decisions. In absence of BI, probably it wouldn't be possible to identify the root cause or even if it is found out, it would probably be difficult to identify the bleeding points and the business organizations may end up taking corrective actions in all territories which probably would cause another problems. Thus, BI just enables to find out right information, to the right person, at the right time, at the right place to help and improve the informed decision making in order to solve the issues business might be facing. So, it is not just a solution to any business problems, it is kind of a tool or a step to identify and solve the required problems for an effective outcome.

8. CONCLUSION:

Companies that build data warehouses and use business intelligence for decision-making ultimately save money and increase profit. Timely foundation and feedback information is needed as part of that effective decision making with the help of different tools. Hence, the paper is to help the decision makers of the company making an effective decision. Therefore, we need to make business intelligence available throughout the organization to explore how to define and specify useful management reports from warehouse data.

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Pattern Recognition for *Cercospora Coffeicola* in Coffee Plant

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Abstract

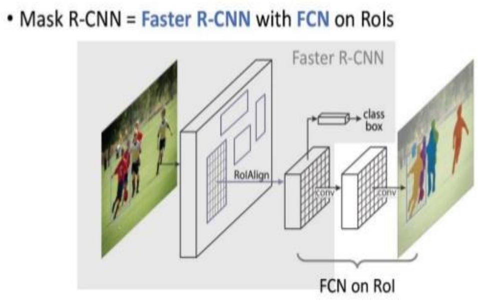
In the current context of Nepal, coffee cultivation is one of the major cash crops cultivated most widely across the country. In spite of being cultivated extensively the yield and growth of coffee are found to be inadequate due to different reasons like old techniques of cultivation, infection, climate change and so on. The main aim of this study is to use the pattern recognition technique to detect a specific plant-pathogen *Cercospora Coffeicola* in coffee plant and prevent from leaf spots and berry blotch disease in the plant. The TensorFlow framework with Mask R-CNN would help to detect the lesions at the pixel level to provide more accurate results.

Introduction

According to the "Statistical Information On Nepalese Agriculture" (015/016) by Ministry of Agriculture Development, more than thirty thousand farmers are directly involved with coffee farming in Nepal. Coffee cultivation has been one of the most effective cash crops with its farming widely spread in more than 40 districts of Nepal. Although widely cultivated and highly effective cash crop at times creates a huge problem for the farmers to get the maximum yield and good quality beans because of some common yet hard to diagnose diseases in the plants.

Cercospora coffeicola is a plant-pathogenic fungus which affects almost 70% of the coffee cultivation worldwide. The fungus is responsible for a common disease Cercospora leaf spot which if ignored, later enhances into berry blotch (a condition where the proper growth of the coffee berries is effected). The disease is considered to have a huge economic impact for the farmers due to its damaging effects on plants, yield and the quality of the beans.

The main aim of the research is to train a model to recognize the pattern at early stage of the Cerscospora leaf spot and prevent from further damage of the coffee beans. Since the pattern recognition must be done minutely at the pixel level, Mask R-CNN would be one of the most suitable model for training.



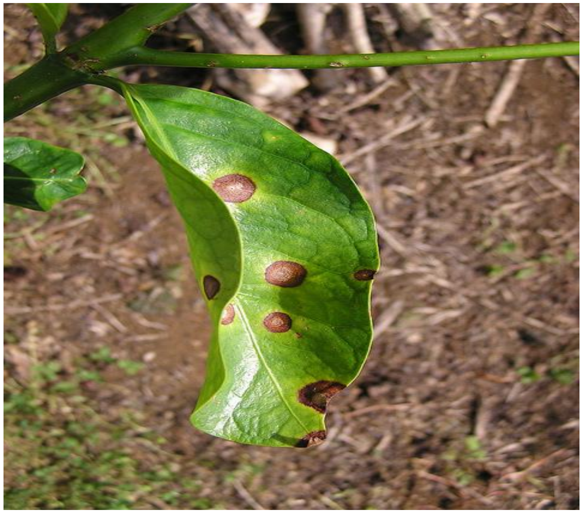
Source: Towards Data Science

Mask R-CNN is a simple upgrade to the Faster R-CNN, a Faster R-CNN returns a class name and the bounding boxes for each detected objects whereas Mask R-CNN returns one more addition output i.e. object mask which basically indicates the pixel level where the object is actually placed. Training of the model shall be conducted in TensorFlow frame work.

Diagnosis of Cercospora Coffeicola

Although the plant-pathogenic fungus is seen in many different plant species but it has a similar diagnosis and symptoms in all the plants, mostly seen on the leaves of the effected ones.

The basic symptom is a circular shaped spot with gray or white centers. The lesions are usually irregular shaped and causes blight on the leaf, they appear as a small, chlorotic presence on the upper leaf surface which further expands to deep brown patches. Moreover, leaf blight is not solely caused by Cercospora Coffeicola which makes it difficult in diagnosis process even if the leaf blight is seen in the coffee plant the real cause cannot be confirmed easily. The center of the leaf spots is grayish which are encircled by a distinct ring of 0.2 – 0.6 inches in diameter with the margins varying from dark brown to reddish brown or purple to black in color.



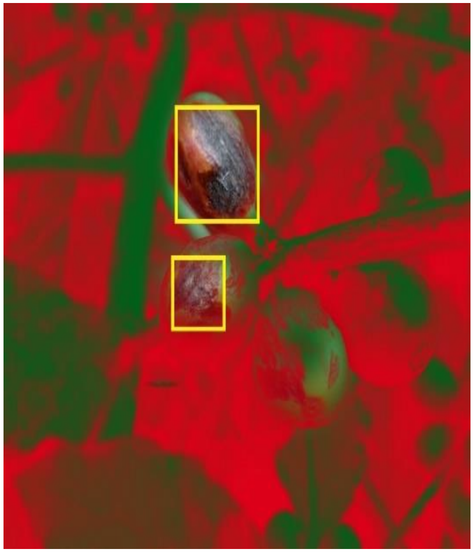
Picture showing leaf spots in coffee leaves
Source: PlantVillage- Penn State

In addition to this, bruises in berries are initially brown and are irregular or oval in shape which are rarely 0.2 inches and at times are encircled with a purplish halo.

Proposed System

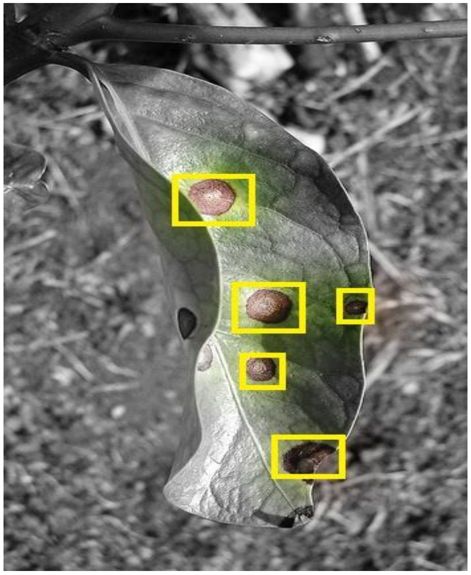
For the training of the model, we collect the samples of effected plants from different region across the country. Followed by segmentation of the collected samples where the major concern would be:

- Segmenting the irregular bruises in the berries of the plant and observing the brown and irregular shape.



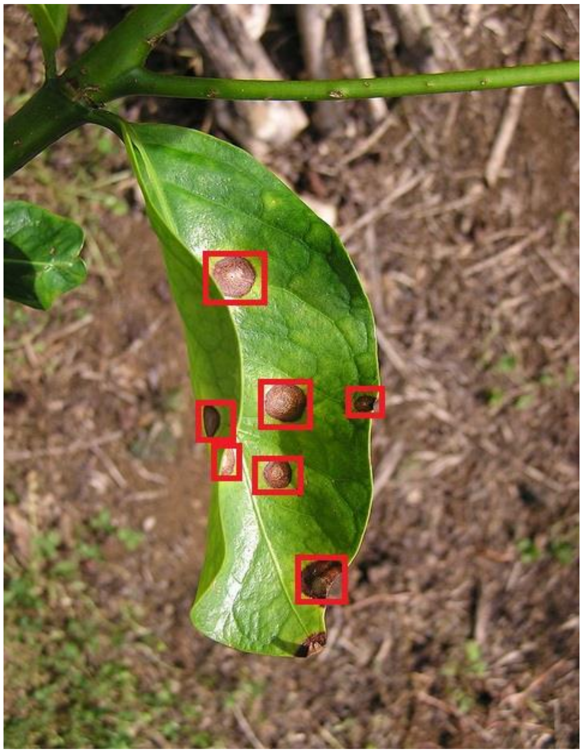
Segmented Image of berry blotch

- Segmenting the brown eye patches in the leaf of the plant and observing the circular patches.



Segmented image for brown eye

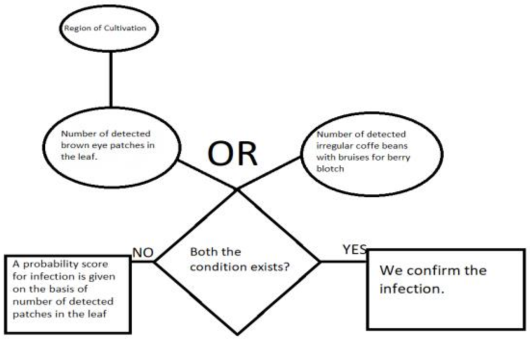
So basically, we are here training basic two objects; one the leaves with the brown eye patches and the next is the berries of the coffee plant with purple halo along with the bruises. We train or fine tune a custom Mask R-CNN model in TensorFlow to recognize the lesions.



Detection of brown eye patches in leaf

The pattern recognition is done separately for plants of different regions, since the changes in the habitat might be crucial depending on the development of plants. For example, at high, wet, cloudy altitudes the leaf spot changes into leaf blights. So the system shall prompt user to select the region of the cultivation and further helps to lower down the probabilities of inaccurate outputs. The next step on the diagnosis of the plant-pathogen would be identifying the leaf spot in the leaf or the purple halo bruises on the berry of the coffee depending on the picture provided.

The diagram on the right hand side shows a simple flow of the system highlighting the process and the feature in the proposed system.


Region of Cultivation
Number of detected brown eye patches in the leaf.
OR
Number of detected irregular coffe beans with bruises for berry blotch
NO
Both the condition exists?
YES
A probability score for infection is given on the basis of number of detected patches in the leaf
We confirm the infection.

Steps for the proposed system

Future Improvisation

The *Cercospora* led diseases is one of the most common diseases observed in varieties of plant species including; okra, gram, pomegranate and many more. But in most of the infected plants, the species differ depending on the habitat and plant morphology but all the species belong to the same genus i.e. *Cercospora*.

Therefore, the future improvisation of the system can be used in studying the different species of the plant-pathogen and their effect in different species of the plant which indeed can be a major help in the field of agriculture. Fine tuning the same Mask R C-NN model with the new samples of different species found in the different regions of the country would help to improve the accuracy and prediction.

Conclusion

From the research we can conclude that a pattern recognition method can be used to detect the infected coffee plants from their leaves and their berries. Although the prediction would depend on the training data sets which must be collected from the different region of the country as different habitats of the plant might affect the infection in the leaves or the berries of the plant. Moreover, the prediction accuracy in berries would be more accurate than in the leaves of the plants because in the infected plant species the berry blotch condition is always followed by the brown eye patches in the leaves.

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Development of Actuator interface circuit for portable device for health monitoring of metallic structure

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ABSTRACT

Damage detection of the metallic structures such as hydro-powers pipelines, water supply pipelines and bridges are the crucial issues in the modern world. The early detection of the generation of cracks and corrosion in such structures can prevent the unwanted accident and can save the structures as well as human lives. One of the widely used method in structural health monitoring is to generate the lamb wave and to analyze the wave for detection of damage in the structure. This paper describes the generation of the actuation lamb wave through low power portable device. The frequency and amplitude of lamb wave plays a vital role to determine the quantity and quantity of the damage in the structure. The proposed device can generate up to the lamb wave with central frequency of 137 kHz, 6-cycles and 10 Vp-p amplitude. The device comprises of amplifier, signal selective circuit and microcontroller with DMA controller and DAC to generate, as well as, to control the frequency of the actuated lamb wave. The generated lamb wave can be further used with different sensors such as Laser Doppler Velocimetry (LDV), Piezoelectric (PZT), Micro electro mechanical system (MEMS) accelerometer and so on for further analysis of the lamb wave data.

Key Words: Structural health monitoring, damage detection, lamb wave generation, lamb wave actuator

INTRODUCTION

The PZT excited structural health monitoring system is one of the widely used and well proven technology in research area of structural health monitoring [1~2]. The size, weight and low cost of the PZT actuators make it suitable to use it in low power and portable devices. With the modern technologies, such as controller with low power and high processing speed and wireless communications, many researchers have inclined to the development of smart technologies. Many researchers have successfully integrated the modern technologies with structural health monitoring system to develop smart devices [3~5]. With further advancement of the technologies, such as capability of the controller to process the signal with floating point unit, the researcher has further developed the intelligent system to monitor the structure [6]. However, the PZT actuator developed is either low in frequency or low in amplitude. Another limitation found in smart or intelligent system is that it uses single actuator to detect the damage in the structure. It is well proven that the multiple actuator in the system can not only detect the damage but also can localize it [7]. This research tends to utilize modern technology with the PZTs to develop an actuator circuit with amplitude up to 15 Vp-p, frequency up to 137 kHz and handles up to 8 actuators. The filter or signal selective circuit is designed to filter out the aliasing noise. The filter topology used in the circuit is multiple feedback filter topology. The multiple feedback filter makes sure that the sensitivity remains low even if there is variation in component. The single end topology of the multiple feedback filter also makes it suitable for shifting the voltage level of the input signal by providing the suitable voltage at the other end of the amplifier [8].

The circuit mainly consists of microcontroller and the actuator circuit. The microcontroller fetches the frequency and actuator information from the user, then generates the lamb wave and send it to the desired actuator. The actuation circuit amplifies, filters and shift the voltage level of the lamb wave to make it compatible with PZT actuators. The figure 1 shows the overview of the system.

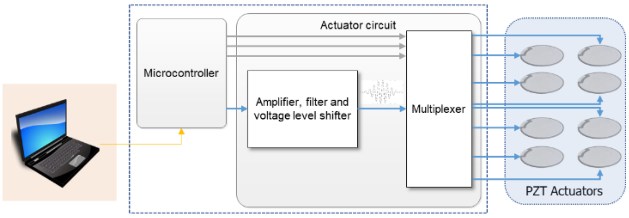

Figure 1 Overview

The in-built DSP (Digital Signal Processor) has been used to generate the waveform data with precise frequency information and the in-built DMA (Direct Memory Access) transfer the waveform data from the buffer to the DAC (Digital to Analog Converter) of the microcontroller to produce an actual lamb wave from the controller. The DSP is the processor that can fetch multiple instructions at the same time, mainly used for floating-point data, which results in precise frequency information of the lamb wave. The DMA is the feature of the controller that allows access to system bus of the controller without the intervention of the core controller. The programming flow of the controller is managed through RTOS (Real Time Operating System). RTOS is an operating system developed to manage the task of the controller in real time applications, typically without any buffer delays.

DEVELOPMENT OF ACTUATOR INTERFACE CIRCUIT

For the development of the actuator interface circuit first the firmware, then amplifier with filter and voltage level shifting circuit were designed. The firmware was developed using RTOS platform. The firmware's flow is controlled by three tasks of RTOS. First task is a simple led status task, which shows the status of the system, i.e. if the system is running or not, if the system is gathering information from the user, or if the system is generating actuation signal or not. Second task continuously monitors the serial communication to gather the information such as central frequency of the lamb wave, number of actuators to actuate and which actuator to actuate from the user. Third task generates the waveform in accordance to the user information and selects the desired actuator. The actuation wave is generated by combining the exponential wave and cosine wave and reversing it accordingly. The equation to generate the wave is given by

$$lamb\ wave = \begin{cases} e^{\frac{t1^2}{2}}.\cos(n.t1) & for\ t1 < a \\ \left[e^{\frac{t^2}{2}}.\cos(n.t1)\right]^{-1} & for\ t1 \geq a\ and\ t1 < t \end{cases}$$

Once the lamb wave is generated, the DMA (Direct Memory Access) controller is triggered to transfer the generated wave data in the buffer memory to the DAC (Digital to Analog Converter), which in turn generates the lamb wave. The maximum frequency that were generated via controller is 137 kHz. The generated wave is passed then passed through the amplifier with filter and voltage level shifting circuit. The transfer function of the actuator circuit is given by

$$T.F. = \frac{1.939\text{e-}26\ s^3 - 0.001683\ s^2 - 1.175\text{e}04\ s}{4.11\text{e-}18\ s^3 + 5.314\text{e-}11\ s^2 + 0.0001488\ s + 192}$$

The Bode-plot and Nyquist plot of the circuit is shown in figure 2 and 3.

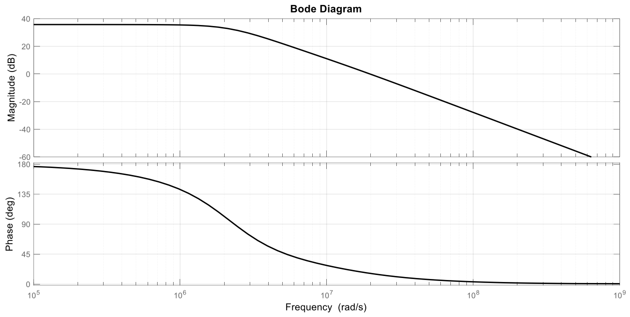

Figure 2 Bode plot

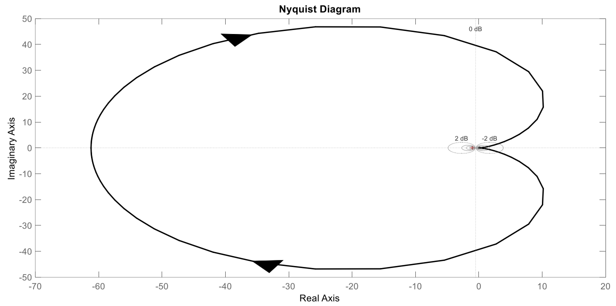

Figure 3 Nyquist plot

Two twelve-volt batteries have been used to power up the device. The power consumption of the circuit during actuation is 0.576 watt.

IMPLEMENTATION OF THE ACTUATOR CIRCUIT

The circuit was first assembled and check for the lamb wave generation. Figure below shows the lamb wave generation circuit with anti-aliasing filter and amplifier. As can be seen in the figure 4, the lamb wave generated are high in amplitude and filtered in accordance to our requirement.

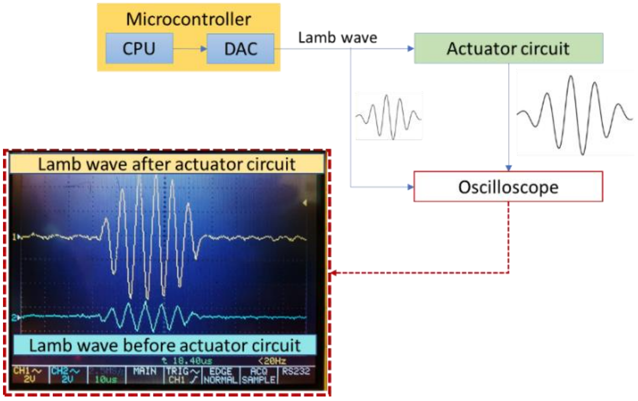
Microcontroller
CPU
DAC
Lamb wave
Actuator circuit
Oscilloscope
Lamb wave after actuator circuit
Lamb wave before actuator circuit

Figure 4 Lamb wave generation

The signal was further tested with the actuator and sensor system. The steel structure is used as test specimen. The test configuration for the validation of the actuation signal is shown in figure 5. The actuator is placed on the test specimen and the ultrasonic wave data, sensed by the PZT sensor, was observed through the oscilloscope.

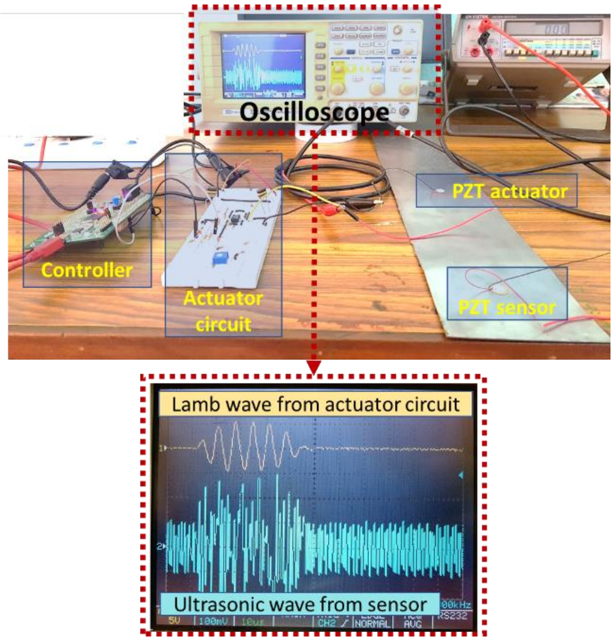

Figure 5 Testing of the circuit

As can be seen in the figure 5, the ultrasonic wave was successfully generated from the actuation signal.

SUMMARY AND FUTURE TASK

The actuation lamb wave was successfully generated by using the microcontroller, which in turn has successfully actuated the specimen and produced ultrasonic wave through it. This proves that the low power and low weight ICs are capable of producing the wave power enough to actuate the specimen. As the actuator is battery powered, it can be easily ported and can be used with the solar powered devices as well.

The future task of this research is to work with multiple actuators and sensors to detect and localize damage in the structure.

ACKNOWLEDGEMENT

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Bluetooth Smart: Rape Issues Solution

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Abstract—**The world is now getting huge interest on IoT and every day the no of IoT devices are increasing. The environment around us is being smarter through the IoT technology. The devices are getting internet connectivity and making our activities smarter and easier.**

The IoT devices can be a very good solution for controlling the today's issues of insecurities like rape, kidnap. In this paper we tried to highlight some possibility of IoT in light of Bluetooth Smart as a solution to such crime or actions and means of saving lives.

Keywords—IoT, Bluetooth Smart, privacy and security, Internet, IoT, Bluetooth Smart

I. Introduction

Internet of Things (IoT), refers to the devices with access of Internet. The term was first used in 1999 by Kevin Ashton, to connect objects to Internet.

Now We are in peak of using IoT devices for our daily actions, By means of sensors the objects are getting Internet Connectivity and now gathering data, analyzing and predicting the next sequence has been common.

Bluetooth Low Energy (BLE) a.k.a Bluetooth Smart, is now evolving as it is the one with low consumption of Energy. After introducing BLE in Bluetooth 4.2 and offering Internet Protocol (IP), we can now connect to other IoT devices. And the most competitive advantage is out of box support in most smart phones.

Bluetooth carries a good potential market in these IoT worlds, as It is also evolving through security, privacy and increased data rate and speed.

II. Issues on IOT

A. Internet

Since IoT refers to connectivity of Internet, the dependency had increased a lot. For smallest act also, we use internet without considering the privacy and security. Since Internet is a global access which means vulnerable to our data gathered by IoT devices. In intra home activities also like switching, monitoring we use internet the most. This shows our dependency on Internet.

B. Energy and Bandwidth

Using Internet consumes more amount of Energy and also requires high bandwidth for transferring data. IoT needs to frequently communicate over Internet for analyzing and processing the data, which means continuous consumption of Energy.

C. Privacy and Security

The data gathered by IoT are distributed all over the Internet so It creates problem on privacy and security. As we depend most on Internet the small act can also be regulated by Internet with vulnerability of Profiling, Identification, Inventory Attack etc.

III. Bluetooth Smart

To overcome these issues in IoT, Bluetooth Smart can be a very good alternative of option to enhance the power of IoT. We can automate different activities with Bluetooth like home activities which maintains a good security and privacy.

A. Bluetooth smart and IoT

Introduction to Internet Protocol Support Profile (IPSP), enables an IPv6 enabled Bluetooth peripheral, and a mechanism to discover and establish a link layer connections. Bluetooth Gatt service called the HTTP Proxy Service has been standardized for the BLE connected IoT, which further complements the connectivity of BLE devices with the Internet

B. Improved privacy and less power consumption

The privacy is increasingly threatened due to increased IoT devices. The personal data can be derived from sensors data, user data and other sources. The privacy is too concerned with IoT devices due to more personalized data.
Bluetooth can operate from hours to month in a coin cell battery, Hence, it can stand as a good lasting resource for transmitting signal.

IV. Bluetooth Smart Usecases

Bluetooth is operable in a coin size battery for hours to month, so we are using it as a medium for transferring signal between peer to peer. The range of Bluetooth Smart is about 200m. so the information can be transmitted locally, The Bluetooth devices can be auto paired and can be made acceptable all the time. Hence if device catches a signal then it can aware the owner about the received signal.

A. Signal and Information

The bandwidth of Bluetooth Smart is limited to about 2 Mb/s, so focusing in this capacity we can encode our emergency signal information creating a code dictionary in every Bluetooth device.

The signal can be of different type and information, so only the possible short information signal can be transmitted.

Consider an example of code log/ code dictionary

Code	**Signal/Information**
0001	Fire Signal
0010	I am lost, Help Me
0011	I sense Danger

Fig:1, Code Dictionary

These are the some highlighted overview of code dictionary, we can create such dictionary and install on each bluetooth device, so when one needs help then, by simply sending code a complete info can be transmitted.

B. Scenarios and Area of Application

Firstly, we need a good interface among hardware and human, utilizing it. The no of smart watch is increasing, so It is a very good option for applying the Bluetooth smart code dictionary. And we have to make devices capable of auto pairing, then decoding and encoding signal.

Consider a rape case issues in Nepal, the most common problem in these cases is, she is alone. Mostly, the accidents are mean to happen when the girl/victim are alone. So, if we could minimize this problem then the rape issues will be certainly outnumbered.

The distance of accidental spots and nearest people are around 200m. But the victim could not ask for help.

In these cases, we can use Bluetooth Smart for asking help, for transmitting unsafe signal. Whenever another device comes in a range, he/she will be notified about the accidents happening around. And the victim can be rescued in time.

C. Other Options

a) Mobile App: Different mobile apps are out there for the sake of controlling rape issues and asking help. Bt the few drawbacks we found on them are:

1) Time Issues: You will be needing minimum of 30 sec to send the info. Using app and then comes the issues of network connectivity.
2) Distance Issues: The information will be given to family/police which will need surely a certain time to reach to you for rescue.

These seems in applicable, since your mobile phone will also be attacked.

b) Alarm/Noise emitter: There are devices which will produce a irritating sound and signal for help, but those devices are also susceptible to be attacked, increases the chances of being murdered.

D. Conclusion

Using Bluetooth Smart in IOT devices like smart watches, and integrating the functions like code dictionary will increase the performance of Bluetooth Smart and makes it applicable in life saving purpose. The limitation of IoT like Internet and insecurities can also be minimized by using Bluetooth.

The issues on Bluetooth like interference range etc are yet need to be solved, but this technology can be a very good option to use.

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Nepal: A Wonder State for Technology

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Abstract: Every year, Nepal witnesses an *exponential* growth in the number of youths leaving their homeland for a safer life and higher career opportunities. On the other hand, looking at how the rest of the world is progressing by means of technology, Nepal seems to lag too far behind. This however is also an indication about the countless opportunities still available when it comes to technology.

Keywords: Nepal, Countless Opportunity in Technology, Empowerment of Youths

1) Introduction:

The youths have extreme negative view in regards to career opportunity in Nepal. In contradiction to that, Nepal is clearly a country which offers a fair deal of applications for technology. There are numerous things yet to be done in the country. To make things done, Nepal presumably requires a huge number of technical human resource. As it is a challenge, it is also an opportunity. An opportunity for all the youths to shape up their career thereby making their native land a better place to live.

2) Areas of Application:

Here are a few areas of application for technology in Nepal:

A) Agriculture

The best application of technology in developing countries like Nepal is smart agriculture. Farmers monitor crops more effectively and make better predictions on planting, weeding and harvesting using AI tools. It can also be used to analyze one plant at a time and add pesticides only to infected plants and trees instead of spraying pesticides across large swaths of crops. Few california based tech companies are an example of this use of AI.

B) Medical field

We can see that in the hospital especially public, people have to wait for the queue. Proper implementation of online booking system can solve this problem with ease. People can fix doctor appointment online and directly visit the doctor. By replacing paper documents with the electronic recorded system, doctors can track down the patient on a computerized system. Since the patients data is stored on a computer, the data can be analyzed and record of the patient can be noted. External research and clinical expertise help to select the correct order of information and patents guide accordingly. Finding the solution can be a piece if cake. Based on medical history computers can predict the future and may bring better accuracy to result in upcoming days. AI can be used as a Diagnostic tool.

C) Automation:

In Nepal, many tasks are done manually which are easily performed by automated machines in most countries. This significantly improves productivity and people can focus on things of higher priority.

D) Tourism

Everything for tour and traveling is available on a website. By this application people can decide variables like destination, cost and time. For this, if there is conversational application it will be more effective. And also Chabot, NLP can reduced complexity. Face Recognition technique can be used so that travelers can seemly move through airports, immigration customs and board aircraft without the need of having travel documents. There are social media listing tools, by listening to people interest it display co-relates travel journey, awesome! By analyzing previous data future of travel and tourism of Nepal can be made more effective and awesome.

3) Problems:

The main problem is clearly lack of skilled human resource. There's a huge gap in terms of knowledge and skills between fresh university graduates and the real tech industry. In addition to that, laws and policies have also proven to be discouraging youths trying to do something innovative at certain times. Even registering a company is tedious and frustrating job which in the most countries is a single window job. Carrying out legal and governmental procedures tends to be a huge barrier between aspiring youths and their dreams.

4) Conclusion:

Nepal is evidently a bare state. Lots of challenges and with the challenges, lots of opportunities exists. Innovation can start from anywhere. All we required is the right mindset and the passion to make it happen.

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Super-resolution: An Overview and its Modern Application

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***Abstract*— The objective of super-resolution is to reconstruct a high-resolution (HR) image from a low-resolution (LR) input image. Super-resolution technique has been there for quite some time and has received a lot of attention recently in the research field. In this paper, we aim to provide an overview of super-resolution and its different techniques used for reconstructing a high-resolution image. The paper also discusses various applications of super-resolution that impact our daily life.**

Keywords: Super-resolution, image reconstruction, applications.

I. Introduction

In this world of digitization, most of the electronic image applications require high-resolution images or videos for image processing and analysis. Resolution describes the details of an image, high-resolution image capture more detailed image. Resolution enhancement is desired for two principal application areas: Pictorial enhancements for the human interaction and representation for the machine perception.

The classification of SR can be done in two families, i.e. single-frame based on the input LR (low resolution) and multi-frame based on the input LR. Similarly, about the resolution, we have many types, pixel resolution, spatial resolution, spectral resolution, temporal resolution, and radiometric resolution.

Here our primary focus will be on spatial resolution. Spatial resolution is defined as the pixel density of an image and can be calculated as pixels per unit area. (Pixels are the small elements which make a digital image).

Today, Charge-coupled devices (CCD) or a Complementary metal-oxide-semiconductor (CMOS) are the image sensors which are more likely to be used[1]. For achieving HR (high resolution) image one of the solutions is to be able to develop more advanced optical devices. To determine the spatial resolution of the image to be captured directly depends upon the sensor sizes or the number of sensor element per unit area. CCD or CMOS sensors are arranged in a two-dimensional array so that the two-dimensional image signal can be captured. For the possible higher spatial resolution there must be the higher density of sensors. If inadequate sensors are used then LR with blocky effects is obtained it is due to the aliasing from low spatial sampling frequency. To increase the spatial resolution one way can be reducing the sensor size which will increase the sensor density. This causes the amount of light incident on the sensor to decrease which causes shot noise[2].

The spatial resolution is limited with the types of image sensors. Also due to the image details are bounded by the optics, i.e. (high-frequency bands), sensor point spread function (PSF) associated with lens causes blurring, lens aberration effects, aperture diffractions and optical blurring due to the motion. So, the hardware component for imaging and optics are costly and impractical in real case scenario: example, the camera used in CCTV and mobile devices.

SR is a technique which constructs a high-resolution image using several LR images despite using a low-resolution camera. The basic concept can be portrayed as combining the non-redundant information contained in the LR frame for the generation of HR image. In 1964, Harris introduced the theorems for solving the diffraction problem in the optical system. This can be referred as the theoretical foundation of SR problem. After two decades, Tsai and Huang proposed an idea to improve the spatial resolution of Landsat TM (Landsat thematic mapper) images. Since then various other research has been carried out. At the beginning, most of the methods were focused on the frequency domain. Due to more computational efficiency and simple theoretical basis, the frequency domain algorithms were popular. However, sensitivity to model errors and difficulty in handling more complicated motion models this algorithm is prevented from further development.

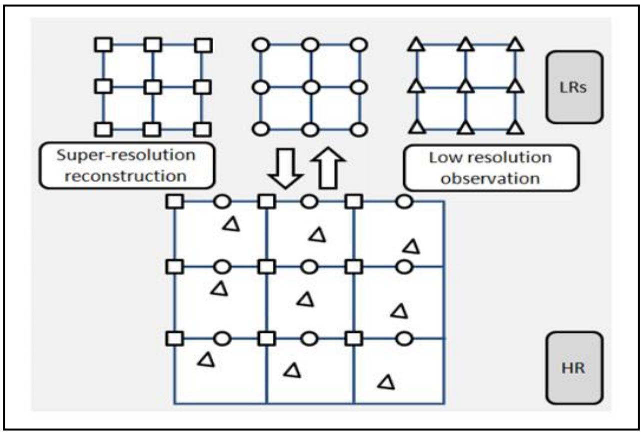


FIGURE 1: Super resolution reconstruction from multiple low resolution frames. Sub pixel motions among the low resolution images are the information needed for the SR reconstruction.

Spatial domain methods have became the trend because of the limitations on the frequency domain algorithms. Non-uniform interpolation, iterative backward projection (IBP), projection onto convex sets (POCS), the regular zed methods and various other hybrid algorithms are used as spatial domain methods.

II. TECHNIQUES FOR SUPER-RESOLUTION

The observation model:

The image acquisition process is under the influence of the various factor that inevitably degrades the image. The factors causing the degradation are optical diffraction, under sampling, relative motion and system noise. Usually involves wrapping, blurring, down sampling and noise.

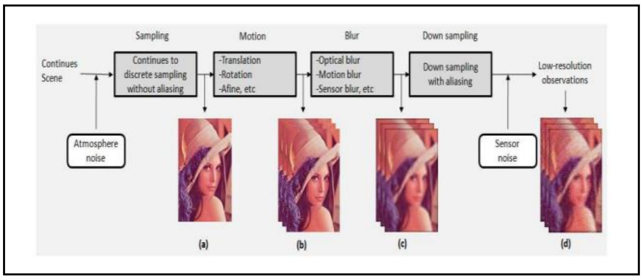


FIGURE 2: The observation model of a real imaging system relating a high resolution image to the low resolution observation frames with motion between the scene and the camera.alues for the six versions implemented.

$$Y_k = D_k\, H_k\, F_k\, X + V_k, \text{Where, k} = \ 1,2,3 \ldots.\text{k} \qquad \textbf{(1)}$$

Where, X denotes the HR image i.e. the digital image which is sampled above Nyquist sampling rate from the band limited continuous scene. Y_k denotes the kth LR observations from camera. F_k denotes the motion information. H_k models blurring effects. D_k is the down sampling operator. And V_k is the noise.

Matrix representation of linear equation (1) is,

$$\begin{bmatrix} y_1 \\ \vdots \\ y_n \end{bmatrix} = \begin{bmatrix} D_1 & H_1 & F_1 \\ \vdots & \vdots & \vdots \\ D_k & H_k & F_k \end{bmatrix} X + V_K \qquad \textbf{(2)}$$

It can also be represented as,

$$\underline{Y} = MX + \underline{V} \qquad \textbf{(3)}$$

In real imaging systems, this model is ill-posed because the matrices are unknown and it must be calculated by using the available LR observation which makes it more ill-conditioned. Proper prior regularization is needed often crucial.

A. *Super-resolution in the frequency domain:*

Tsai and Huang used the multiple shifted LR images for HR image in a frequency domain formulation[3]. This formulation uses shift and aliasing properties of the continuous and discrete fourier transformation.

Let $x(t_1, t_2)$ Denotes a continuous high resolution scene. The global translations yields K shifted images,

$$x_k(t_1, t_2) = x(t_1 + \Delta k_1, t_2 + \Delta k_{2)} \qquad \textbf{(4)}$$

With $k = 1,2,3 \ldots.k.$ where, $\Delta k_1$and Δk_2 Equation are arbitrary but known Shifts.

The continuous Fourier transform of the scene is $x(u_1, u_2)$and those of the translated scene is $x_k(u_1, u_2)$. Using Shifting properties of CFT.

$$x_k(u_1, u_2) = e^{[j2\pi(\Delta_k u_1 + \Delta_k u_2)]} x(u_1, u_2) \qquad \textbf{(5)}$$

The shifted images are impulse sampled with the sampling period T_1 and T_2 to yield observed LR image,

$$y_k[n_1, n_2] = x_k(n_1 T_1 + \Delta k_1, n_2 T_2 + \Delta k_2) \qquad \textbf{(6)}$$

Where,$n_1 = 0,1,2 \ldots\ldots, n_1 - 1$,$n_2 = 0,1,2 \ldots\ldots, n_2 - 1$

Denote these low-resolution image by $y_k[r_1, r_2]$ i.e. DFT

The CFT of the shifted images is related with their DFT by aliasing property.

$$y_k[r_1, r_2] = \frac{1}{T_1 T_2} \sum_{m_1=-\infty}^{\infty} \sum_{m_2=-\infty}^{\infty} x_k\,(\frac{2\pi}{T_1}(\frac{r_1}{N_1} - m_1), \frac{2\pi}{T_2}(\frac{r_2}{N_2} - m_2)) \qquad \textbf{(7)}$$

Assuming $x(u_1, u_2)$ is band-limited $|x(u_1, u_2)| = 0$ for $|u_1| \geq \frac{(N_1,\pi)}{T_1}$,$|u_2| \geq \frac{(N_2,\pi)}{T_2}$,

Combining (5) and (7) we relate the DFT coefficients of $y_k[r_1, r_2]$ with the samples of the unknown CFT of $x(t_1, t_2)$ in matrix form as,

$$\underline{y} = \emptyset \underline{x} \qquad \textbf{(8)}$$

Where, $\underline{y}$ is a$k * 1$ column vector with the k^{th} element being the DFT coefficient $y_k[r_1, r_2]$, $\underline{x}$ is a $k * 1N_1N_2 * 1$ column vector containing the samples of the unknown CFT coefficients of $x(t_1, t_2)$ and $\emptyset$ is a N_1N_2 matrix relating $\underline{y}$ and $\underline{x}$. Equation (8) defines a set of linear equations from which we intend to solve $\underline{x}$ and then use the inverse DFT to obtain the reconstructed image.

B. *Interpolation: non-iterative approach:*

It is the spatial domain approach which is developed for tackling the difficulties of frequency domain method. It is the simplest and non-iterative forward model for SR.

$$Y_k = D_k\, H_k\, F_k\, X + V_k = \ D_k\, F_k Z, \qquad \textbf{(9)}$$
$$where, \text{k} = \ 1,2,3 \ldots.\text{k}$$

Three stages of the forward non-iterative based on interpolation and restoration approach is used.

- Low-resolution image registration.
- Non-uniform interpolation to get Z
- Deblurring and noise removal to get X.

The non-uniform interpolation method is used on those aligned LR frames which are placed in HR grid. To fill the missing pixels on HR grid to get Z. Then any classical deconvolutional algorithm with noise removal is used to deblur Z to achieve X. According to the figure 3 the alignment using some image registration algorithm to sub-pixel accuracy is done for LR frames.

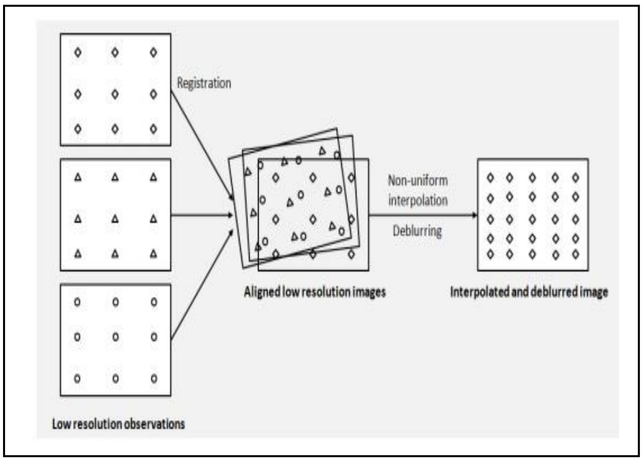

Registration
Non-uniform interpolation
Deblurring
Aligned low resolution images
Interpolated and deblurred image
Low resolution observations

FIGURE 3: The interpolation SR approach based on alignment and post processing of deblurring.

Various techniques using interpolation are used for the restoration of the image which are intuitive, simple and computationally efficient using simple observational model. But ideal estimation is not guaranteed since the registration error can easily be generated to the later processing. Also, it is meaningless without the noise and blurring effect consideration. Interpolation based approaches also need some correction to reduce aliasing if without using an HR image initially as proper regularization.

C. Statistical Approach:

This approach randomly defined towards the optimal reconstruction of SR. Both the HR image and motion of LR inputs are random variables.

Let $m(v,h)$, where v is the motion vector(usually stands for additive noise i.e.,zero-mean and white Gaussian random vecor) and h is the blurring kernel. This matrix is called as a degradation matrix

Using Bayesian framework for SR reconstruction.

$$X = arg \max_{x} \Pr(X/\underline{y}) \tag{10}$$

$$X = arg \max_{x} \int_{v}^{h} Pr(X, m(v,h)/\underline{y})\, dv \tag{11}$$

$$X = \max_{x} \int_{v}^{h} \frac{Pr(\underline{y}/X, m(v,h)) Pr(X, m(v,h))}{\Pr(\underline{y})} dv \tag{12}$$

$$X = arg \max_{x} \int_{v}^{h} Pr(\,(\underline{y}/X, m(v,h)) Pr(X) \Pr(m(v, \tag{13}$$

Here, x and $m(v,h)$ are statistically independent. $Pr(\underline{y}/X, m(v,h))$, is the data likelihood. $\Pr(X)$, is the prior term on the desired HD image. $\Pr(m(v,h))$, is the prior term on the motion estimation

$$Pr(\underline{y}/X, m(v,h))\, \alpha e^{\left\{-\frac{1}{2}\sigma^2 \left\|\underline{y} - m(v,h)X\right\|^2\right\}} \tag{14}$$

$\Pr(X)$is defined using Gibbs distribution in the exponential form

$$\Pr(X) = \frac{1}{Z} e^{\{-\alpha A(X)\}} \tag{15}$$

Here, $A(X)$ is a non-negative potential function. Z is a normalization factor. The Bayesian formulation due to the integration over motion is tedious to evaluate.

If $m(v,h)$ is calculated before and expressed as m then,

$$X = \arg\max_{x} \Pr(\,\underline{y}/x, m) \Pr(X) \tag{16}$$

$$X = \arg\min_{x} \left\{ \left\| \underline{y} - mx \right\|^2 + \lambda A(X) \right\} \tag{17}$$

Where, the above equation is Maximum a posterior formulation, $M$is assumed to be known, λ absorbs the variance of thr noise and α in equation (15).

D. Maximum a posteriori:

MAP approach is used for many models of SR reconstruction. The technique is different in assumption of observation model and prior team $pr(x)$. The most commonly used are listed below.

a. Guassian MRF (Gaussian markov random field)

$$A(X) = X^T\, Q\, X \tag{18}$$

Where, Q is a symmetric positive matrix which contains the spatial relation among the adjacent pixel in the image its off-diagonal elements, Q can also be referred as $\tau^T\tau$.

Here, τ acts as a first or second derivative operator on the image X and is called Tiknov matrix.

According to tiknov regularization,

Log likelihood of the prior is,

$$Log\ P\ (X)\ \alpha\ \|\tau X\|^2 \tag{19}$$

Even the advantages are very significant but due to the overly smooth results sharp edges cannot recovered.

b. Huber MRF

Modeling of image gradients with a distribution with heavier tails is the main advantage over the guassian MRF. Gibbs potential are determined but the Huber function.

$$\rho(a) = \begin{cases} a^2, & |a| \le \alpha \\ 2\alpha|a| - \alpha^2, & otherwise \end{cases} \qquad \textbf{(20)}$$

Where, a is the first derivative of the image using this kind of prior preserve edges and also produce smoothness.

c. Total variation

Total variation (TV) is very much useful for the image denoising and deblurring. Typically use as a gradient penalty funchtion.

$$A(X) = \|\nabla X\|_1 \qquad \textbf{(21)}$$

Where, ∇ is a gradient operator using laplacian operator.

E. Joint MAP restoration:

The two parts of SR construction can be: LR registration and HR estimation. The method above treat these process as a two different processes. The working was to registration of first and estimation of second. In joint MAP the above equation can be extended where PSF (point spread function) and the motion is included.

$$\begin{aligned} &\{ \mathrm{X}, \mathrm{v}, \mathrm{h}\} \\ &= \arg\max_{x,v,h} \Pr(\underline{y}/X, m(v,h)) \Pr(X) \Pr(m(v,h)) \\ &= \arg\max_{x,v,h} -\log[\Pr(\underline{y}/X, m(v,h))] - \log[\Pr(X)] \\ &- \log[\Pr(m(v,h))] \end{aligned} \qquad \textbf{(22)}$$

Tom et. Al. further divided the process into three sub problems, registration, restoration and interpolation. This improves the estimation more accurately than using two processes.

F. The Bayesian framework:

Unlike the MAP estimator, the posterior distribution is calculated instead manual setting of specific value of the parameters. Bayesian method calculates whole posterior distribution unlike in ML or MAP.

$$\begin{aligned} &\mathrm{P}(\mathrm{X}, \mathrm{m}(\mathrm{v}, \mathrm{h})|\mathrm{Y}) \\ &= \Pr\big(\underline{Y}/X, m(v,h)\big) \Pr(X) \Pr\big(m(v,h)\big) / \Pr(\mathrm{Y}) \end{aligned} \qquad \textbf{(23)}$$

Where, $P(Y)$ is generally ignored in MAP estimators. It is independent of the unknown variable and it cannot be computed so approximation must be done for reconstruction.

G. Example based super-resolution:

The methods above were based on aggregating multiple frames which have complementary spatial information. If only a single LR image is observed then the measurements are insufficient. A recent uprising process for the regularization of the ill-posed SR is example based. To overcome the inadequate measurement limits using examples which develops the priors by sampling from other images.

One of the approaches of example-based is by using the example directly. This approach is proposed by Freeman et. al. where two set of training patches are maintained,

$$\{X_i\}_{i=1}^{n}, sampled\ from\ high\ resolution\ i \qquad \textbf{(24)}$$

$$\{Y_i\}_{i=1}^{n}, sampled\ from\ low\ resolution\ image \qquad \textbf{(25)}$$

The observation model,

$$Y_i = D\,H\,X_i + V_k \qquad \textbf{(26)}$$

Using the MRF model as shown in figure the co-occurrence of HR and LR is applied to the target image for HR prediction in a patch-based fashion.

The parameter of the observation model should be known as prior; the training sets are tightly coupled with the image targeted. The size of the patch must be a proper choice. Due to variation path size if it is too small, then co-occurrence priors to weak for prediction and if it is too large, there may be a need of huge training set.

III. Application

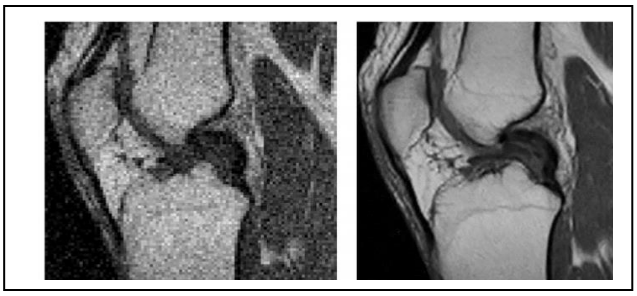
After going through the methods above, we will discuss the specific application of SR. The uses of SR in our daily life with which we can benefits in various ways are the basic concern.

A. Video information enhancement

The SR technique can be used for the conversion of LR video or image into HD. Hitachi Ltd. Successfully used the conversion of standard definition TV into high definition television. Moreover, Apple Inc. used SR based optical image stabilization and also applied for a patent on the concept. This technology will be used in our phones, computers, and tablets in the near future.

B. Medical application

SR has a very significant role in the medical field. The good quality of the medical image can be generated which will have a profound impact on the ease of diagnosis. As in CT scan, MRI and other medical procedures image enhancement are needed. The geometric deformation on the image can be corrected. It is more desirable to detect the disease in early stage. This application of SR will give a better and clear understandability of the image we try to achieve in medical diagnosis.

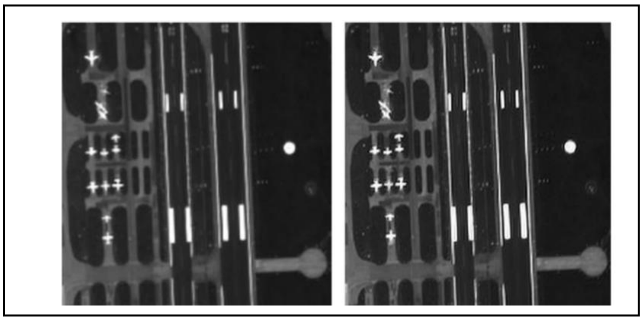


C. Surveillance

Traffic surveillance and security cameras which have the digital video recording can also be improved using SR. due to many weather condition and different motion complexity it is still a challenge.

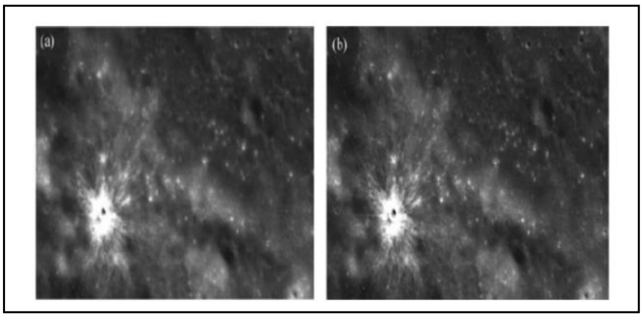
D. Remote sensing (Earth-observation)

Initially, the research about the SR was done for the betterment of the image quality in Landsat remote sensing image. More than decodes the technique has been developing for remote sensing image. Some of the few relevant examples are SPOT-5 which can reach 2.5m through the SR of two 5m images by shifting a double CCD array by half a sampling interval. Moreover, Landsat, CBERS and worldview 2 also provide the possibility of SR. many researchers have also tried to use the example-based methods. Recently 24 small satellites capturing and delivering real-time “videos” using a sub-meter resolution using SR which has been done by Skybox.



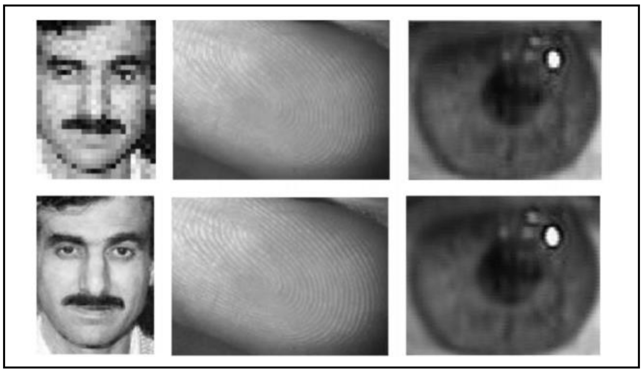
E. Astronomical observation

Many astronomers are exploring the outer space, and for those researchers, SR can be a beneficial utility. By enhancing and improving the quality of astronomical image, the exploration can obtain more depth. Lunar exploration program and the Mars Odyssey mission are the SR example of Chinese Chang’ E-1 lunar images. Moreover, Hughes and Ramsey used (THEMIS), i.e. thermal emission system to generate the enhanced thermal infrared image of surface mars.



F. Biometric

The recognition of faces, fingerprints and iris images where the enhancement of resolution is very important factor for the proper biometric information. The resolution is the crucial factor with which the detection process can be made efficient. The details of images like the shape and structural texture should be enhanced for the recognition ability. A very fast and accurate biometric information can be generated if the resolution becomes clear and distinguishable.



IV. CONCLUSION

In this paper, we have discussed about the Super-resolution technique which is one of the most popular approach for reconstructing High-resolution image from Low-resolution image in spite of low resolution camera. We have also looked at various methods of super-resolution and their various applications in the daily life.

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Internet Of Things In Education And Different Ethical Issues

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***Abstract*-The internet of things is the conceptual system which is defined as the interconnecting different devices, machines , objects or people which help to provide different identity and ability to give unique identifiers and helps to transfer data in different network. The internet of things(IOT) has developed internet oriented communication to be occurred with physical devices, different sensors and controllers which has changed education sector in high amount. With the implementation of sensors in objects, cloud computing, augmented reality and big data different type of environment can be determined. This process has developed new mode of communication between people and educational institutes. In this research proposal paper aim to show the impact of IOT in education from authors research review. This proposal will be focus on the IOT project in education where our research will be focus on smart school/college.**

Keywords: Internet of things, smart college, Benefits and application of IOT

I. INTRODUCTION

In present world, internet of things is common term which is very close to our daily life and it is preceding towards leading technology . It has influence in the things which is everything we do and way we interact around us[1]. The aim of IOT is to transform traditional cities into smart cities. IOT in present day has been used in city infrastructure changing traditional cities into new cities where they is connection of IOT devices in every building. IOT has been used in health sector as , the different machines and technology where doctors and health representative use make the life easier for every worker as well as the patients. IOT has been flourishing in every sector day by day.

Internet of thing main theme was to develop a network which gives physical object (RFID) Radio frequency identification label or near field communication(NFC) which help to identify object in global network which enable millions of devices are to be connected with each other and they can also interact with each other[2].

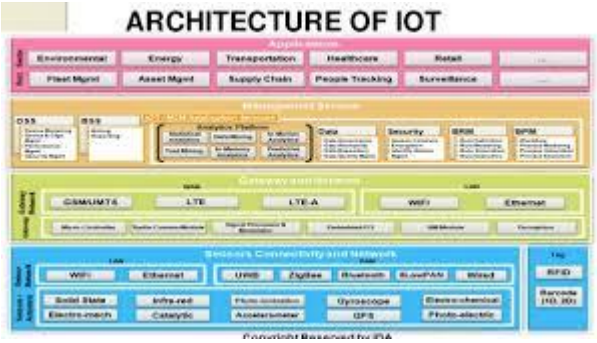

Fig 1: Architecture of IOT

Currently, business model has adapted gradually with internet of things technology in smart cities environment with high scope which is offered by different domain since in logistics, security , health and smart building as in china and japan. There are many things to resolve the challenges which are impose by internet of things.Government and different educational institute has been using IOT for uplifting processes , take data and help in promoting sustainability. There have been wide use of smart objects and devices in different type of university. They enable different technology like chips, sensor and other devices which are easily understood and mass produced very easily so it is mostly used in classroom. In this research proposal I have include motivation for research proposal in section 1 where section 2 simply demonstrate the research question and section 3 signify the research timeline which is followed by methodology and conclusion.

Motivation For research paper

As the technology has advanced daily, people all over the world are benefited with IOT directly or indirectly. Since with the high demand of advantage of IOT in the city, house, health sector and education , being a student I am motivated for topic IOT and use of IOT in education. The purpose of this conference paper is to give description of IOT where benefit of IOT in education, difficulties while implementing IOT in Education, demerits of IOT in education and how present world is booming with IOT are described. I have also proposed the boundaries of my conference paper where I will focus on overview of IOT in present world, concept of smart school and university along with benefit of IOT to education mitigating its demerits. The use of IOT helps to transforms static classrooms and education environment to digital classroom which can be easily connected to smart devices[3] . This techniques of IOT in education is very useful for disability student or teachers where they can extract materials online and can see their classroom activities through home and can know how all the system are working from anywhere at anytime.

II. RESEARCH QUESTION

The objectives of the research is to know about the influence of IOT in education. In present world IOT is used in different places for benefit of the people. With the use of IOT in education student will lack creativity and they can be lazy, there may be private issues. The main research question are finding benefit of IOT in education, difficulties while implementing IOT in education and how IOT is booming in the present world.

III. PAPER DESCRIPTION

IOT is being popular day today with the advanced of the internet, different devices, system and software are interconnected with each other. People have become more advanced. These integrated devices connected with internet and generating and viewing how all the devices and system are running in different places, institution is the today reality. Individual can easily share all of the data , progress, concepts , different simulation with each other from different places. IOT has great influence in the home, city, health sector , education with the use of IOT the physical devices of these sectors are connected to each other which form smart home, smart city , smart hospital along with smart school and smart college. IOT also enables different services with interconnection of information and communication technology.

The implementation of IOT in education is in just starting phase. The development of smallest wireless devices which requires function and most of them are controlled by smart phones gives benefit for student who are engaged in remote controlling of devices.

The key objectives of this report are:-

1. To find the benefit of IOT in making school and college into smart school and smart college
2. The difficulties and demerits of IOT in education
3. How IOT is booming in present context

From 2016 it is estimated that there are about 6.4 billion of the devices which are connected with each other[4]. The implication of IOT in education has been very beneficial to the educational institutes where it makes student centred approach in function which helps to find hear beat rate, brain signals and it provides different notification , the sensor connected devices helps to collect different data which include physical and mental activity , heart beat rate, calories consumption, stress level with the help of this school administration can provide new nutrition schedule, reduce stress causes which will be very useful for students. It helps in improving educational institute securities. There have been problem of kidnapping children from school, shooting of children in school premises with gun, this will be in control with the use of smart gadget when connected with people where security is achieved with door gateway and recognition software. The use of global digital security also reduces maintenance cost.

Internet of things has major impact on todays education system where it provides better path how to learn, along with that it helps in tracking objects, students , staff and helps to connect devices across school which brings safety to institution[16]. It also help to track buses of school where student can track the buses and they shouldn’t wait for long. It also helps to ensure cashless environment and these things are just beginning of IOT in education. IOT had higher benefits it cannot be implemented everywhere, there are some shortcoming of IOT in education such as security issue, integration and low financing in different ways. There may be problem in financing as IOT requires different hardware and software where wearable devices like beacons, wristband along with interactive board is costly and integration of those devices with each other and software can also malfunction. There is no single platform for IOT user so it is difficult to integrate. Since IOT network is very big it consist of different devices which connect many gadget and device and it leads hacker to breach the security of devices and find loop holes. This things can be mitigate by having authentication tools and firewall only.

In this conference paper chapter 1 consists of introduction of IOT whereas chapter 2 consists of the review of the 5 different papers and chapter 3 consist of the conclusion.

Iv. EFFECT ON EDUCATION BUSINESS MODEL

There had been research going on for IOT in education. In this report 1 writer has proposed smart classroom as an intelligent environment which is collaborate with different types of hardware and software. There are uses of different smart object which are used in university. This paper mainly focus with effects of IOT in education where it mainly give special concentration on use of IOT in higher education, how energy management is done in campuses and effective campus security along with classroom access control where it include systematic student healthcare and describe how teaching can be enhanced[6] . Moreover, education business model which is based on Canvas Business model approach is described in suitable way.

This report describes seven categories where technical education can be derived which are visualisation, learning, social media , Digital consumer, technology . The concept of smart classroom is special environment where it contains video projector, camera , sensor and face recognition and different entities which are fitted to know student progress along with performance and achievement. It has described IOT in education as personalized and medium for effective interaction with student. Report describe how student can solve their problem how they are suffering by just sending alert to administration. IOT is used in classroom for improvement of teaching and learning where remote presence of students, optimizing classroom. IOT not only help student but also to administration where they can understand student and their needs along with student health, safety and they can connect everything on campus management . This paper gives idea how IOT can benefit higher education and it describe how future IOT in education should be.

IOT business model

This paper describe education business model where business model is a tool which consists of object s concept and close relationship with objective to express business logic in firm. It defines 9 sections where customer segment focus with people whom organization serves. In any organization customer are student, parents and government value proposition, customer relationship, channel key activities , key resources , key partners cost structure , revenue streams are new framework used in education business model[5].

Benefits

There have been benefits achieved such as:-

Adding new value proposition

1. The addition of value proposition in education business model with active involvement at IOT in education.

a) It will reduce cost by automating operation where energy can be able to access real time energy consumption.
b) It helps in customization of curriculum.
c) There will be easier for access of leaning resources.
d) Collaboration can be done easily between stake- holder.
e) Helps in increasing virtualization and personalization.
f) Real time interaction becomes easier.
g) Constant data collection and analysis possible.
h) People and environment database can be formed.
i) It helps to save time where we can access different part with the help of RFID or NFC.

Problem tackled

The problem tackled in this report is as follows.

a) It has focused on higher education but the infrastructure cost seems higher.
b) It has increased technology and management cost.

Conclusion

This research explains mainly how internet of things can enhance smart campuses and classroom where they categorized application of IOT into different segments and this campus energy management, access control system , ecosystem monitoring and canvas model show IOT has played big role on education system which directly reduce cost along with comfort and collaboration and make relationship between channel and customer by forming virtual and personalized relation.

V. A SURVEY ON ROLE OF IOT IN EDUCATION

The paper " A survey on role of Internet of things in Education " defines IOT as a growing network where variety of connected things are rewind. The use of IOT in education helps in improvement of teaching process and educational sector . This paper mainly describe usefulness and application of IOT in education sector and present research work where it focus on challenges and its impact in future.

This paper has taken quotes from Cisco where they use internet for everything for physical and virtual objects. Internet of everything will bring people together , people to machine together , machine to machine together in form of computers, laptops, smart devices. IOT always communicate with the help of wireless technology like RFID, Zig-bee, NFC, WlAN, WIMAX and LTE. IOT faces challenges which are security, privacy , availability , mobility, reliability performance, scalability along with management.

IOT technology always had played crucial role for improvement of all level of education system which include student to teacher of different classroom to campus. Paper gives idea how twin integrates sensor with cloud service which allow for easy setup . When we point Twine to WIFI network and these sensors are recognized by web application where real data can be seen through sensor . IOT help student to use IOT a interaction and project goals. This paper mainly focus role of IOT mainly in education where it focus on recent research, challenges and future impact of IOT in education.

IOT hasn’t only bring transformation in educational system but has changes infrastructure of educational institutions[4]. IOT in education has brought improvement in all level of stakeholder related to them . It has given example of WIFI oriented Twine7 product which helps to give sensing of different devices. Paper has described the example of implementation of education of IOT in education taking united kingdom example where UK open university has introduced. “ My digital life “ which is based on IOT concepts , this will help student easily understand environment around world where they use different model like IOT based interactive model teach. Paper describe objective of smart environment which are learning, reasoning and predicting.

IOT based smart classroom

Paper describe how all university campus are connected to internet with multiple object like doors, projector, printer, classroom and parking etc. This paper focus on changing these multiple object into smart object in single system. It describes some of the feature to be smart system.

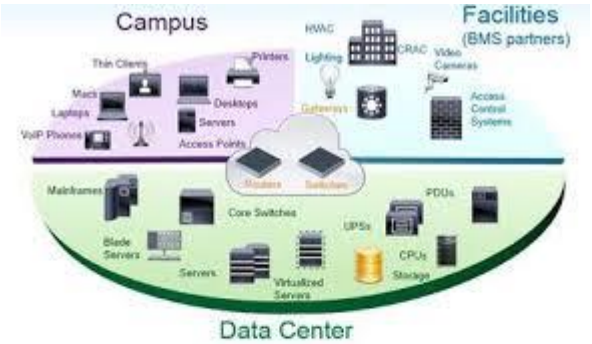

Fig2 : Smart classroom

Smart IOT based classroom

Smart IOT based lab room

IOT sensor for Note sharing

IOT sensor for mobile devices

Paper describes IOT enabled Hotspot and e-learning application. Paper describe smart attendance system with use of NFC and RFID where status of attendance can be check real time and give real time feedbacks to lecturers paper focus on use of Zig-bee for supporting communication in lab.

VI. CHALLENGES AND BENEFITS

The paper has identified challenges with IOT in Education . There are many issues for successful integration of IOT devices. There are many things like network bandwidth, reliability in WIFI connection, web analytics, security ,device availability for student , training and cost of equipment. This paper has given more focus on security and privacy. As many data can be collected between student and Educational institutes and if these data breaches it will harm stakeholder. The security and privacy issue has been one of the biggest challenge. This paper illustrate effective WIFI connection all the time as one of the challenge. The management of all connected devices effectively and cost control has been one of the challenges.

The weakness of this paper is that it has only identifies the common challenges that the IOT implementation in education where it has failed to describe how the security issues can be solved , how cost minimization of connected devices can be done. It hasn’t identified how stakeholder can use connected devices with effective training. Moreover, paper has said IOT in education will change traditional education system and it also change architecture of education system but it fails to give effective architecture. The concept of web analytics isn’t properly described.

Strength

Paper has find out how the future education system will be beneficial to IOT in education which is described in proper way. It describe how teachers, students can be beneficial and how interactive learning has made life easier for both student and teacher with the help of example of US student. IOT will help to improve learning process in future. The tools use in IOT will bring appealing, flexibility and fulfil different need of students. IOT used in education will open door for student for new innovation and betterment of lives of student and teacher.

VII. TRANSFORMING EDUCATIONAL ENVIRONMENT THROUGH GREEN INTERNET OFTHINGS (G-IOT)

This paper focus on benefits of ICT in education through G-IOT concept. The concept of G-IOT brings utilization in energy and pollution. It will enable more benefits of ICT and reduce harm. The paper focus why educational sector should follow G-IOT and its benefit as G-IOT helps in environmental awareness and minimize health hazards. This paper mainly focuses on benefit of G-IOT in education. Paper states that role and implication of IOT has been common where use of IOT has improved education equality. The main benefit of IOT in education is anytime and anyplace learning, The benefit of technology in education has hidden where some of the social cost that has to be bear with this process of connecting 19- 20 billions device[8]. Since production and disposal of these devices are accomplished by release of many polluted air, water and land. There hasn’t been any concern about environment degradation. There should be approach to reduce possible negative impact of novel technology product and solution on human health. So, paper focus why stakeholders are moving towards green ICT and G-IOT.Paper moreover focus on importance of education in society with possibility of G-IOT inclusion in educational activities and help in sustainable development.

The paper focus on existence of seven technology , tools and strategies which bring new development and it will help in education sector. These are consumer technology, digital strategies, enabling technology, internet technology, learning technology, social media technology and visualization technology. IOT leads to next level of connectivity towards learning system. Student are benefited by different ways. Every material which are presented called student centred. The sustainability for IOT in education sector needs green approach by every stakeholder like schools, university, staff members, students and administrative people.

Figure 3 : green school

Benefits and implementation

Paper focus on following thing that G-IOT brings to education sector . Institute should buy devices which will reduce energy consumption and environmental impacts efficiently . For this remote access to equipment should be done. Virtual learning session should be done. The uses of cloud computing and big data along with outsourcing. Virtualization and optimization should be done. Shared printer concept along with green printing strategy should be done. The minimization of generation of wastage and maximization recycling and reuse of ICT equipment via IT devices should be done. Improvement in design of school and university should be done where building should be smart building with the help of monitoring like HVAC (heating ventilation and air condition) which creates integration of these devices with other building services.

Paper has focused on how potential harmful effect of IOT on human and environment can be minimized. It focus on how it can reduce cost and resource usage. It focus on how it can reduce cost and resource usage. It gives concept how green behaviour on education environment can be beneficial to stakeholders. It gives ideas how institutions should purchase interacting devices as they should be aware of renewable resources. It gives wide concept of minimizing recycling and reuse of ICT equipment via old IT devices. Maximum reuse and repair ICT equipment before replacing with new one. It gives wide concept on minimizing wastage of educational sector.

Weakness

Paper fail to describe how seven categories like customer technology , Digital strategies , Enabling technology , Learning technology and social media technology integration could help in making green IOT in education. Paper focus on how old devices can be used and new eco friendly devices should be purchased but fails to describe architecture and production technique of eco friendly devices.

VIII. INTERNET OF THINGS (IOT): AN OVERVIEW

Paper focus on the emerging technology of Internet of Things (IOT) provides promising benefits to individuals and various organizations. With the advancements in smart devices, wireless network, and other technologies, the field of IOT is moving forward. However, along with the promises, it has its challenges as well. This paper looks over the benefits, challenges, and the security issues associated with IOT.

Historical Background

IOT enables communications between person and object and object and object[9]. The interconnection of various sensors, RFID devices, and other objects creates a digital ecosystem. According to Carlos Elena-Lenz, the main aspects of IOT are Intelligence, connectivity, safety, energy, expressing, and sensing where each characteristics can be traded off during the design.

Technology and Platform of IOT

There are four main components of IOT networks: control units, sensors, modules for communication and power sources driven by the following features respectively: collect and transmit data, run devices, get information and help in communication. Sensor is the one that connects physical world with the virtual world which collects data from environment and convert them into digital data. Some of the technologies assisting IOT includes, RFID (Radio Frequency Identification), Bluetooth, Zig bee, Wi-Fi RF links, and cellular networks.

Pervasiveness of IOT

Some societies are not feeling easy with the development of the this technology fearing human functionalities like replacement with machine and thus the fear of unemployment.

Benefits of IOT

There are various advantages as well as challenges of this emerging technology in various fields. They are discussed below:

Health Sector: IOT can help monitor patients and identify the signals with urgent attention. Patients also get relevant information regarding their health.

Security: Vehicles and property can be monitored through IOT. In cases of crashes, emergency call and rescue can be delivered. Even kids could be monitored.

Business: Businesses can monitor their asset, production process, consumers, and inventory control ultimately improving their visibility of constant supply.

Education: In education, there are numerous benefits. Data could be collected and analysed easily for researches. Learning skills can be improved as it provides a new approach to studying. Education can be more mobile with this technology. The error that occur as a result of manual handling can be reduced by this technology. This increases efficiency. Students who cannot attend school for various reasons can get distant learning and can participate completely in a classroom activity. Special students can get support from this technology as well.

Challenges of IOT:

Broadly, the challenges of I0T are categorized into three categories: privacy, over reliance, and unemployment.

Privacy:

There is a big possibility of hackers hacking information putting many individuals and companies at risk of information exposure or leaking.

Over reliance: When the system collapses, over dependency could result in a catastrophic event leading a failure of a whole business.

Security Issues:

With the spread of IOT, cyber-attacks are likely to increase. Various problems like unauthorized data access, sharing of those data, privacy breach could be highly inevitable. Strong security solutions are necessary to address this problem. The system developed must be impregnable, inaccessible to unauthorized users, and devices must be controlled. Setting standards can help to address the security issues to some extent.

IX. Conclusion:

IOT have the potential to bring a technological upliftment of the human society and the development of this technology depends on a number of other important fields, ranging from nanotechnology to wireless sensors. With this technology, real world can connect with a virtual world throughout the world through various sensors and other technologies.

Strength: good overview of IOT. Good historical information. Well Structured

Weakness: Not much information. Not detail information. No examples.

Internet of Things (IOT): Education and Technology

IOT is " not a single technology but it is combination of various technology which work together in tandem[12]. This is the report which is made my Curtin university for its vision for 2030 for the development of its campus as city of innovation where it take Internet of things as its key features. IOT mainly focus on its application in home, betterment to education system. Paper suggest that the use of IOT in education is in infancy level where there is little information for student about the IOT. This reports mainly focus the case of students who are disabled. The paper defines the concept of smart campus where the purpose of I campus isn't to enhance interactivity in education but to create a campus made of different intelligent computer system. These system should understand individual context of student as well as having an intelligent understanding of environments in which they study.

Benefits and risk

This report finds the risk and benefits of IOT for students with disabilities where education centre is focus on mobile based learning. This report explains brief history of the IOT and use of IOT in educational concepts. This report questions tendency of seeing technology as unequivocal benefit to Disabled people. This report mainly takes report with the help of interviews with currently enrolled student of Curtin university with disabilities. In the first section it tries to focus on benefit and risk of IOT but from the interviews it found out that IOT is in very early stage of development. Students always modifies their technology with specific needs. Students are always immune to change. IOT is giving more opportunities but lecturers retain control of classroom. They hope to find out how educational materials can be bitterly managed. This interview taken with disabilities who learning has been easier for them after adoption of IOT. The report concludes with the conclusion that how Curtin university can adopt IOT for creating intelligent design with campus setting to ensure student can get best use of IOT .

Paper finally gives recommendation for deployment of IOT which is useful for all upcoming education institutes which are described below:-

1. Curtin University shouldn't immediately deploy technology but it should take time in planning and it should find best technique for deployment of IOT.
2. More Priority should be given in incorporating IOT in specific issues like teaching and learning where consideration should be given to student with disabilities.
3. The future implementation of the IOT solutions should be on the use of the personal smartphone as primary interface.
4. IOT solution must be accompanied by training to ensure that all staff and student are able to use it effectively.

Student with disability are who are in Australia have lower rate of completion rate in study than fellow student. IOT offers opportunity for those student to be involved in IOT where more student can be engaged in higher education. The IOT will offer flexible and timely ways to better manage accessing educational materials.IT has widely describe concept of smart campuses , benefits and risk of IOT .

Weakness of paper:-

It fails to describe how many disabled student can be involved in education with IOT. It fails to describe mitigating factors for the security issues in the campuses.

Strength
It has widely described IOT in education , its benefits and risk with the help of interviews which gives clear view to everyone about the IOT in education. IT tries to tell the role of disable student in adoption of IOT.

The conclusion that I have taken from this conference paper is that there is lot more we can do in education through IOT . The things should be done in wise way for mitigating security issues since IOT is in early stage so many problem are coming due to irresponsibility of different device developer. There might be lot of problem in implementation due to costly IOT devices and these are the things that every institutions cannot afford for implementing IOT . The main conclusion I have made from this paper is that with reference to the first paper if the education business model is used it helps in making the work of the administrative staff, teacher and student to work efficiently. The second paper conclude that IOT has made the technology advanced and it saves time but it is unable to explain about the security issue of the paper. The paper 4 conclude how Green IOT helps in controlling the energy consumptions and cost minimization in making education institute environment friendly and paper 5 helps to explain the benefits of IOT for the disabled people.

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Earliest Due Deadline Real-Time Scheduling for Load Balancing in Fog Computing

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***Abstract* - Fog computing is a recent invention and it is new emerging technology. The birth of fog computing is directly related to the growth of IoT. It is very difficult to provide the requested resources for cloud due to day by day increase in the number of devices and the user data. Thus, as a supplement to the cloud computing and as extension to it, fog computing concept can be used. It acts as a bridge between cloud and users. Thus, it provides lot of benefits by minimizing the burden on cloud. Its purpose is to manage resources, perform data filtration, preprocessing. The fog manager need to assign available resources to tasks for execution to improve system performance, reduce response time and maximize utilization of resources. One of the biggest issues in fog computing systems is the development of effective techniques for the distribution of real tasks on multiple processors. The paper implements Earliest Due Date scheduling policy for real tasks and then resources are allocated to these tasks using Round Robin method. For scheduling, task length and absolute deadline are provided randomly. The paper also modifies Earliest Due Date scheduling that reduces number of missed tasks by executing probable missed tasks at the end. However, the modified algorithm do not improve maximum lateness.**

Index Terms Fog Computing, Cloud Computing, Task Scheduling, Real-time systems, Earliest Due Date scheduling.

I. INTRODUCTION

With the development of mobile internet, more and more heterogeneous devices are connected to the network [2]. Although large-scale cloud data centers can meet the complicated requests of users, bandwidth limits may cause network congestion and even service interruptions when many users request services from the data center at the same time. The QoS (quality of service) cannot be ensured if the request has to be processed by the far cloud end. Under this circumstance, fog computing was developed [3].

Fog computing is a new resource provision mode in which the users not only can use the virtualized resources but can also provide services. In fog computing, some simple requests with high time sensitivity could be processed by geographically distributed devices that can absorb some pressure of the cloud data center. All devices with spare resources can be resource supporters of fog computing, even some sensors and smart phones. Since the resource supporter is closer to the resource consumer, fog computing is superior to cloud computing in terms of response speed [4].

Real time jobs need to be executed within certain time. If they are not executed within time frame, sometimes they do not carry much value. So it is very essential to schedule real time jobs so that more and more real time jobs can be executed. Load balancing is a technique which divides workload across multiple computing resources such as computer, hard drives and network. The load balancing helps client requests to achieve in best way to ensure proper utilization of resource consumption and it also tries to fix the problem that all the processor in the systems and every node in the network shares equal amount of workload assigned to them. Although many load balancing algorithm exists with some pros and cons but there are very few load balancing and scheduling algorithms for fog environment. In the fog-cloud environment, job scheduling algorithm is used to allocate the load from the clients to all servers to satisfy the fair distribution. The achievement of the fairness will minimize the long time waiting of any task. In addition, it will increase the execution speed of the user's tasks in using the available resources with optimum consumption of storage to minimize the response time of the submitted tasks. There is need to schedule tasks so that clients get response soon and servers get fair amount of loads

II. RELATED WORK

The purpose of real time system is to execute the services within deadline. The real time services need their computation time and communication time and data resources to be processed in scheduling of allocating resources to satisfy those transactions. [1]. Below are some of real time scheduling algorithm

Rate Monotonic (RM) Scheduling Algorithm [5] is a uniprocessor static-priority preemptive scheme. The algorithm is static-priority in the sense that all priorities are determined for all instances of tasks before runtime. What determines the priority of a task is the length of the period of the respective tasks. Tasks with short period times are assigned higher priority. RM is used to schedule periodic tasks. Deadlines are at the end of the periods.

Deadline Monotonic (DM) [6]: There exists a scheduling algorithm similar to RM called deadline monotonic In the case of the DM algorithm the deadline determines the priority of the task; the shorter the deadline the higher the priority.

Earliest Deadline First(EDF) [7] is a dynamic priority driven scheduling algorithm which gives tasks priority based on deadline. The preconditions for RM are also valid for EDF, except the condition that deadline need to be equal to period. The task with the currently earliest deadline during runtime is assigned the highest priority. That is if a task is executing with the highest priority and another task with an earlier deadline becomes ready it receives the highest priority and therefore preempts the currently running task and begins to execute.

Least Laxity First (LLF)[8], also known as least slack time is a dynamic priority driven scheduling algorithm that assigns priority based on the laxity. The definition of laxity is the tasks deadline minus the remaining computation time of the task. It can also be described as the maximum time a task can wait before it needs to execute in order to meet its deadline. The task with the currently least laxity is assigned the highest priority and is therefore executed. The executing task will be preempted by any other task with a currently smaller laxity. When the task is executing the laxity remains constant. If two tasks have similar laxity they will continually preempt each other and it will therefore create many context switches.

Earliest Due Date (EDD) is a scheduling algorithm that minimizes the maximum lateness. The Jackson's rule says that given a set of n independent tasks, any algorithm that executes the tasks in order of non-decreasing deadlines is optimal with respect to minimizing the maximum lateness. The assumptions about task set for applying EDD are tasks have same arrival times(synchronous arrivals) and tasks are independent. EDD is non-premptive and EDD produces a feasible solution [9].

In [10], the study designed an implementation of dynamic real time scheduling environment using EDF algorithm. The findings of the results analysis showed that the cloudlets have spent less time in the cloud data center which resulted in better performance outcomes, also the deadline value and the number of hosts had a major impact on the cloudlets performance. Because of complexity of estimating deadline, deadline is calculated by summing the arrival time at a cloud resource and the execution time and the assumed proportional value (0.15, 0.25 and 0.5).

In [11], the scheduling algorithm schedules tasks based on length and deadline. Results were compared with traditional algorithms and comparative analysis showed reduction in makespan and average waiting time.

In [12], Hodgson's algorithm try to reduce number of tardy jobs by deferring the jobs with longest execution time. The algorithm applies EDD rule on taskset T. If each task can be processed on time, this is final schedule. Else move as much tasks with longest processing time from Ts to Tn as is needed to process each task from Ts on time The schedule subset Tn in an arbitrary order. Here subset Ts of taskset T can be processed on time and subschedule Tn=T-Ts cannot be processed on time.

III. METHODOLOGY

The research work attain to examine tasks performance that are time sensitive in cloud environment. Implement EDD scheduling policy to sort incoming tasks, assign cloudlets to cloud computing data center simulated by cloudsim using round robin scheduler, evaluate the performance of tasks by varying number of hosts, cloudlet lengths, deadline variation.

A. Conceptual Model

There are different types of real time system and the algorithm used will vary depending on the type of algorithm used. So for this research, following properties of real system has been used.

- The tasks used for the research are aperiodic tasks. That means these tasks will not repeat periodically
- The tasks are independent tasks. That means the output of one tasks will not affect other tasks.
- The real time system used is soft real time system.
- The ready time is identical. That is all tasks come at same time.
- Since ready time of all tasks are synchronous, the non-preemptive scheduling algorithm has been used

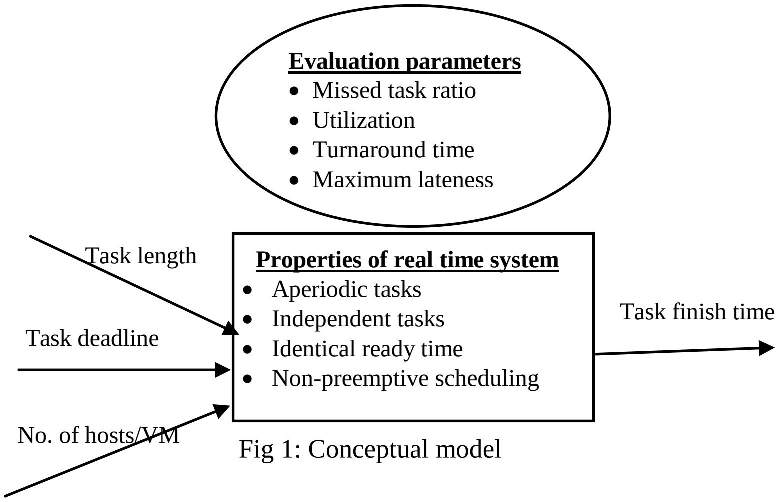

Fig 1: Conceptual model

B. Overall Process

The most important thing in RTS is meeting task deadlines. Scheduling of tasks involves the allocation of processors (including resources) and time to tasks in such a way that certain performance requirements are met. The purpose of the real time system is to execute the services within the deadline. The soft real time system has been used and static scheduling has been used. The tasks will be prioritized as per deadlines. Then the tasks are executed in multiprocessors using Round Robin load balancing technique.

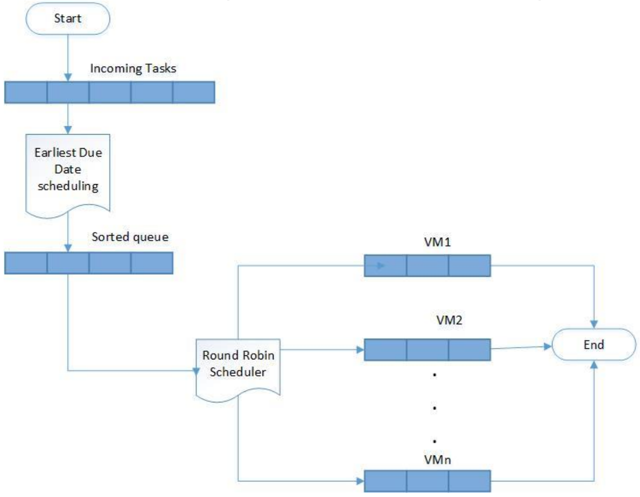

Fig 2: Flowchart of EDD algorithm

The EDD algorithm executes all tasks regardless of tasks meeting deadlines. Modified EDD algorithm first filters tasks which can meet deadline and which cannot. Those tasks which can not meet deadline are postponed at the end so that there is possibility of tasks at the bottom of the queue can meet deadline. These missed tasks are executed at the end.

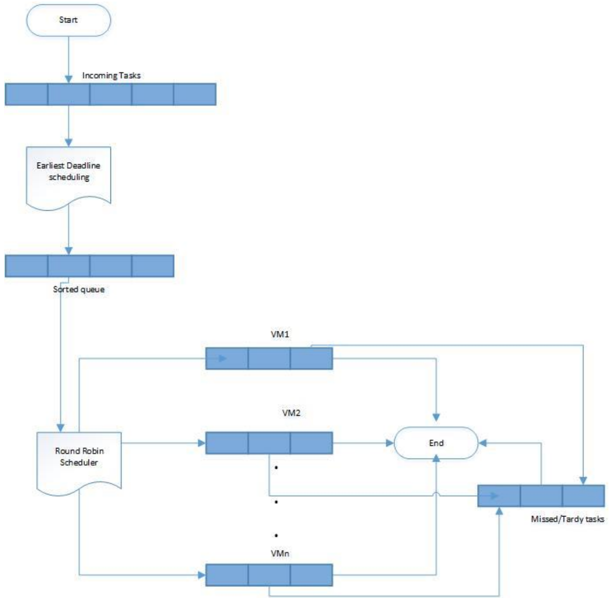

Fig 3 : Flowchart of Modified EDD algorithm

The table below shows EDD and Modified EDD algorithm in detail.

Steps	**EDD**	**Modified EDD**
One	Input tasks with varying deadline and different task length	Input tasks with varying deadline and different task length
Two	Sort the input tasks as per deadline. The tasks whose deadline is nearest is put at the top of the queue. This sorting as per deadline is called as EDD algorithm	Sort the input tasks as per deadline. The tasks whose deadline is nearest is put at the top of the queue
Three	Execute tasks from top of the queue	Execute tasks from top of the queue
Four	There are different VMs to execute tasks. Load balancing algorithm Round robin forwards each task to each server from list in order. Once it reaches last VM, the loop again jumps to first VM and start again. The load is equally distributed to all VMs in this method.	There are different VMs to execute tasks. Load balancing algorithm Round robin forwards each task to each server from list in order. Once it reaches last VM, the loop again jumps to first VM and start again. The load is equally distributed to all VMs in this method.
Five	For each VM, pick task from front of the queue and start execution.	For each VM, pick task from front of the queue and start execution.
Six	Execute each task. During execution, if tasks meet deadline, these tasks are marked as success. If these tasks cannot meet deadline, these tasks are marked as missed or called tardy tasks.	*(Modification begins)* Before executing task, find if tasks can be completed within deadline. If it can be completed within deadline, execute tasks. If tasks cannot be completed within deadline, put these tasks into missed queue.
Seven	Count number of missed tasks or tardy tasks.	Execute all tasks within the general queue. The completed tasks are marked as success tasks.
Eight	Measure different performance parameters like turnaround time, VM utilization, maximum lateness	After all tasks get executed from general queue, execute the tasks from missed queue. The execution can be done in any order. These tasks are marked as missed or tardy. *(Modification ends)*
Nine	Repeat above steps till all the tasks are completed	Count number of missed tasks or tardy tasks.
Ten		Measure different performance parameters like turnaround time, VM utilization, maximum lateness
Eleven		Repeat above steps till all the tasks are completed

Table 1: EDD vs Modified EDD algorithm

C. Data Collection

The EDD and modified EDD algorithm has been implemented using cloudsim simulator. Before implementation, the algorithm needs input data and various factors to be measured for analyzing outputs.

Input data are randomly generated within defined ranges. The most important input parameters are task length and task deadline

Generally task finish time is the parameter that need to be measured. Based on this finish time, different performance factors need to be measured like laxity time, turnaround time, missed task ratio, etc

D. Schedulability Analysis

Schedulability analysis of EDD for uniprocessor is given as [9]:

$$\sum_{k=1}^{i} C_k < d_i$$

For multiprocessor, the process should be repeated for each VM. So for m VMs, the process should be repeated for m times. The full equation for multiprocessor is given below.

$$\sum_{j=1}^{m}\sum_{k=1}^{i} C_k < d_i$$

where i=1,2,….,n
n= total number of given jobs in particular VM
m= total number of VMs
Ck: execution time of jobs
di: deadline of ith job

E. Evaluation Technique

The main performance parameters are Turnaround time, Missed tasks ratio, Utilization of VM.

a) Missed tasks ratio It is defined as ratio between number of tasks that do not meet their respective deadline to total number of tasks, that is

Missed ratio= ∑(number of tasks that miss respective deadline)/(number of tasks)

b) Turnaround Time minimizes amount of time to execute a particular task. Turn around time can be calculated as following.

Turn around time= ∑(completion time- arrival time)/(number of tasks)

c) Utilization of VMs(UV): It is defined as the amount of useful work done by VMs in it's life time, useful work means task executed on VM must meets it's deadline, that is

Utilization of VMs= ∑(size of tasks that meet deadline)/(sum of computation power of VMs in each host)

d) Lateness: It is difference between completion time and deadline of jobs.

Lj=Cj-Dj

Where Lj is lateness for jth task
Cj is completion time for jth task
Dj is deadline of jth task

Negative lateness means that all tasks completed within deadline and positive lateness means that there are some tasks that did not complete within deadline. Lower lateness means that tasks complete ahead of deadline. So all scheduling algorithms try to minimize the maximum lateness.

IV. RESULTS

The experiment was conducted by simulating in cloudsim by varying different parameters. First the EDD algorithm was implemented using these parameters. Then same data was used for implementing modified EDD algorithm. The data sets were written in text file first before executing. Then same data set has been used for modified EDD.

Only one parameter is varied during the process. The detailed outputs for different cases have been provided in the appendix. The results for different cases are described below.

A. Schedulability Analysis

Whether a task or set of tasks can complete within specified timing constraints is provided by Schedulability test or analysis. If tasks have hard timing requirements, such a schedulability analysis must be done before actual tasks' execution. It is to ensure that all tasks meet deadlines. The analysis further provides accuracy of the algorithm used.

For EDD algorithm, the schedulability analysis under different conditions have been done and it has been compared with the actual results. The comparison has been provided below.

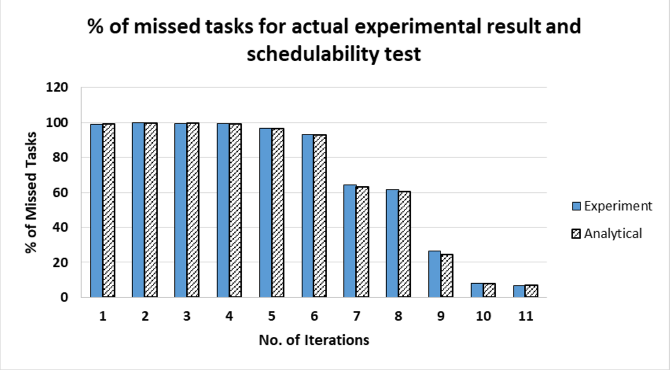

Fig 4: % of missed tasks using Schedulability Analysis and experimental result for EDD algorithm

From the diagram it is clear that the missed tasks % seems similar from both experiment and from schedulability analysis. This clarifies that mathematical equation for schedulability test for EDD algorithm is correct.

B. Evaluation parameters

1. Missed Task Ratio

Missed Task ratio is defined as ratio between number of task that missed deadline to total number of tasks. The missed ratio has been plotted against number of VMs varying different parameters like number of tasks, deadline parameters, etc.

The missed tasks was recorded for EDD algorithm first and then using same parameter modified EDD was implemented. Then graph was plotted for missed tasks % along with number of VMs used

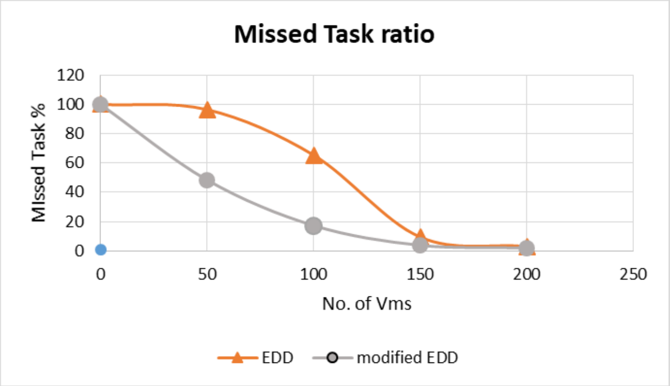

Fig 5: Missed Tasks using EDD and modified EDD

The missed tasks % decreases as we increase number of VMs. This is due to fact that if we increase the number of VMs, the tasks can be executed in different VMs and tasks pipeline will be decreased. This will helps tasks to complete soon and lesser tasks will miss the deadline. As it can be seen that the % improved in missed tasks for two algorithms is from 5.6% to 48.1 %. Modified EDD is better than EDD algorithm in case of number of missed tasks.

Missed tasks changes if deadline parameter is changed remaining all parameters constants. The missed tasks decreases as absolute deadline is increased. In this case also, modified EDD is improved than EDD

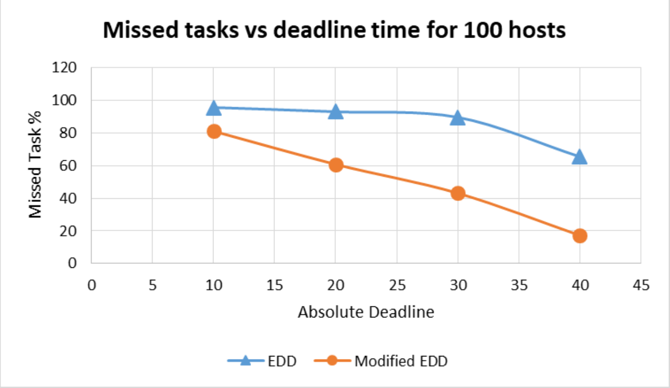

Fig 6: Missed Tasks % for various absolute Deadline time

2. Turnaround Time

Turnaround time is the amount of time that it stays in the system. Since the execution time for tasks are fixed, the turnaround time is determined by waiting time of tasks. The less turnaround time means that it has to wait lesser for executing the system. The turnaround time has been plotted against number of VMs by varying different parameters of the tasks

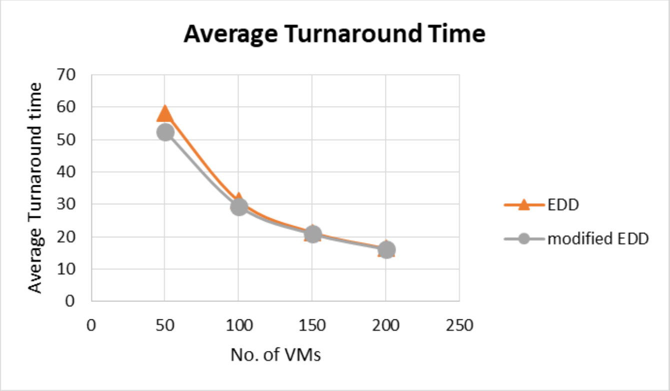

Fig 7: Average Turnaround time for EDD and modified EDD

3. Maximum Lateness

The lateness of job is defined as difference between completion time and deadline of the job. The maximum lateness is the maximum lateness value among all tasks' lateness. The maximum lateness can be either positive or negative. Negative lateness means all tasks are completed within deadline. The positive lateness means that one or more tasks are not completed within deadline.

As from the graph, it is seen that maximum lateness has not improved using modified EDD. It has been degraded while using modified EDD. It is because when tasks are executed at the end if tasks probably misses' deadline, lateness of that task will increase and ultimately effect maximum lateness

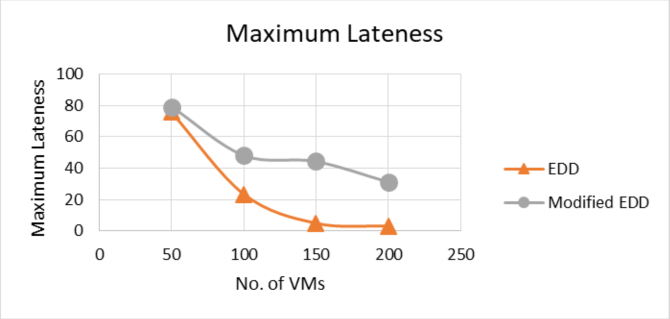

Fig 8: Maximum lateness for EDD and modified EDD

Discussion

The results have been calculated by varying random task length and deadline. From the results it was seen that for both algorithms, missed tasks percentage decreased when number of VMs was increased as it increases the computation capacity of data center. At the same time, utilization of VMs increased when increasing the number of VMs/computational capacity. Moreover the average turnaround time decreased when the number of VMs/computational capacity is increased.

Modified EDD decreased number of missed tasks further than EDD because it delays the probable missed tasks. These tasks are put aside into another queue to execute later. Those tasks which missed deadline will be executed later to give space for other jobs in the bottom of the queue. Since context switching seems negligible in terms of executing the tasks at the end of the queue, the modified EDD reduces the missed tasks.

However, modified EDD cannot improve average turnaround time. It is because the jobs which misses deadline has to wait for long time.

Similarly the maximum lateness is also not improved because of the missed tasks which are executed at the end and they are completed far from the absolute deadline

V. CONCLUSION

In this research, Earliest Due Date (EDD) algorithm has been implemented to schedule real tasks in fog computing environment using random deadline value and task length. The EDD has been implemented to reduce the maximum lateness and to decrease the number of missed tasks. It is observed that increment in absolute deadline value and number of computational power has reduced the number of missed/tardy tasks.

Comparing the results of EDD and modified EDD showed that modified EDD reduced number of missed tasks in all cases. However modified EDD could not improve maximum lateness. Average turnaround time is improved in modified EDD but it is not significantly improved.

Modified EDD can be used in cases where one need to reduce the number of missed tasks whereas EDD can be used where one needs to minimize maximum lateness.

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Systematic Management of SIM Cards

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Abstract

This is the research paper based on systematic management of sim cards. Generally, it can also be termed as the inventory management of sim cards. This system normally keeps the record of the sales, purchase or the sim cards for the particular interval of time.as of this system is designed for the retailers who are assigned by the telecommunication company for selling sim cards. Here, in this study, systematic management of sim card is for keeping the records of sim cards with its serial number, phone number, pin number, PUK code and all related codes. The main objective of this study is to terminate the traditional entry of the sim cards which was initially written in a form by hands and are stored in piles of file and systematically enter the details of the sim card. The details of the sim card along with the details of buyer is stored in the database systematically so that it can be used for future purpose as well. Acquiring systematic entry of sim card details is highly recommended by this system so that the data would not get lost.

Keywords: traditional, SIM cards, purchase, inventory, sales, customers, management.

I. INTRODUCTION

Inventory management system refer to the management of the physical resource which is hold by the business with some specific objective for balancing the need of availability of the products. It is used for automating the sales in order to fulfill the process. Generally inventory management is for keeping the track of the resources through unique codes such as barcodes, serial number which is provided by the operator themselves. It is an approach to take supply chain as a whole rather than taking it separately for some specific purpose.[1] Inventory management system is for maintaining the stocks that are kept in the ware house. The tracking and monitoring the use of the stocks helps in making the reports of the inventory status.[7] The cost can also be minimized with such kind of system. The inventory management system (IMS) helps any kind of business to analyze their processes related to sales and purchase of the products to make effective decision about inventory.[8]

In this study we are researching about the inventory management of the sim cards in the context of Nepal. In Nepal there are only three vendors via Nepal Telecom, Ncell and Smart Cell. In this system the details of sim cards will be entered in bulk. The sim cards will be provided by the telecommunication company to the retailers. The retailers get the physical sim cards along with the excel sheet of the sim card numbers in bulk amount from the respective telecommunication company and sell them either to the individuals or to other resellers. Here, we mainly focus on purchase, sell and inventory management of the SIM cards that are hold by the retailer company. In this system, we entry the customer details and the SIM card number of the SIM they have bought for registration. With this project, it will be easier for the retailer company to keep histories of the SIM card they have sold and they have given for sale. The archive of customer details along with their respective SIM card number is kept in the database of Retailer Company and for the official registration of SIM card they send a file to the telecommunication company themselves. The main objective of this project is to minimize manual process of purchasing SIM card and to manage the purchased SIM from Telecom Company and the SIM cards that have been sold to the customers.

Inventory management can be applied for the calculation of the quantities as well as managing the physical resource and its monetary value. [6]

II. PROBLEM STATEMENT

In the context of Nepal there are only three Telecommunication Company and the people from all over the country are dependent upon the sim cards from those three companies only. People mostly buy the sim cards from the retailers rather than buying the sim card directly from the telecommunication company. When the customer buys the sim card from the retailer they are supposed to fill up the form with their personal details manually, then it is stored by the retailer and handover the physical sim card to the buyer. The problem that occurs here is that the seller will have to write each and every detail of the customer as well as the sim card they hold and the chances that the paper may get lost, destroy, damage due to which when that paper is needed it cannot be made available. The retailer company will not have the exact details of how much sim cards have been sold and the quantity remained in the stock so as how much they have earned selling sim cards coming from each vendor.

III. OBJECTIVES

Every research is conducted with certain objectives. The main objectives of this research are as follows:

- To provide automated system to the retailers for keeping proper record of simcards coming from different vendors.
- To store the information of the customer in the database for future use.
- To keep the systematic record of the sim cards corresponding to its serial number received by reseller in bulk amount by the company.
- To prevent the data from getting lost and misplaced as the data will be stored in the database with proper backup.

IV. Literature Review

Review

Sim cards are mandatory if you have a cellphone and you want communication medium. Every cellphone holder needs a sim card. People buys the SIM card of any telecommunication company they want. The telecom company doesn’t sell the SIM cards on their own, so they assign various retailers to sell their SIM card. To manage all the SIM cards provided by the telecom company, this kind of system is a must to keep systematic records of the SIM cards that have been sold by the retailers.

Inventory Management and its benefits

Inventory management is a requirement of every businesses. It is for keeping the systematic records of all the stocks that the businesses hold. There are several benefits of inventory management such as it helps to take smart business decisions going through all the obstacles and challenges, it will report about all the products related with its sales and the businesses can also know about the expenditures they have made on the product. [9]

Related Study

Bession Low-Code Telecom Solutions

Bession Inventory Management system tracks plastic cards for all SIM card sizes (standard, micro, Nano, eSim) and it securely stores and manages all SIM card information, including the ICCID, PIN/PUK codes. It also manages all available phone numbers. This system manages thousands of users. [12]

V. Architecture of Overall System

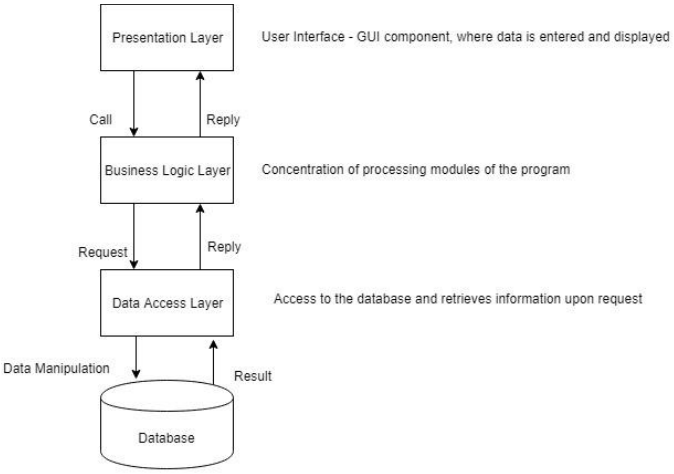
Presentation Layer
User Interface - GUI component, where data is entered and displayed
Call
Reply
Business Logic Layer
Concentration of processing modules of the program
Request
Reply
Data Access Layer
Access to the database and retrieves information upon request
Data Manipulation
Result
Database

Figure: 3-tier architecture of the system design

It is a 3-tier architecture consisting of presentation layer, business logic layer and data access layer. It also consists of a database for storing all the information that has been entered in the presentation layer. Basically, in the presentation layer, the data is entered and displayed. And in the business logic layers various operations occurs such as inserting, deleting and updating of the data that has been entered in the presentation layer. Business layer receives the data and processes them and is sent to the database. Then the database receives the request through the Data Access Layer and manipulates the database and sends the accurate data to the Business Logic Layer. And lately, business logic layer acquires the result from the database server and then finally return to the client.

VI. PROPOSED METHODOLOGY

We have proposed iterative model for designing this system. It comprises of various phases viz feasibility, planning, requirement, design, development, verification, evaluation and deployment. After all the phases are gone through finally the deployment of the software is being done following the iterative model. Iterative model mainly focuses on the primary, easy implementation and later on it gains complexity along with ongoing progress and wider feature until the system is finally accomplished.[10]

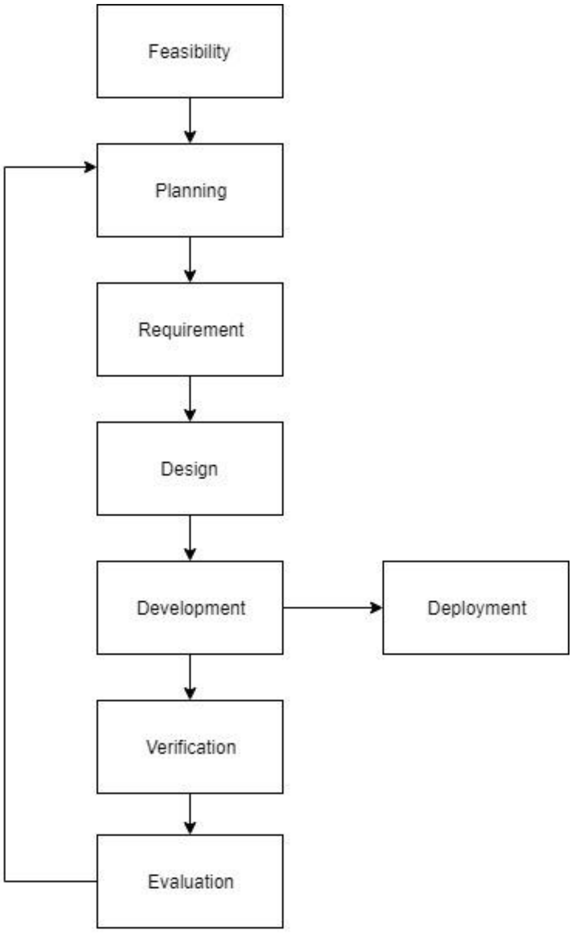

Figure: Proposed Methodology Design

For moving forward with this study, we have gone through various types of feasibility such as technical feasibility, operational feasibility and economic feasibility. After the feasibility was studied the planning of how the software is to be designed was done.[11]

Financial Feasibility

It is the process to ensure that whether the provided budget will fulfill our goal or not. The financial feasibility study is more commonly called the cost/benefit analysis. No budget was estimated for our project so it is financially feasible.

Technical Feasibility

It is the process to ensure that whether the given technology can support requirements

or that a goal is technically possible.

In context to our system we already had a necessary technical equipment’s and thereby the codes were all written by our self so our system is technically feasible.

Operational Feasibility

It is the process of deploying and operating a project.

since the system is not publicly established yet but in context to the current telecommunication company situation all the requirements have be fulfilled so it is operationally feasible.

The requirements was then collected and the software was designed and developed and the verification and evaluation of the software was carried out and finally after finishing all these processes the deployment of the software was finished.

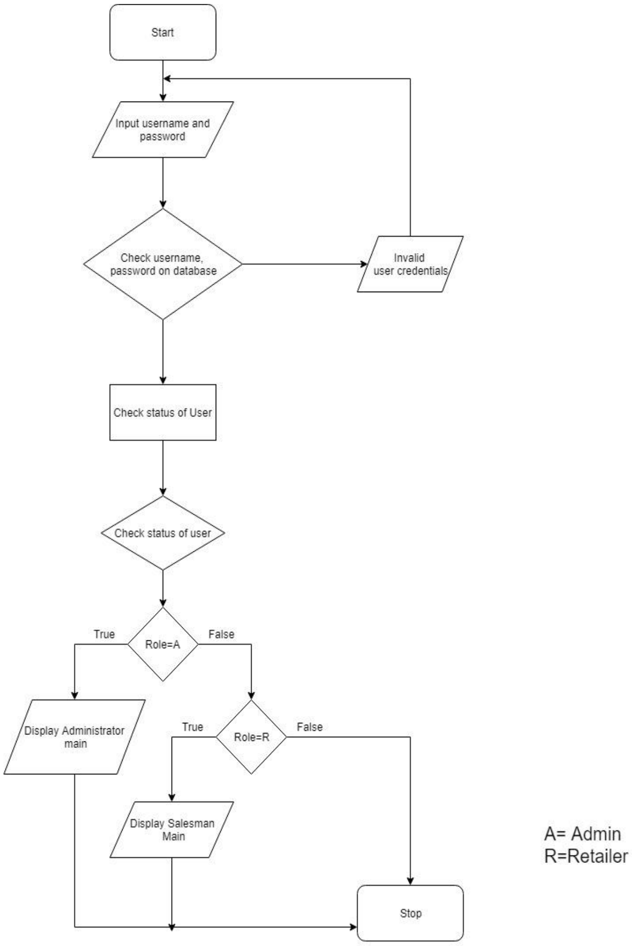

Figure: Flowchart of the system

VI. CONCLUSION

Thus, using proposed research methodology and various theories related to inventory management this system will be built for the ease of both the customer and the retailer. There will be proper detail of the customer who bought the sim card with which it will also be easier to track the person in case of corruption by that person related to thefts or criminal activities. The systematic management will also prevent data from getting lost and misuse.

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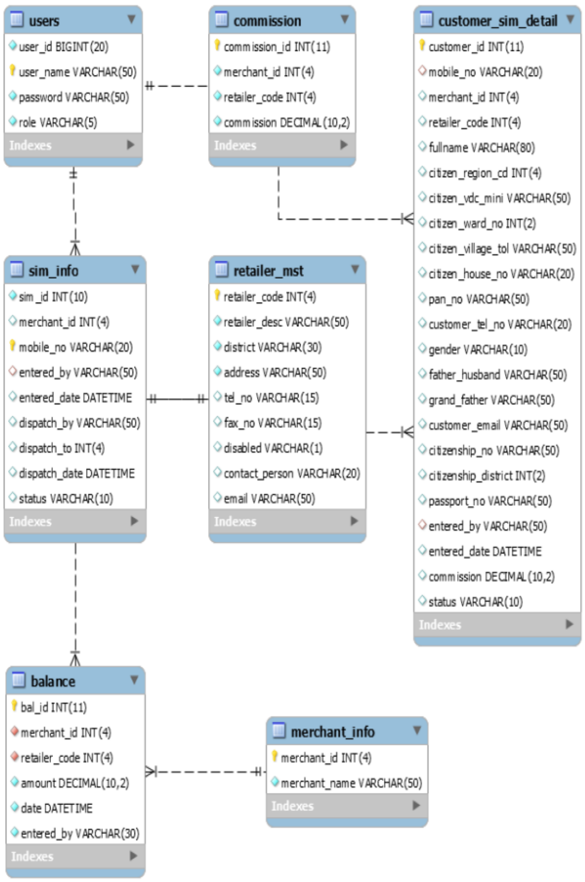

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Figure: Domain Model of System

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Weather Research and Forecasting Application Performance Benchmark using MPICH and OpenMPI

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ABSTRACT

Last few decades have experienced an unprecedented use of multi-core and multiprocessor architectures for building systems with high computational power. A large number of Message Passing Interface (MPI) implementations are currently available, each of which emphasize different aspects of high-performance computing and are intended to solve specific research problem. Weather Research and Forecast (WRF) model's performance is crucial for saving computing time. This is important because computing time in general is resource intensive and hence highly expensive. This research implements MPICH and OPENMPI as MPI's API, for shared and distributed parallelism using WRF Application. WRF build times were calculated with increasing number of cores and WRF runs were carried out on number of processors ranging from 5 till 30 in DMPar mode, and from 5 to 20 in SMPar mode. WRF run times showed significant change in SMPar with linear curve while in DMPar mode, it showed a non-linear curve with increase in number of processors both in MPICH and OPENMPI. The time taken to run WRF using DMPar mode in MPICH is lesser than in OpenMPI. In SMPar mode, WRF takes lesser time to run in OpenMPI than MPICH. The findings were such that DMPar functions better, in terms of time taken to run WRF, in MPICH and SMPar functions better in OpenMPI.

Keywords: Weather Research and Forecast, high performance computing, MPICH, OPENMPI, DMPar, SMPar Distributed Memory, Shared Memory, Run Time

1. INTRODUCTION

The Weather Research and Forecasting (WRF) Model is an atmospheric model designed for both research and numerical weather prediction (NWP). WRF Model is a next-generation mesoscale numerical weather prediction system designed for both atmospheric research and operational forecasting applications. The model serves a wide range of meteorological applications across scales from tens of meters to thousands of kilometers. One of the major features of WRF model is its software architecture which supports parallel computation and system extensibility.

OpenMPI is a particular Application Programming Interface (API) of Message Passing Interface (MPI) whereas OpenMP is shared memory standard available with compiler. These APIs are basically intended to parallel programming or parallel computation using OpenMP or MPICH for applications. MPIs are available as API of in library form for C, C++ and FORTRAN. There are numerous MPI's API available in the market, such as, OpenMPI, MPICH, HP-MPI, Intel MPI, etc. Among them, OpenMPI and MPICH, which are chosen for this research purpose are freely available and does not require license. These APIs can be used to parallelize programs. MPI standards maintain that all of these APIs provided by different vendors or groups follow similar standards, so all functions or subroutines in all different MPI API follow similar functionality as well as arguments. The difference lies in implementation that can make some MPIs API to be more efficient than other. Many commercial CFD-Packages gives user option to select between different MPI API. When MPI was developed, it was aimed at distributed memory system but now focus is both on distributed as well shared memory system. However it does not mean that with MPI, one cannot run program on shared memory system, it just that earlier, we could not take advantage of shared memory but now we can with latest MPI 3.

Shared Memory System

In Shared Memory, all processors can see whole of the available memory.

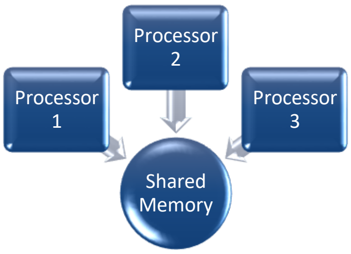

Figure 1: Shared Memory, Processor 1, 2, 3 can see whole memory

In this memory system, Weather Research and Forecasting model's domain is divided into the pieces amongst the cores of processors in a single node. The processors have a single memory and all the cores share that memory. Because the communication has to be to and fro from memory to CPU and vice-versa, there is a communication lag in every time step.

Distributed Memory System

Processor can see limited memory in Distributed Memory System. They can only use memory available to them only. Distributed memory is slightly dissimilar to Shared Memory and the differences are important. With distributed memory, WRF domain is divided up into pieces amongst more than one node. The processors in each node have their own memory; it is distributed, not shared. To share the information, the values have to be gathered, bundled, and sent to the computer(s) that need it after every time step. The time needed to do the sending prevents the run time from being halved when the number of computer is doubled. This can however be overcome using InfiniBand (IB), which is an expensive computer networking communications standard used in high-performance computing that features very high throughput and very low latency.

1.1 Problem Statement

Multiprocessor computers have different architectures in terms of the assembly of the processors with their memory. Due to the architectural differences of multiprocessor computers, there are two standards for programming in parallel—Open Multi-Processing (OpenMP) and Message Passing Interface (MPI). Parallelizing serial programs is often a challenging task, as to distribute a job over a number of processors with a minimal communication among them since the speed of the network limits the overall execution of the program. Depending upon the parallel application, it might be unknown whether MPI or OpenMPI works best based on the system resources and the scalability of the application. Thus, using WRF application this research will try to address the limitations of using parallel application with MPI vs. OpenMPI.

1.2 Research Objectives

i. To build a Beowulf cluster with MPICH in multiple nodes for Distributed Computing.
ii. To build Weather Research and Forecasting model using OpenMPI and MPICH for research purpose.
iii. To compare the performance of MPI Libraries - OpenMPI and MPICH, in WRF model.
iv. To benchmark the capability of Weather Research and Forecast model, to achieve

scalable productivity at increasing core counts.

1.3 Significance of the Study

The goal of the parallel programming is to reduce the execution time, idle time and communication time. Both the MPI and OpenMPI standards have similarities in various implementations such as source code compatibility (except parallel I/O) and support for heterogeneous parallel architectures such as clusters, grids, groups of workstations, SMP computers and etc. One of the major difference is the programming approaches that undergo SMPD and MPMD. This research approach is anticipated to help researchers, scientists, WRF users and community to choose between the distributed vs. shared algorithm based on the CPU architectures, cores, scalability of the application and other available system resources.

2. METHODOLOGY

The model for parallelism is related relatively closely to the hardware the model runs on. In installation of Weather Research and Forecasting application, Shared-memory Parallelism (SMPar) is for multi-core/multi CPUs, and Distributed-memory Parallelism (DMPar) is for clusters. In practice what happens is that OpenMP directives are enabled and the resulting binary will only run within a single shared-memory system. This option is not highly tested, however, and is usually not recommended. The resulting binary will run within and across multiple nodes of a distributed-memory system (or cluster). We can also configure for a build that includes both SMPar and DMPar. The resulting binary can be run hybrid, meaning using OpenMP for parallelism within nodes (total or partial) and MPI across nodes. Getting a hybrid build to have its OpenMP threads and MPI tasks placed properly on the processors can be difficult, though, and this option is also not usually recommended.

2.1 Cluster Configuration

In this research, focus is on OpenMP for parallelism using the SMPar and DMPar separately and then calculate the performance of Weather Research and Forecasting model on scalability. Initially the system dependencies including GNU C Compiler, v4.8.4 was installed, and then the other prerequisites for WRF application such as MPICH and OpenMPI, NetCDF, HDF5, FLEX, BISON and BYACC was installed. For the research, Beowulf cluster was used. One of the major requirements to create a Beowulf cluster was to create a password less SSH. Finally, Weather Research and Forecasting model was configured and built successfully .WRF v3.8.1 model was run with grid resolution of 5km X 5km for 12 hours data set. The cluster is configured in Dell™ PowerEdge™ M620 7-node cluster with 2 X 10 core Intel (R) Xeon(R) CPU E5-2660 v2 @ 2.20GHz. The memory used in each node is 64 gb, DDR3 1333 Mhz. Ubuntu 12.04 LTS is the operating system used for the research. The MPIs used are MPICH 3.2 and OpenMPI 2.0.2. The compiler chosen was GNU Compiler 4.8.4 and a miscellaneous package NetCDF 4.4.1.1. The entire research is performed on a parallel application- WRF (Weather Research and Forecasting) v3.8.1. The file system used is ext4.

2.2 Research Design

In a Distributed Memory, domain contains patches in application, whereas it contains tiles in shared memory. Similarly, each system job runs in processes in distributed memory whereas it runs in threads in shared memory. In distributed memory, the hardware cluster is measured in nodes, and in shared memory parallel it is measured in processors.

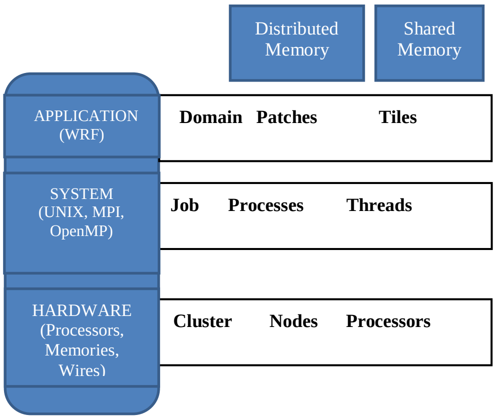

Figure 2: Research Design in Distributed and Shared Memory Parallel

WRF, WRF- Chem and WPS were compiled using the tarballs. In first step WRF was built from source, WRF-Chem unzipped to WRF folder. The second step included building WPS from source.

3.3 Weather Research and Forecasting Model build

The compilation was successful and the following executables were created in WRFV3/main:

1. ndown.exe
2. real.exe
3. tc.exe
4. wrf.exe

3.4 Weather Research and Forecasting Preprocessor (WPS) Build

The compilation was successful and the following executables were created in WPS:

1. geogrid.exe
2. metgrid.exe
3. ungrib.exe

3.5 Weather Research and Forecasting Compile using DMPAR – GFORTRAN

Weather Research and Forecasting model was compiled in dmpar mode using GFORTRAN compiler.

3.6 Data Collection Technique

The GRIB (*GRIdded Binary* or *General Regularly-distributed Information in Binary form*) data format sets taken for the research is obtained from the Computational and Information System Laboratory at the National Center for Atmospheric Research (NCAR) in Boulder, Colorado.

For this research, 12 hours of data set of January 15, 2016 was considered and the area under consideration was for 5x5 km^2.

4. RESULTS AND DISCUSSION

4.1 Weather Research and Forecasting Application Build Time

The time taken by Weather Research and Forecasting application was observed against increasing numbers of cores. It was observed that with increasing core counts, the time taken to build WRF decreased linearly. WRF Build Time was recorded to be 12 minutes 59 seconds while WRF compiled using 1 socket and 6 core. Similarly, WRF Build Time was recorded to be 13 minutes 46 seconds while WRF compiled in 1 socket and 5 core, 19 minutes 49 seconds while WRF compiled with 1 socket and 2 core. WRF Build Time was recorded to be 31 minutes 51 seconds while WRF compiled using 1 socket and 1 core.

With increasing numbers of core, the time taken for the Weather Research and Forecasting model to build decreases linearly. That is to say that WRF build time depends on number of cores. This is same in both the cases of DMPar and SMPar mode. WRF run time depends on mode that is being used to run the application. But, unlike WRF run time, WRF build time does not depend on mode (DMPar mode or SMPar mode).

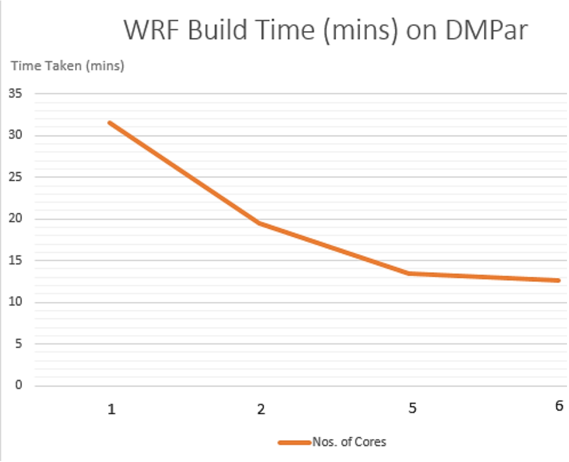

Figure 3: Weather Research and Forecasting model build time (mins) using DMPar

WRF run time was measured across 5, 10,15,20,25 & 30 cores using DMPar mode in MPICH and OpenMPI respectively. While doing so, a non-linear curve was obtained which showed comparatively better performance of DMPar mode in MPICH over OpenMPI.

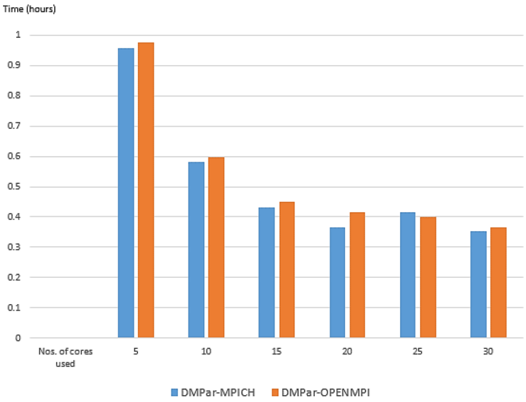

Figure 4: Time (hrs) taken to run WRF using DMPar in MPICH vs. OpenMPI

Similarly, WRF run time was measured across 5, 10, 15 & 20 cores using SMPar mode in MPICH and OpenMPI respectively. While doing so, a non-linear curve was obtained which showed comparatively better performance of SMPar in OpenMPI over MPICH.

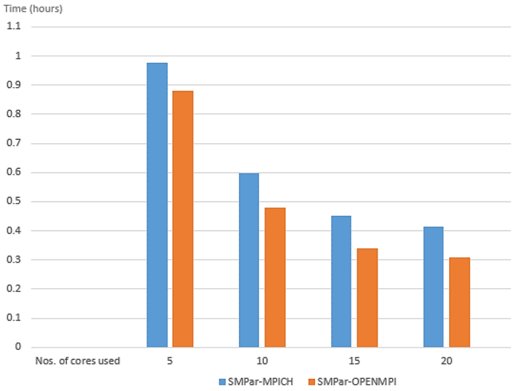

Figure 5: Time (hrs) taken to run WRF using SMPar in MPICH vs. OpenMPI

4.2 Efficiency Calculation of MPICH in DMPar mode

Nos. of Cores	DMPar-MPICH Time (hr)	DMPar-OPENMPI Time (hr)	Efficiency (DMPar-MPICH)
5	0.96	0.98	**2.11**
10	0.58	0.6	**2.51**
15	0.43	0.45	**4.67**
20	0.36	0.42	**13.89(Peak performance)**
25	0.42	0.4	**3.87**
30	0.35	0.36	**3.14**

Table 1 : Efficiency calculation of MPICH in DMPar mode

From table 1 above, in DMPar mode using MPICH, it is seen that the peak performance is obtained while using 20 cores. With the increase in the number of cores, efficiency has gradually increased up to 20 cores, thus generating a non-linear graph. On 5 cores, DMPar mode is seen 2.11% more efficient in MPICH than in OPENMPI. Similarly on 10,15,20,15 and 30 cores, DMPAR is 2.51%, 4.67%, 13.89%, 3.87% and 3.14% efficient respectively. This performance lag in DMPar mode is basically observed due to communication lag and network latency.

4.3 Efficiency Calculation of MPICH in SMPar mode

Nos. of Cores	SMPar-MPICH Time (hr)	SMPar-OPENMPI Time (hr)	Efficiency (SMPar-OPENMPI)
5	0.98	0.88	**10.75**
10	0.60	0.48	**24.57**
15	0.45	0.34	**32.72**
20	0.42	0.31	**35.21**

Table 2: Efficiency calculation of OPENMPI in SMPar mode

From table 2 above, OPENMPI in SMPar mode is observed to be more efficient than MPICH in the same mode. With the increase in the number of cores, efficiency is seen to be gradually increasing, generating a linear graph. On 5 cores, SMPar mode is seen 10.75% more efficient in OPENMPI than in MPICH. Similarly on 10, 15 and 20 cores, SMPAR is 24.57%, 32.72% and 35.21% efficient respectively in OPENMPI. This performance lag in SMPar mode is fundamentally caused due to communication lag.

5. CONCLUSION

Weather Research and Forecasting Model's significance for meteorology and atmospheric modeling rests largely on the fact that over the years, it has supported as well as stimulated a productive and evolving community by providing solid common ground on which to pursue ideas and build on results. Large-scale data sets bring a great time and space complexity for WRF performance benchmarking by using various memory algorithms, especially with open source software. However, this research proves upon the conclusion that in best practice, MPICH is better to build Distributed Memory Parallelism (DMPar), and, OpenMPI to build Shared Memory Parallelism (SMPar).

In conclusion, time taken to run WRF using DMPar mode in MPICH is lesser than in OpenMPI. On the other hand in SMPar mode, WRF takes lesser time to run in OpenMPI than MPICH. This is to say that DMPar functions better, in terms of time taken to run WRF, in MPICH and SMPar functions better in OpenMPI. Furthermore, the curve is non-linear when compared with no. of cores vs. WRF run time, for both MPICH and OpenMPI in SMPar or DMPar mode. This means that increase in number of cores does not necessarily mean the WRF output will have significant changes in its performance in DMPar mode. The research will help identify the Intel architecture with varied number of processors best for running WRF dataset.

6. RECOMMENDATIONS AND FUTURE ENHANCEMENTS

The two-way interactive nested grids are engineered in the Weather Research and Forecast (WRF) model such that they can be efficiently integrated in parallel computing architectures that use distributed memory, shared-memory, and hybrid (distributed/shared) memory configurations. This research focuses on distributed memory algorithm and shared memory algorithm implementation in WRF benchmarking. There can further be a future study using Hybrid option, which used both SMPar and DMPar mode for WRF performance analysis. Similarly, memory consumption at every number of cores taken into consideration can be measured. Due to resources limitation, the research was performed up to 20 cores in SMPar mode. Thus, in SMPar mode, the performance curve of WRF can be observed over large domain with nos. of cores greater than 20.

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Potential Sectors to use ESRI Story Maps in Nepal

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Abstract

This paper focuses on potential use of cloud based ESRI (Environmental Systems Research Institute) story map for Nepal. Government, INGO, NGO, local agencies and others generate data and maps related to topics important to their work but they are not as interactive nor user friendly and are limited within organization. Here, story maps can be considered as one of the powerful way of sharing and engaging end user in simple, effective and efficient way. Story maps is a web application that combines interactive maps with narrative text, images and multimedia content to tell a story. Different sector of Nepal can benefit with the use of story map, as it helps to convey message in compelling way, enhance the public engagement with data and interactive maps and communication. ESRI story map uses ArcGIS Online cloud based platform so one need not worry about hardware.

Key Word: ESRI, Story map, cloud based platform, ArcGIS, web application, mapping

Introduction

Maps are the one of the efficient ways of conveying a huge amount of information in a simple way. For many past centuries it has been used to tell stories in different forms, such as, stone carve, paper, wooden carve, etc. They can summarize a situation, show pattern, and trace a route, location and many more. Nowadays, maps have been integrated with data analysis and technologies like geographic information systems (GIS), web, mobile and cloud. With these evolution in technology "ESRI", one of the pioneering in ArcGIS, is the world's most powerful mapping and analytics software. ESRI Story Maps are web based application used to powerfully communicate by telling story using the capability of interactive maps, digital multimedia, images, text to educate, inform and entertain in unique and understandable way. It helps people to understand the additional information about the location, region, event and problems under there working areas.

Nepal is a landlocked country in South Asia with two technology giants: China and India as neighboring countries. Though Nepal is lagging behind in development, accessibility of internet to public is growing rapidly. Visual interactive map based story telling can be effective for sharing knowledge focusing on particular topic making user engaged and bridge the gap between technology and people, with internet as a preliminary requirement. Story map enables scientists, researcher, educators, professionals and others to enhance their ideas, methods in interactive maps with multimedia, text and figures in compelling way to communicate with large and non-expert audience. ESRI Story Maps are open source, cloud based platform of ArcGIS online, and can easily be used to communicate.

Elements of Story Maps

Nearly all story maps share these common elements: the story or narrative component itself, text, spatial data, cartography, supporting content, and user experience.

Story

Story is the concept or message that a story map is intended to communicate. If the story is complex, it's possible that it should be made into several story maps.

Text

Text for stories published in digital media should be as brief as possible.

Spatial data

Story maps are derived from a variety of sources, such as, existing maps, aerial or satellite images, GIS data published as a map service, tabular data with location information, mash-ups or combinations of various maps.

Regardless of the data type, only content that directly supports the story should be collected and included; if it doesn't, it should most likely be deleted. It should come from a credible source, and the source or sources should be cited within the story.

Cartography

Good cartography is attractive and understandable representation of spatial information and is essential to a good story map.

User experience

The user experience, or the design and presentation of interactive functionalities, should be as intuitive and unobtrusive as possible.

Story Map for Education

Story Maps can be exceedingly effective interdisciplinary teaching and learning tool. Inclusion of story map technology in education is increasing in number of countries abroad, and this is expected to strengthen the creativity, multidimensional experiences and communication of students. Extracting important results or data and presenting in meaningful and simple way with the help of maps enables student to understand the context more clearly and can still have the focus intact.

Story Map for Tourism

Tourism contributes greatly as one of the largest sources of foreign exchange and revenue generation in Nepal, and is one of the major economy of the nation. In the recent years, development of ICT (Information and communication technologies) and its usages have revolutionized tourism industry and the influence of it is observed in Nepal greatly. Internet amenities and mobile applications have changed the tourism industry sectors and its practices, as the trend of using such services for travel planning and experiencing are becoming travel staples. To contribute upon the trend, GIS (Geographic Information Systems) can play an important role in tourism in Nepal by promoting various locations and answer to numerous geographically challenging whereabouts. Information of both major and minor landmarks can be easily illustrated using story maps. ESRI Story Maps application helps user to combine authoritative maps with narrative text, images and several multimedia content, making it easier to harness the power of maps to tell geographical stories. It can showcase places on an interactive map with details of each place.

Story Maps for natural disaster

Nepal is prone to various natural calamities and is continuously suffering due to earthquake, flood or landslide, causing severe impacts to communities. Risk communication is a vital part in the efforts of impact reduction attempts. Effective communication can bring behavioral changes in society which can lessen the causalities of natural hazards. Story Maps shows a media approach to natural hazards and risk communication by combining maps, videos, images and also text messages on an online interface. This helps in mitigation, preparation, operations, response, recovery and disseminating public information. Timely and accurate mapping of disaster areas is important for efficient and effective management of relief activities. It can help reduce loss and damage due to floods.

Story Maps for Government

Common usage possibilities of Story Maps can be depicted in day to day governmental undertakings. It can help to design and plan by evaluating alternative solutions and create optimal design. Similarly, it aids in decision support by gaining situational awareness and enabling information-driven decision making. Story Maps makes effective sharing and collaboration by empowering everyone to easily discover, use, make, and share geographic information. It enables analytics by discover, quantify, and predict trends and patterns to improve outcomes. In data management, Story Maps contribute to collect, organize, and maintain accurate locations and details about assets and resources.

Implementation of ESRI’s Story Maps in ICIMOD (International Centre for Integrated Mountain Development)

ICIMOD has been telling the stories on a wide variety of issues and findings in the Hindu Kush Himalayan regions through interactive map, text and multimedia components, through Story Maps. Story Maps have been created for “Assessing the Agricultural Difficulties in Nepal”, which describes how farmers are demoralized by the problems that they are facing in the field. Similarly, a story map based on the report - "Glacial Lakes and Glacial Lake Outbrust Floods in Nepal" was published in 2011. Story Maps was used to build “Understanding Forest Fragmentation in Lorpa Watershed”. Other international implementation of story maps has been to compare the changes in glaciers in Bhutan Himalayas in a decade, to locate tourism resources of Haa, Bhutan and to prepare flood inundation maps in view of the floods and landslides that 2017’s monsoon has triggered in Bangladesh. In addition to these, ICIMOD supported government during 2015’s earthquake to disseminate information about number of health post, schools, open space and other facilities using Story Maps. ICIMOD has also won the third prize in the ESRI Storytelling with Maps Contest under the category ‘Best Travel and Destinations’ at the ESRI conference, which was held in San Diego, USA on 2014. The story map drew attention to the 14 highest peaks in the world, all of which are above 8000 meters and located in the Hindu Kush Himalayan region. The story includes a general narrative with the images of the 14 peaks and a brief description of each peak. The map was developed using GIS based location data, and images and information compiled from various sources. The images of the peaks were arranged in descending order of altitude. Users could click on the image or on the number provided on the map to learn about a particular peak.

Methods of Creating Story Maps

There is a provision of two different options in order to use ESRI's story maps, public subscription and organizational subscription.

Organizational subscription

To become a member of an ArcGIS online organization, user or the organization's administrator needs to subscribe an ArcGIS organizational account and configured Enterprise logins. Organizational subscription allow the administrator not only customize homepage but also administer the organization as a whole. This includes managing user accounts, monitoring accounts, creating groups, access roles and manage the security policy.

Public subscription

If user is not a member of an ArcGIS Online organization, he or she can create a public account to access ArcGIS online. Public subscription offer a limited set of functionality. A public accounts lets author to make web maps and share maps, data, and applications with others. User can also get access to content shared by ESRI and GIS users around the world.

A public account comes with 2GB of total storage space. You can upload items up to 1 GB in size.

Story Maps are part of ArcGIS Online, ESRI's cloud-based mapping and GIS platform, so users can sign in with ArcGIS Online account to create stories. Story Maps along with the maps and data used are hosted securely in ArcGIS Online, without any download or installation requirement.

Ways to build story maps:

1: Using the builder tools

Story builder is an easy method of implementation which does not require any coding. It simply requires a click on Build button for selected app templates.

2: Creating web map in ArcGIS online

User needs to develop map on ArcGIS Online which can then be shared to create story map web application.

3: Downloadable configurable apps

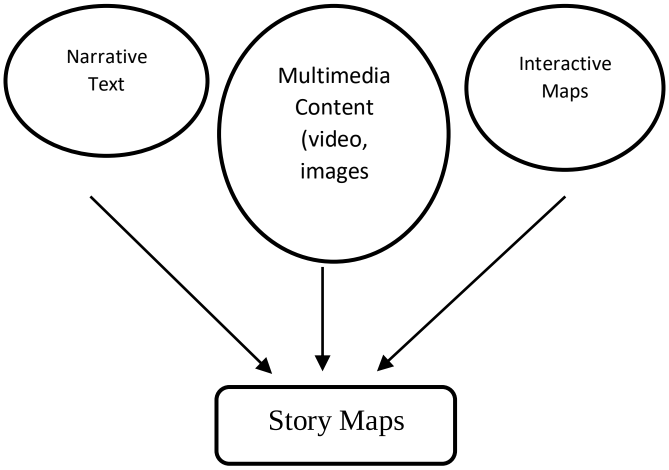

Fig 1: Components of story maps

Result and Discussion

Story Maps have been used as a convenient and efficient means of communication at ICIMOD for the past couple of years, and its application is increasingly becoming adoptive in the organization. The simplicity of its use is the biggest advantage, thus, enabling the possibilities of its inclusion in several sectors of Nepal. Short and concise text assists reading and understanding. This approach is required as people have limited attentional resources. Maps support the understanding of natural disaster issues spatially and allow user to interact with the Story Map resource. This is likely to improve retention of information. Story Maps' in-built interactivity is very important and enables individuals to engage with the resource. For example, asking those at risk to identify their homes and level of risk could be a useful engagement exercise. Using a balanced mixed media approach, to communicate hazard and risk information is important and helps alleviate information overload. It also potentially supports multi-sensory learning, which has associated benefits.

There are several geographically challenged touristic areas in Nepal whose information is not available online. For all such locations, creating a story map helps to make the information available in an interactive way to visitors. This also enables them to strategically plan the visit and stay. Similarly, an illustration of potentially vulnerable areas of the nation can greatly minimize the impact of various natural casualties, addressing the lack of effective risk communication through story maps. For educational purposes, an instructional interaction with students help to foster effective teaching-learning environment. It further enhances student's ability to interact with map and allows to explore spatial patterns and trends which leads to understanding about the true nature of a geographic phenomenon. The story map can be a brainstorming tool for government to create spaces and opportunities for communication, participation and knowledge sharing.

One of the challenges is achieving a high quality digital product using the web as medium. Nevertheless, current web mapping technology provide the means to develop high quality thematic map and base map and research in web map cartography. The story map can be updated more frequently and cost-effectively through electronic publication rather than paper publication, and links to more materials can be incorporated.

Conclusion

The goal of this study is to suggest how story maps can be best utilized in various potential domains in the context of Nepal. There are several potential areas including, but not limited to, education, tourism, natural disaster and government, in Nepal, which can highly benefit by the use of Story Maps. The effectiveness of this technology within a critical GIS framework can be understood, evaluated and discussed by both non-users and users of it. Involving students actively in the process of creating storytelling with maps can spark their creativity by thinking and telling their own stories. Storytelling with maps is an opportunity to promote imagination to solve problem and think beyond normal boundaries. Interactive atlas provides for a more engaging, interactive, and exploratory environment for government. Last but not the least, accurate location information presentation in a graphical way can enhance user's capability of navigation and can thus be an effective means of communication.

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Information and Communication Technology Challenges for Digital Tourism Business Model for Nepal

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Abstract: Information and Communication Technology has created a huge impact on the business models. It has changed the way business was done few years ago, redefining business in the light of digital technologies. Tourism is one such vital industry that finds enormous application of Information and Communication Technology on it, changing the entire value chain from tourism creation and marketing to distribution and consumption. Tourism is one of the biggest industries of Nepal and the government of Nepal has targeted this industry as a prime source for economic development. Nepal government has identified that the role of ICT is vital for the growth and development of Tourism. Besides a lot of technological development and innovation in global tourism industry, Nepal is unable to attain benefits from the application of Information and Communication Technology. In our study we have examined the factors that are responsible for poor implementation of ICT in Tourism industry of Nepal. We employ qualitative exploratory method based on interviews, structured and semi structured questionnaires to accomplish the study. The study contributes in finding the factors responsible for poor implementation of ICT and analyzes the challenges regarding its implementation. Further, the findings are elaborated to build a conceptual framework for Digital Tourism Business Model for Nepal.

Keywords**: ICT, Tourism Industry, Digital Business Systems, Tourism Model.**

I. Background

Tourism has grown as an industry worldwide in the last two and half decades and has outshined traditional industries to become one of the world's largest and fastest growing economic activities [4] [5]. Scholars have found that there is a huge transition in Tourism industry in the current times due to penetration of Information and Communication Technology [5]. The use of ICT to promote tourism and overcome geographical challenges has become particularly important. The application of ICT is the most important aspect for a successful tourism economy [1][5][6] as the whole industry relies on correct and timely information. ICT plays a vital role as an information carrier in case of emergency situations, changing climatic conditions and other sensitive aspects. Thus ICT serves as a backbone for this industry integrating the beneficiaries, the service providers and product sectors [11], making it as a solid chain of interdependent components.

ICT is a boon for the under developed countries like Nepal and it can serve in many aspects to gain advantage in business, governance or other sectors. Nepal heavily relies on Tourism and it has become a leading economic activity. Tourism Industry is a main contributor in GDP of Nepal and generating huge employment. The government of Nepal has realized that in order to grow economically and generate employment opportunities, it must focus on the Tourism Industry. Moreover, it has also realized the importance of ICT in Tourism Sector. There are many plans and policies initiated by the government to take advantage of the global information network and increase the national and the international competitiveness in Tourism industry. Despite this vision a little or marginal progress is made and there has been no recent research focusing on understanding ICT usage in the tourism sector. This work argues that due to the lack of research in this area, ICT application in the tourism industry needs a deeper investigation. Thus, this study aims to analyze the current ICT infrastructure of Nepal and highlight the challenges that are seen in the adoption and integration of ICT. Further a broader conceptual model for Digital Tourism Business Model for Nepal is also discussed.

II. LITERATURE REVIEW

Studies on ICT use in the tourism industry have shown that the use of ICT is not only a vital component of the tourism industry, but that ICT will continue to be crucial tool, especially for developing countries (UNCTAD, 2005). The adoption of Computer Reservation System (CRS) in airlines in 1950s and the transformation to Global Distribution Systems (GDSs) in the 1980's, Hotel property management systems and hotel CRS systems later, are some on the oldest application of ICT in tourism [9][10]. The birth of Internet brought a revolutionary changes to the structure of this industry by letting the service providers sell their products and services directly [9][10][11]. There are new models in practice which threatened the intermediaries worrying them of being cut off and replaced [8][9][10]. The Internet has become a key success factor for hotel operations, affecting distribution, pricing, and consumer interactions (O'Connor & Murphy, 2004). Work of (Poon 1993) analyzed the rapid shift-taking place between traditional tourism sector and new tourism industry [3]. Deepti Shakner revisited the work of Poon and Sheldon and talked about ICT applications in different sectors like airlines, hotels, tour operators, road and rail transport [9]. Similarly, many prominent authors talked about the role of ICT in Tourism and how the new technology will further change this industry.

Tourism in Nepal started with the camping accommodation since the very beginning of the 1950s when Maurice Herzog and his team scaled Mt Annapurna on June 3, 1950 and Tenzing N Sherpa and Edmund Hillary first ascended Mt Everest in 1953 [4]. The formal growth of accommodation facilities in Nepal started with the establishment of 'Royal Hotel' by a Russian national, Mr Boris Lissanevitch, in February 1955 [4][6]. The planned development of tourism in Nepal started after 1956 with the starting of the first five-year plan (1956-1961 AD) and subsequent establishment of Tourist Development Board in 1957 under the Department of Industry [2][4].

Scholars in Nepal have studied various aspect of tourism time and again including tourism as an economic activity to change in biodiversity. The scholars like Adhikari, and Ghimire have studied tourism as an economy, the impact of climatic changes on tourism and change in biodiversity. The Nepal Tourism Board and scholars of Kathmandu University studied tourism as source of economic and social change, expeditions in Himalayan region, natural life and biodiversity Shrestha and Jeong worked on use of ICT in Tourism Industry and they highlighted the problems faced by tourist in Nepal [12]. Most of the scholars have worked in Tourist studies in Nepal but only few have talked about the role of ICT in Tourism.

III. Research Methodology

The study under consideration is exploratory in nature and employs qualitative research methodology as a part of the research. The data collection was carried out for a period of two months which included face to face interviews, structured survey and semi structured surveys with the Government officials, the Tourism Industry Practitioners and the Tourist in Pokhara and Kathmandu. The data was collected from 125 persons including the above three types. The Tourism Industry Practitioners constituted 32%, Government Officials constituted 24% and Tourist constituted 44% of the share in data collection as depicted in figure 2. Collection of reports, literature and data related to ICT and Tourism Industry of Nepal was considered as secondary part of the study. The components of the study included:

- Face-to-face interviews and Group discussions with Government officials, managers and employees of service sector as a dominant form of data collection.
- A survey based on semi-structured questionnaire for a random sample of Tourist, in Lakeside, Pokhara and Thamel, Kathmandu was conducted.
- Collection of existing designs, reports, documents and literature related to ICT and Tourism Industry of Nepal.

IV. The Research Design

The research design consists of data collection from three prominent players of Tourism Industry, the Government officials, the Tourism Industry Practitioners and the Tourist. The collected data is analyzed using statistical tools and supported by references from related literature in the field. The data is then interpreted to infer results and construct a model for Digital Tourism Business of Nepal a shown in the figure 1 below.

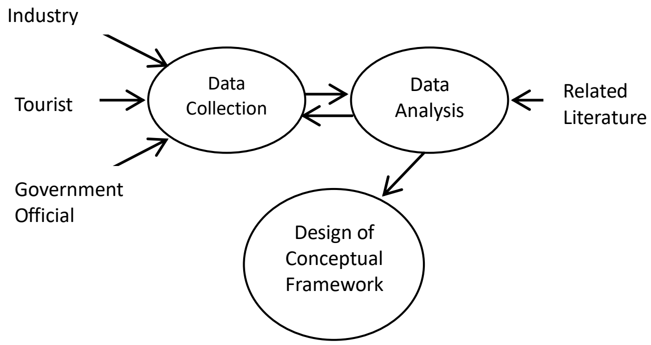


Fig 1. Representation of respondents participation percentage in the survey.

V. Data analysis and findings

This section represents the data analysis and findings of the data collected through qualitative research methodology for understanding the challenges in the implementation of ICT in Nepal Tourism Industry.

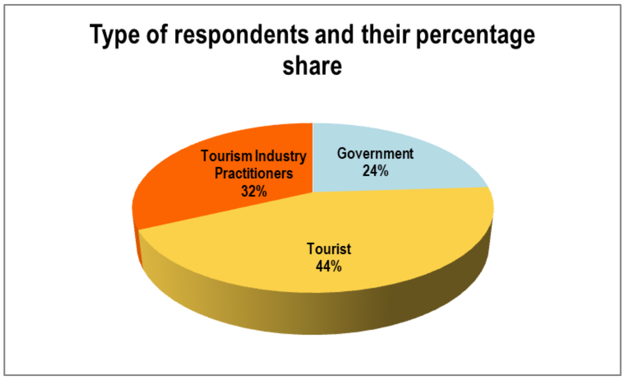


Fig 2. Representation of respondents participation percentage in the survey.

The three major components of study: the Government officials, the Tourism Industry Practitioners and the Tourist are included to collect data and analyze at various levels. The survey concluded that ICT is considered as a major component for the tourism industry but different factors were responsible to see the successful implementation of ICT in tourism. There were different types of challenges that were posed in the implementation of ICT in Tourism Industry of Nepal. The study revealed that there are some gaps observed in the ICT and Tourism Industry of Nepal which are depicted in figure 3.

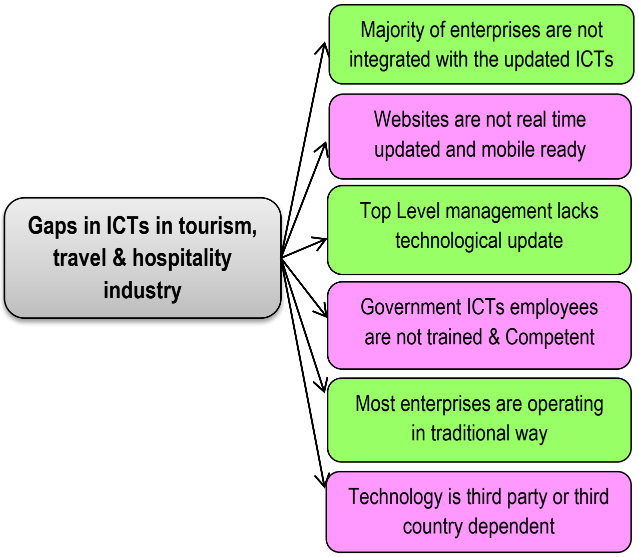

Gaps in ICTs in tourism, travel & hospitality industry
Majority of enterprises are not integrated with the updated ICTs
Websites are not real time updated and mobile ready
Top Level management lacks technological update
Government ICTs employees are not trained & Competent
Most enterprises are operating in traditional way
Technology is third party or third country dependent

Fig 3. ICT and Tourism Industry gaps.

Further the overall ICT scenario was related to broader concepts like Infrastructure, Planning and lack of vision in the implementation of ICT. The geographical challenges, educational challenges, cultural and social barriers were also significant factors. About 38% of the respondents agreed that ICT technologies and systems are improving in Nepal, 21% rated good and equal number of percentage rated it bad. It was surprising to see that 9% were of the view that ICT systems and services are in a non-existent state.

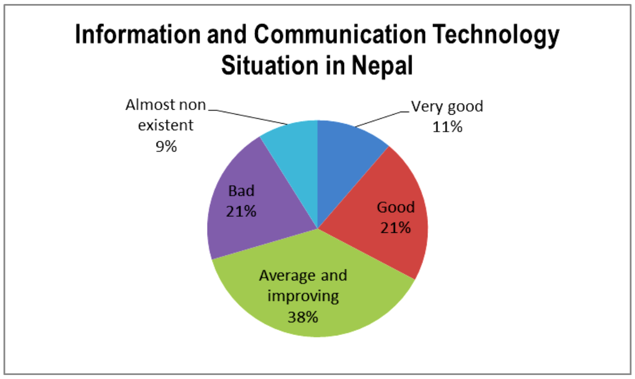


Fig 4. Information and Communication Technology situation in Nepal

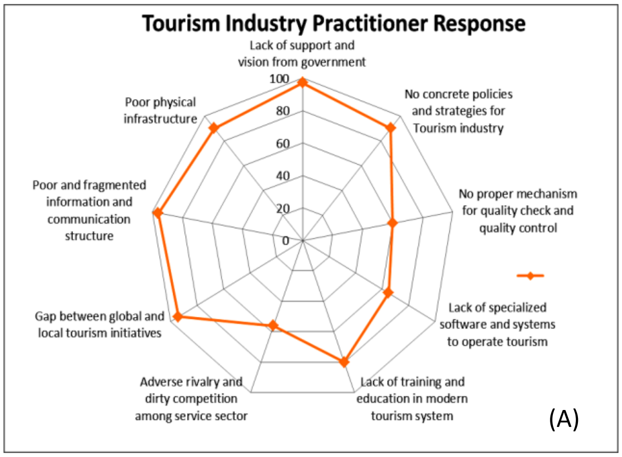
They explained there reasons for putting it this way were due to surficial use of ICT. They argued that ICT is used as a supporting tool and in a very limited state with no concrete implementation. Further explaining their view they said still electronic transaction are still not possible in Nepal. There is no e-business, e-transaction and e-payments existing in Nepal, whereas the world is using these services at ease in the Tourism sector. Nepal, according to them lacks far behind in the implementation of a full-fledged ICT in Tourism business.

The interview and survey of government officials stated that ICT is very important tool not only for tourism but as a whole proper functioning of e-governance. They were of the view that it is mandatory for tourism and tourism ministry cannot ignore the power of ICT in better performance of tourism industry in Nepal. They brought out several factors that are responsible for the poor functioning of ICT in Tourism sector of Nepal. The factors that were listed our by them were of main concerns for the government of Nepal as it mostly related to poor governance or lack of governance initiatives as depicted in the Table 1 below.

Table 1. Factors responsible for poor performance of ICT in Nepalese Tourism Industry

Government Officials response	
Lack of Strategy and Vision	80%
Poor marketing and management	70%
Lack of Physical Infrastructure	90%
Lack of Technological Infrastructure	60%
Lack of Policy and policy vacuum	65%
No Central database	98%
Geographical challenges	88%
Lack of coordination between ministries	60%
Less competency with new technological tools	55%
Lack of fully automated services	55%
Rely on traditional and digital method of working	60%
No specialize tools and systems for Tourism	65%
Lack of Integrated system approach for all the related components	79%

The other major respondent of the study included the Tourism Industry practitioners. The analysis of data depicted that tourism service sector was using ICT systems and tools at an extensive level. The introduction of internet had changed the way tourism business was done before. The industry practitioners stated that almost every activity they do in the business in related to ICT directly or indirectly. The industry respondents were of the view that besides such an extensive use of ICT in their business they lack way behind in the use and application of ICT. Their main reservation was for the government and its lack in the proper planning, development and implementation of ICT. The main factor raised by them was in terms of planning, policy and execution. Other factors included infrastructural development, geography, work culture, education and training in the related sector as some of the major challenges faced by tourism industry in terms of ICT as depicted in figure 5a. and 5b.



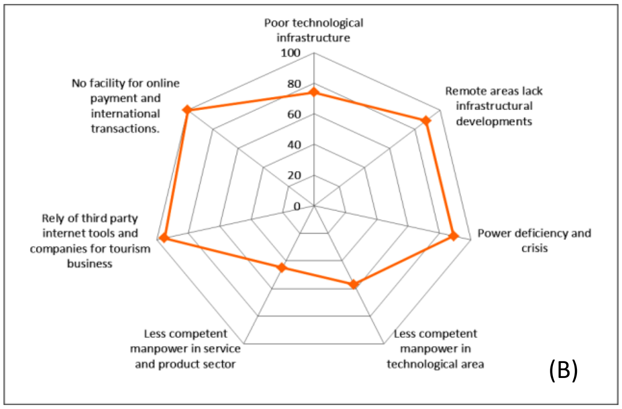


Fig. 5a. and 5b.depict the factors responsible for poor ICT in Tourism as per survey

Tourists are the main part of the business and are the source of tourism industry. An understanding of the need of the tourist is mandatory in the understanding of this research. The growth of ICT has boomed the internet and empowered users as the ultimate decision makers. The tourist in Nepal had major complaints in the tourism industry regarding poor logistic and hospitality. Regarding ICT they were not satisfied with the way ICT was implemented in the tourism sector. They were of the belief that Nepal lacks far behind in the implementation of ICT as compared to global scenario. The lack of proper information, incomplete information, random information and incredible information were some of the major concerns of the tourist. They pointed to the fact that Nepal till date has no payment gateway and majority of the tourist have to depend on travel agencies or tourist agents for payment and other services that sometimes are not as good as expected. The lack of ICT as a core tools has abandoned quality check, proper information management and proper monitoring. Some of the core issues raised by tourist are depicted in the table 2 below.

Table 2: Tourist respondent responses regarding the ICT in Tourism Industry of Nepal

Tourist Customer response factors
Poor global reach and presence on the internet and websites
Poor promotional plans and inadequate Information access
Lack of Proper Management of Tourism Infrastructure and Services.
The internet connectivity is not available everywhere across the country
Fragmented databases and information gaps in all sectors of Tourism.
Lack of proper information access to International tourist on health, hygiene and ecology.
Very less data on websites / portals / books / brochures regarding tourist destination in Nepal.
No proper integration and communication mechanism of public sector, private sector, local and community tourism sectors.
No proper channels and mechanism for information update in terms of natural hazards change in biodiversity, ecology.
No plans to mitigate emergency situations and accidents occurring in the tourist destinations.
Poor and dangerous transportation system
Lack of trained and skilled manpower in the tourist industry.
No legal frame works and standards in service industry to guarantee quality tourism.
No quality standards checks for products and services in tourism
Variable prices and random services depending on negotiation
No clear policies regarding product and services of Nepal
Tourism sector is mostly controlled by private sector resulting in inconsistent services
Lack of electronic payments and automated services.

VI. THE CURRENT SCENARIO OF TOURISM INDUSTRY AND ICT DEVELOPMENT IN NEPAL

This section deals with understanding the current status of Tourism industry of Nepal and development scenario of ICT Infrastructure of Nepal from available data and literature.

A. The Current Status of Tourism Industry in Nepal

Tourism is a vital industry of Nepal and the direct contribution of Travel & Tourism to GDP was NPR85.2bn (USD0.8bn), 3.6% of total GDP in 2016. Travel & Tourism directly supported 427,000 jobs (2.9% of total employment). [7][16]in 2016. This is expected to rise by 6.0% in 2018. Visitor exports generated NPR48.6bn (USD449.8mn), 17.7% of total exports in 2016. Travel & Tourism investment in 2016 was NPR16.5bn, 3.0% of total investment (USD0.2bn) as show in figure (2)(3). The service sector has 4819 industries registered with government of Nepal, [7] including Star hotels, International Airlines, Domestic airlines, Paragliding etc.

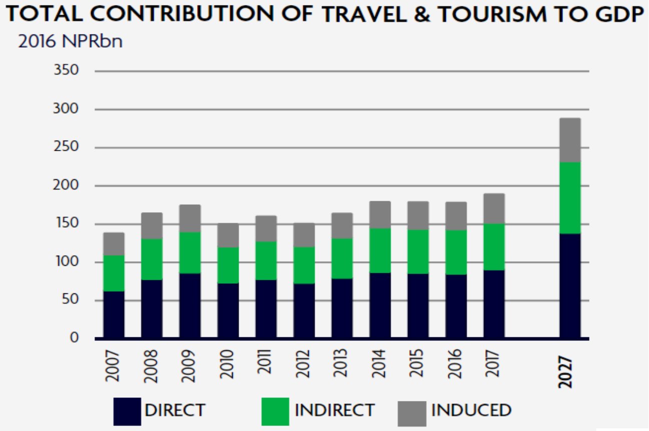


Fig.6. Contribution of Travel and Tourism to GDP of Nepal. Source: World Travel & Tourism Council.

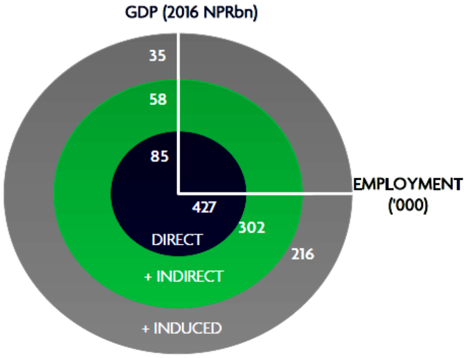


Fig.7. Contribution of Travel and Tourism to Employment of Nepal. Source: World Travel & Tourism Council.

The data available from World Travel & Tourism Council indicates a positive inclination of tourist inflow in Nepal. It can be observed that there is an increase in the number of tourist visiting in Nepal since 2013 A.D. with 2015 as an exception due earthquake. The other years show gradual increase of tourist number in Nepal. The government of Nepal plans to increase the number of tourist visiting Nepal by 2020 to 29.6% in the current state as shown in fig. 4. [7][17]

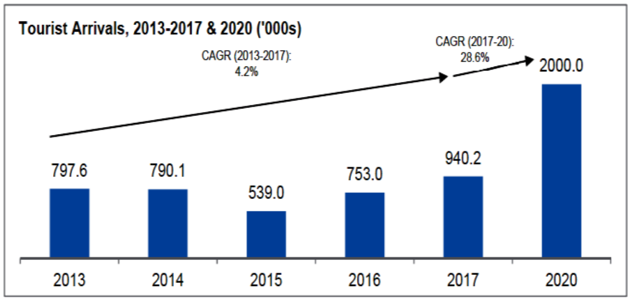


Fig.8. All figures are rounded. The base year is 2013; Source: World Travel & Tourism Council; Frost & Sullivan analysis

B. The ICT Development Scenario of Nepal

The development of ICT in Nepal started with the establishment of Nepal Doorsanchar Company - a government owned entity established in early 1913.(Rathjens, Butman, and Vaidya, 1975). [13] [14] In 1980 the digital exchange system was established making telecom services available to the general public. The major technological breakthroughs of Nepal are listed in the table (6) below. [14] [15]

Table 3
Stages of ICT development in Nepal

1913	Nepal Doorsanchar Company
1971	Introduction of computer in the country for census (IBM1401)
1974	Establishment of the Electronic Data Processing Center
1980	Digital Exchange System
1985	Distribution of Personal Computers in Nepal
1992	Establishment of Computer Association of Nepal
1996	Establishment of the Ministry of Science & Technology
1998	Telecommunications Act 1997 and Regulation
1998	Establishment of Nepal Telecoms Authority (NTA)
2000	Announcement of the first IT policy, “IT Policy 2000”
2001	Establishment of the National Information Technology Center
2003	GSM and CDMA services. Formation of HLCIT
2004	Telecommunication Policy 2004
2004	Electronic Transaction ordinance 2004
2006	Electronic Transaction Act Oct, 2006
2007	3G Network and Data Services
2010	Announcement of IT Policy 2067
2017	4G Mobile Network Service
2018	ICT Digital Frame Work

Source compiled form reference[7][13][14][15]

The ICT development of Nepal was not upto the mark till 2005 and it is seen that from 2005 onwards the government of Nepal has concentrated its direction to the development of ICT. Currently, the country has introduced all the latest technological innovations in the sector of communication with mobile penetration rate of 113% in 2017 and internet penetration rate of 57% in 2017 shown in fig. (5), (6) [17]. There is still a lot of gap is seen in the software systems, integration and interconnection of digital system and the country still has fragmented database and poor informational content with regard to tourism industry.

Table .4
4G developments and Investment in 2017

4G Telecom Providers	4G Network and Coverage	Investment 2017-18
Nepal Telecom 50% share in Nepalese markets	Launched: 1, Jan 2017 Current coverage: 2 cities 591126 customers	ZTE, Huawei and Mavenir will invest $15.36 million, $38 million and $21 million respectively to provide LTE core network service to Nepal Telecom
Ncell 46% share in Nepalese markets	Launched: 1, Jun 2017 Current coverage: 21 cities 1079013 customers	Investment more than $460 million for technology transfer and infrastructure
Smart Telecom 4% share in Nepalese markets	Launched: 1, Nov 2017 Current coverage: 4 cities 39155 customers	Investment around $110 million (80% direct investment from Kazakhstan)

Source, Nepal Digital Framework 2018.www.moict.gov.np

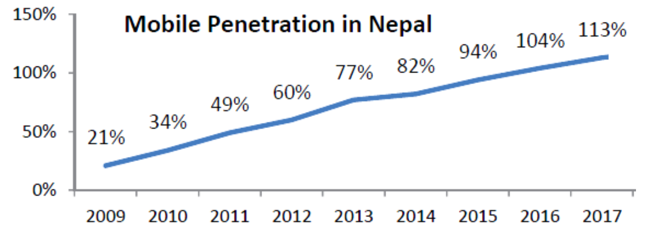


Fig.9. Statistical data representing mobile penetration in Nepal, Source, MIS report of Nepal Telecom Authority, March 2017.

In terms of Human Capital Nepal has shown a positive growth in literacy rate with a positive trend of 59.6% in Asia as per data of 2016. The social site statistics show that Nepal has 24% active users with Facebook 91.03%, YouTube 5.52%, Twitter 1.15%, Pinterest 0.91%, LinkedIn 0.61%, Instagram 0.35%. The current ICT scenario of Nepal looks acceptable and the ICT services can be extensible used with effective planning in the Tourism Industry of Nepal. [7]

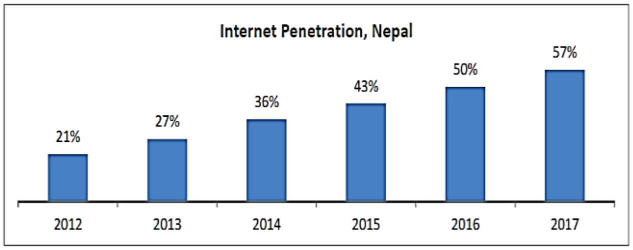


Fig.10. Data regarding Internet penetration in Nepal. Source, MIS report of Nepal Telecom Authority, March 2017.

VII. Digital Tourism Business Model

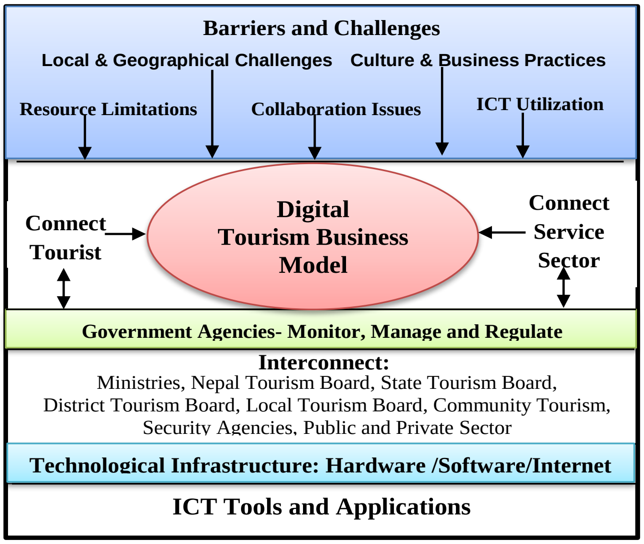

Barriers and Challenges
Local & Geographical Challenges
Culture & Business Practices
Resource Limitations
Collaboration Issues
ICT Utilization
Connect Tourist
Digital Tourism Business Model
Connect Service Sector
Government Agencies- Monitor, Manage and Regulate
Interconnect:
Ministries, Nepal Tourism Board, State Tourism Board,
District Tourism Board, Local Tourism Board, Community Tourism,
Security Agencies, Public and Private Sector
Technological Infrastructure: Hardware /Software/Internet
ICT Tools and Applications

Fig11. Conceptual framework for Digital Tourism Business Model

The data analysis and findings highlights the basic problems that are barriers to successful implementation of ICT in Tourism Industry of Nepal. Based on the data and finding and using existing ICT infrastructure we propose a Digital Tourism Business Model to address the current of Tourism Industry of Nepal. The proposed model is a six layered design with each layer addressing the specific problem of ICT implementation in Tourism Industry of Nepal.

The whole data analysis and findings can be summed into 5 major barriers and challenges of ICT implementation in Tourism industry of Nepal that include:

- Local and Geographical challenges
- Cultural and Business practice challenges
- Resource and Infrastructural challenges
- Collaboration and Communication issues
- ICT Utilization challenges

These barrier and challenges can be addressed by integrating all the player of Tourism Industry into a single model with distinct layers performing distinct functions. Layer 1 highlights the barriers and challenges of the industry that need a core understanding and proper planning to address the depicted problems. Layer 2, 3 and 4 represent the solution to the current problems by interconnecting the players of the Tourism industry through the proposed model at the core. The technological infrastructure available at the present time is sufficient to address the current needs. The figure 12 highlights the requirements of ICT tools and applications to addresses the issues of cultural and business practice, resource limitation, ICT utilization and geographical and local challenges.

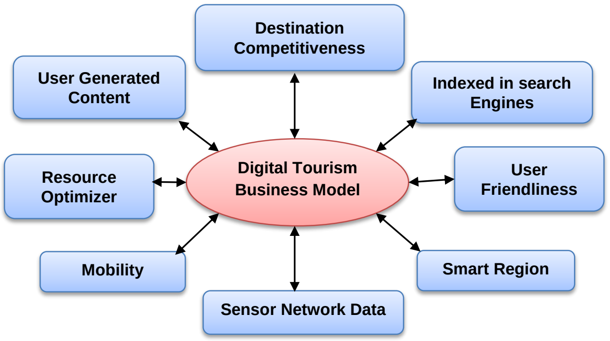


Fig.12.The dimensions of Digital Tourism Business Model Applications.

The proposed model must build in the software applications and tools that are not resource hungry and have the user friendliness characteristics like language and interface. The system should inbuilt GIS based system to provide mobility and smart region navigation. The mobile devices with sensors should be recognized by the system and assist the tourist or service sector with knowledge areas. The system should be free to collect user generated content and work on analyzing data based on visitor's emotional dimension. The system should be easy available through web and indexed in search engines to provide quality and timely information.

VIII. Conclusion

The study undertaken reveals that ICT has a poor and fragmented implementation in Nepal. The data analysis shows that none of the respondents are satisfied with the current scenario of ICT in Tourism. They point out to many factors that serve as a challenge for the successful implementation of ICT in Tourism Industry. The major challenges are seen at the policy and planning level, Resource and infrastructural level, cultural and business practice level, Infrastructural development level, Collaboration and Communication between government, public and private level, and ICT Utilization level. The current scenario of tourism industry and technological growth in Nepal shows positive indication of massive growth in tourism sector. It is seen that the introduction of mobile services with high speed data network can satisfy the information needs with proper planning and implementation of digital system at all levels. The growth of Tourism arrivals in Nepal depict that Nepal has immense scope in tourism and with proper application of ICT it can double its tourism business. The initiatives taken by government show a positive outlook of the government for this industry. The government only needs to lay proper plan and policies for implementation of ICT in tourism industry of Nepal. Finally, with proper focus and planning of ICT in tourism industry of Nepal, the business in this sector can be boosted as expected.

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Context-Aware Privacy Preservation Approaches on Location Based Services using Recurrent Neural Network

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Abstract—
With the widespread proliferation of usage of social networks, smartphones and smartphone apps, privacy preservation has become an important issue. This has led to increased concerns about the privacy of the underlying data. Various social media, mobile devices and sensors are collecting huge amount of data daily and analyzing them for business purpose or designing more convenience systems. But on the run, privacy of people has been on threat. Service providers might have chance to misuse the individuals private information. On the other side, facilitating people for making their lifestyles easier and automated systems can be more expecting. Thus, data mining by preserving the privacy can be the best way. The existing privacy preservation approaches for smartphones usually are less efficient due to the lack of consideration of active defense policies and temporal correlations between contexts related to users. Among various types of data collected according to various contexts, the privacy of trajectory data collected by Location Based Services (LBS) is also very important according to contexts for various persons and groups. In this paper, through modelling the trajectory data and the temporal correlations among contexts, we present an efficient approach that preserves the privacy of location data of users from adversaries dynamically on the basis of the sensitivity of user's context. Our efficient approach adopts active defense policy and decides how to release the current location information and contexts of a user to maximize the level of Quality of Services (QoS) of context-aware apps and services with privacy preservation. To make our approach more efficient and robust, and increase privacy involving long-term dependency we have used Recurrent Neural Network (RNN) model irrespective of the traditional Markov Chain model to model the trajectory data and contexts and their temporal correlations. Further, we have adopted the "release and deceive" policy and implemented a special kind of RNN i.e. Long-Short-Term-Memory (LSTM) and treated sensitive contexts as exceptions to preserve the sensitive contexts. We have conducted the extensive simulations on real datasets and compared the performance of our algorithm and approach with previous approaches on the basis of privacy, performance and utility of data.

Keywords— ***Context-Aware Privacy Preservation, Data Mining, Location Based Services, Recurrent Neural Network***

I. Introduction

Nowadays, smartphones have been greatly proliferated and smartphone applications (apps) and social networking sites have been widely developed. Specifically, context-aware apps greatly facilitate people as context-aware personalized services related to people' contexts have been provided. In fact, a variety of sensors (e.g. GPS, microphone, accelerometers, magnetometer, light, and proximity) embedded in smartphones have the capability to measure the surroundings and the status related to the smartphone owner and then provide related data to context-aware apps. The sensory data can be exploited to infer the context or the status about a user. For example, the location information of a user can be reported by GPS data, the transportation state (e.g., walking, running, or standing) can be evaluated by the accelerometers, and the voice and scene can be recorded by microphone and camera, respectively. Furthermore, the inferred context can be further analyzed by context-aware apps for providing context-aware personalized services. Examples of such applications include *GeoReminder* that notifies the user when he is at a particular location, *JogBuddy* that monitors how much he jogs in a day, *PhoneWise* that automatically mutes the phone during meetings, *SocialGroupon* that delivers coupons or recommendations when he is in a group of friends, etc.

However, these context-aware mobile applications raise serious privacy concerns. Today, people already believe that risks of sharing location information outweigh the benefits in many location based services [12]. One reason why risks are high is that many mobile applications today aggressively collect much more personal context data than what is needed to provide their functionalities [13] (for example, a calculator application might send the user's location to an advertisement server). Moreover, applications rarely provide privacy policies that clearly state how users' sensitive information will be used, and with what third-parties it will be shared. To avoid the risks, a user can decide not to install these application or not to release any context information to them (by explicitly turning off sensors); but then the user might not be able to enjoy the utility provided by these applications. In order to explore a better tradeoff between privacy and utility, we can let the user control at a fine granularity when and what context data is shared with which application [14, 15]. For example, a user might be okay to release when he is at lunch but he might be hesitant to release when he is at a hospital. With such fine-grained decisions, a user can choose a point in the privacy-utility tradeoff for an application and can still enjoy its full functionality when he chooses to release his context information or when his context information is not actually needed.

The context-privacy preservation for smartphones is not an easy task because there exist high temporal correlations among human contexts and behaviors in daily life, and these temporal correlations can be used by adversaries to infer the hidden sensitive information. Consider a user who suppresses his location when he is at a hospital. This, however, might not be sufficient: when he releases his non-sensitive context while he is driving to the hospital, the adversary can infer where he is heading. Similarly, when he releases the use of a hospital finder app, the adversary can again infer where he is heading. In these cases the sensitive context can be inferred from its dependence on non-sensitive contexts. In general, we want to guard against inference attacks from *adversaries knowing temporal correlations*. Such adversaries are realistic because human activities and contexts exhibit daily and weekly patterns. For example, Bob is at work at 9am during the week and he always picks up his children from daycare after returning from work. In most of the literatures, human behavior and activities have been modeled with a simple Markov chain over contexts with transition probabilities that generate the stream of contexts [13, 14, 15]. A Markov chain captures frequencies of contexts and temporal correlations. Adversaries can gain knowledge about patterns and frequencies of contexts from observing a person to create a rough daily schedule or by using common sense; for example, knowing that Bob works full time at a bakery, the adversary can guess that he is most likely to be at work at 9am.Although it is clear that Markov chain is not sufficient to model the location data and contexts, most works use a first-order Markov chain to model the transition probability of trajectory. To the best of our knowledge, it is well-known that *Recurrent Neural Networks (RNN)* is very powerful in modeling the trajectory [16] and time correlated contexts [17]. For example, its *Long-Short Term Memory (LSTM)* variant can well capture long-term dependency. In the model implemented with Markov chain and hidden Markov chain, most of the approaches clearly specify that the adversarial can use Bayesian reasoning to infer the sensitive contexts of the user. To prevent the posterior belief of adversaries to accurately predict the sensitive contexts, they have used δ- privacy parameter and make a relation between posterior and priori belief of the sensitive contexts, so that the sensitive contexts cannot be accurately predicted.

As far as the contexts generated by trajectory data is concerned, the hidden Markov chain are limited to short term dependency and if we consider human contexts of location based services, the better modeling can be done with long-term dependency using LSTM RNNs. Unfortunately, we are not able to directly adopt RNN to model trajectory because of the unique constraint trajectories face. Unlike normal sequence (e.g., sentences), trajectories capture the movements from one edge to another while the movement is constrained by the *topological structure* of road network. Motivated by above findings, we dedicate this paper to new models that can effectively model trajectories. Our goal is to make full advantage of the power of RNN to capture variable length sequence and meanwhile to address the constraint of topological structure on trajectory modeling. As a summary, we make following two main contributions in this paper. First, to the best of our knowledge, this is the first attempt on adopting recurrent neural network techniques to model trajectories and time correlated contexts and on other side we approach that using LSTM and modelling sensitive contexts as exceptions so as to release the deceived contexts and thus providing better privacy preservation approach with best performance and utility than previous approaches.

For modeling sequential dependency, gated Recurrent Neural Networks (RNN), such as Long Short Term Memory (LSTM) and Gated Recurrent Unit (GRU), have achieved the best performance in many sequence model applications [20]. However, there are some technical challenges for integrating temporal context into RNNs. When check-ins are very sporadic and sparse the sequential feature should be “forgotten” due to vanishing of sequential dependency while the temporal context should play an active role for prediction. Thus it is infeasible to feed sequential and temporal contexts together into gated RNN and control them with a single sigmoid gate. Motivated by these findings, we propose a novel Context Aware Recurrent Neural Network approach to leverage the spatial-activity topic for improving the activity and location prediction. As the activity and location prediction share the same inputs and are both influenced by spatial activity topics, we adopt a multi-task learning neural network to predict users’ activities and locations simultaneously. To integrate the context information and sequential pattern, and elevate sequential and temporal regularity of spatial-activity topics, we propose a novel Context Aware Recurrent Unit (CARU) as hidden layer unit. CARU calculates the sequential hidden state to capture the sequential dependency and takes the temporal context as an extra input. After a nonlinear activation function, the temporal context is integrated with sequential hidden state dynamically by a sigmoid gate. Through evaluation on real-world public datasets, the proposed model shows a considerable improvement of better privacy preservation performance.

II. RELATED WORKS

With the rapidly growing popularity of smartphones as well as popular mobile social applications, various kinds of mobile smartphone apps are developed to provide context-aware services for users. Meanwhile, individual privacy issues on smartphones are increasingly receiving attentions due to the risk of disclosure of user’s privacy sensitive information. Various approaches have been proposed to protect users’ sensitive information in location-based services (LBSs) and participatory sensing applications [12]. In fact, most previous privacy protection techniques focus on the static scenarios [7-10], in which the instant sensitive location information is protected without consideration of temporal correlations among locations. The hiding or deception policies are first used in location privacy preserving approaches in [14, 15], in which the current location information of a person may be hidden or a fake location is released to replace the real one if the current location information is sensitive and should not be accessed by untrusted apps. Among the techniques, spatial cloaking and anonymization are widely adopted [7-10], in which the identity of a user who issues a query specifying his/her location is hidden by replacing that user's exact location with a broader region containing at least k users. However, these techniques do not protect privacy against adversaries who have the knowledge of the temporal correlations between contexts. Moreover, the anonymity-based approaches do not readily imply privacy sometimes. For example, if all the k users are in the same sensitive region, an adversary would know the fact.

There have been several popular works of privacy protection against adversaries who are aware of the temporal correlations between contexts [13-15]. The work in [13] considers that an adversary can adopt a linear interpolation to infer the supposedly hidden locations from prior-released locations of a user, in which some zones containing multiple sensitive locations are created in order to increase uncertainty that the user dwells at one of the sensitive locations. Due to the suppression of sensitive locations and the uncertainty of zones, this approach greatly reduces privacy disclosure compared with the simple hiding-sensitive policy.

MaskIt [7] is the first approach to preserve privacy against the adversaries who know the temporal correlations between the contexts of user. In MaskIt, a user's contexts and their temporal correlations are modeled with a time heterogeneous Markov chain, which can be also observed by an adversary. By hiding most sensitive contexts and partial non sensitive ones, MaskIt can increase the difficulty of inferring the hidden sensitive context by adversaries and thus could achieve a better privacy and utility tradeoff. As aforementioned, the number of suppressed contexts is much greater than that in the simple hiding-sensitive approach, leading to a degraded utility and functionality.

The work in [15] considers the interaction between a user and an adversary as well as the temporal correlations between contexts. Unlike MaskIt, in [15], a user controls the granularity of the released contexts, and an adversary has limited capability which means the adversary can only obtain a subset of the user's contexts as the goal of attacking and then actively adjusts his/her future strategies based on the attacking results. In this approach, the interactive competition between the user and the adversary is formalized as a stochastic game, and its Nash Equilibrium point is then obtained. Since the released contexts are some granularity of the truth, the adversary can only gain partial contexts, thus decreasing the privacy disclosure to some degree. On the other hand, since the deception policy is not applied, the obtained contexts by the adversary are still approximately consistent with the truth, which also could be used by the adversary to infer the real sensitive contexts.

A number of privacy preservation techniques have been proposed by using access control techniques, in which the smartphone resources are controlled by the user defined access control policies. To avoid the drawbacks of MaskIt, the privacy preservation approach in [15] is developed using "release and deceive" privacy policy and explains various propositions to defend various cases and scenarios to deal with adversarial attacks on time correlated contexts. The model approached for smartphones to preserve sensitive contexts, used δ-privacy parameter to prevent from adversarial attacks using Bayesian reasoning making them difficult to find exact posterior belief using prior belief of contexts.

Besides the aforementioned mechanisms, a variety of privacy preservation schemes have been introduced in other application scenarios like data collection [7-10], medical care, influence maximization ,collaborative decision-making [19], and others [12]. But most of the proposed approach include short-term dependency and need various steps and propositions to make the model secure against adversaries. To the best of our knowledge, our approach is the first work to provide an efficient optimal approach in which the deception policy is introduced with privacy preservation while considering the temporal correlations between user contexts. In the proposed approach, a Recurrent Neural Networks (RNN) is used to model the trajectory data and the generated contexts. Besides using normal recurrent neural networks, we have used Long-short-Term Memory (LSTM) model of RNN to model the trajectory and hence the contexts. The sensitive contexts can be stored as exceptions and can release false contexts as output form LSTM so that adversaries cannot easily infer the posterior belief. The modeling approach of trajectory using RNN in [16], modeling contexts in [17], the possible reasons of attacks in [21, 22] paved us the way to model the discrete time samples including time correlations using RNN LSTM. We believe that our data in LSTM can be the best model with privacy preservation.

Trajectory models have been adopted to solve many problems in location-based services. [16, 17] both implement route recommendation which returns, for a given destination, the trajectory with the highest probability. [16] adopts trajectory modeling alike technique to recover the missing portions of a trajectory. [13] uses IRL model to solve map matching problem which is actually a trajectory model extended from [19]. Prediction tasks such as [17, 18] also benefit from trajectory modeling by predicting the probability of road transition. However, most of these works use a first-order Markov chain to model the transition probability, which is not able to capture the long-term dependencies and meanwhile suffers from sparsity problem [16]. Among these works, [16] and [17] are most relevant to trajectory modeling. Both works solve the problem by recovering the implicit reward through a bunch of historical actions performed by drivers which is similar to finding out the latent features of products from the opinion stream.

III. SYSTEM MODEL & PRELIMINARIES

3.1.1. System Model. We illustrate a smartphone context sensing system in Figure 1, where the privacy preserving system protects a user's privacy context from those untrusted smartphone apps.

In Figure 1, the raw sensory data are first collected by smartphone sensors and filtered by the privacy preserving system, which in turn transmits the processed sensory data to those untrusted context-aware apps. Thus, the privacy preserving system served as a middleware in the system, and then the untrusted context-aware apps could not access the raw sensory data and could only obtain the released sensory data from the privacy preserving system. In the process of handling the sensory data, the privacy preserving system infers the related context from the collected sensory data by using the model about the temporal correlations between user contexts and then releases the filtered sensory data with privacy preservation. Based on the released sensory data from the privacy preserving system, the context about the user could be reasoned and the context-aware services are accordingly provided to the user by the context-aware apps with the capability of obeying the user's privacy protection policy.

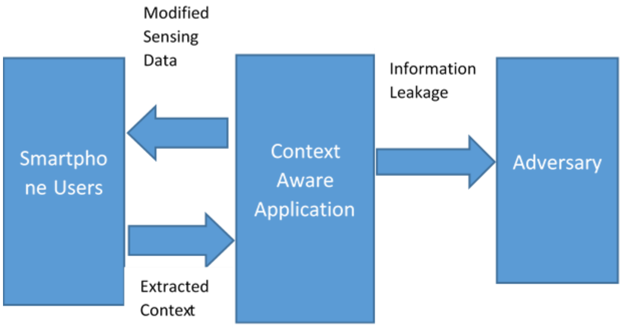

Figure 1. Smartphone Context Sensing System

User's context can be inferred from sensory data. That is, at any time the privacy preserving system can obtain user's context according to the collected sensory data. So, in the following we use context to represent the related sensory data for ease of illustration.

In this paper, we adopt periodic discrete time as in [13-16]. At any discrete time period **t** a user's context $\mathbf{C_t}$ can be inferred and then handled by the privacy preserving system, and then the result context $\mathbf{O_t}$ can be inferred and then handled by the privacy preserving system, and then the result context $\mathbf{O_t}$ is released to the context-aware apps with privacy preservation. To preserve user's privacy, the output $\mathbf{O_t}$ is released to the context-aware apps with privacy preservation.

To preserve user's privacy, the output $\mathbf{O_t}$ from the privacy preserving system falls in two different forms, real or fake. The real ($\mathbf{O_t} = \mathbf{C_t}$) means the raw sensory data related to the real context Ct is released to the context-aware apps. On the contrary, a fake context means the context $\mathbf{O_t}$ inferred from the released sensory data is not the original context $\mathbf{C_t}$ at time t.

Based on the user's predefined privacy parameter, the privacy preserving system makes a decision to release the real sensory data or a fake one with the goal that the expectation of the released real contexts is maximized while guaranteeing the privacy preservation. Unlike the "**release or suppress**" paradigm in [13], the privacy preserving system in this paper introduces the "**release or deceive**" paradigm in [14, 15] to increase the number of releasing real contexts while guaranteeing user's privacy.

Moreover, the proposed Privacy Preservation Model for Context-aware Privacy Preservation System can be implemented in block diagram as in Figure 2.

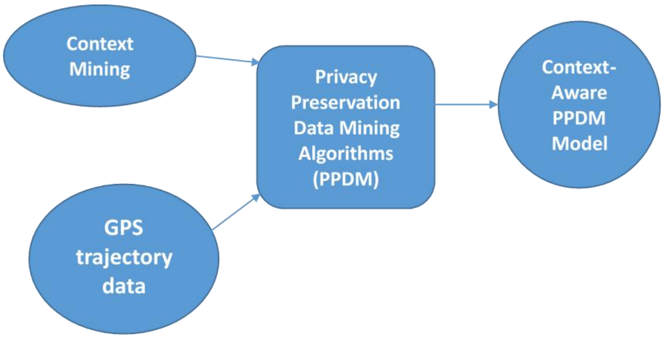

Figure 2. Proposed PPDM Model

3.1.2. Context Model and Recurrent Neural Network.

As aforementioned, the periodic discrete time is adopted, so we try to model a user's contexts over a period of discrete time (e.g., a day, a week). All the possible contexts of a user in a period of time are represented by a finite set C_t= {C_1,… .C_N} in which N represent the number of discrete times in one period of time. As in [7, 24].The states in *M* are labeled with contexts *fc*1*; : : : ; cng*. The transition probability *at i;j* denotes the probability of the user being in context *cj* at time *t* given that he is in context *ci* at time *t* - 1. We use the term *state* to denote a user's context at a given time (e.g., at home at 9pm). We consider a model over a day: the states in *M* represent all possible contexts of a user in a day. For each day, the user starts at the "start" state in *M* and ends *T* steps later in the "end" state. Here, *T* denotes the sensing frequency. We denote by *X*1*; : : : ; XT* random variables generated from *M*, each taking on the value of some context *ci*.

Adversary Model. We consider RNN LSTM modeling can be strong enough to protect adversarial attacks. Taking the sensitive contexts as exceptions, we can prepare a different rule for the sensitive contexts irrespective of normal contexts.

RNN for Modeling Sequences

The recurrent neural network is a neural network which can process sequence with arbitrary length. For any time step ***t,*** it feeds the input ***xt*** and produces the hidden state *ht* = *φ*(*xt*, *ht*-1) from previous hidden state *ht*-1, where *φ* is a non-linear function. By recursively unfolding *ht*, we will get

ht = *φ*(*xt, φ*(*xt*-1, *φ*(*xt*-2*, φ*(...)))) = *f*(*x*1:*t*),

indicating that the hidden state of RNN is a function of all past inputs *x*1:*t*. By introducing gating mechanism of RNN, e.g., LSTM [16] and gated recurrent unit [17], which solves the gradient vanishing and exploding problem [16], it can be more powerful than shallow sequence models such as Markov chains, and RNNs are popular in modeling trajectory data and contexts. For context modeling task, RNN models the distributions of next context *x*˜*t*+1 given current part of context *x*1:*t*. At time *t*, the input is *xt*. After one iteration in RNN layer, the hidden state of time *t* (i.e., *ht*) is produced by *φ*(*xt*, *ht*-1). The output layer adopts a multi-class logistic regression, i.e., an affine transformation with weights *W* ∈ R|*E*|×*H* and biases *b* ∈ R*H* followed by softmax function, to get the distribution of the next context.

Mathematically,

p(˜ *xt*+1 = *i*|*x*1:*t*) =exp(*j* exp(*WW*[*i*,[*j*, :]:]*hth*+*t* +*b*[*ib*]) [*j*])

To adopt RNN in modeling trajectory, we can regard each edge as a word/state and a trajectory as a sentence. However, we want to highlight that the transition from one word to any other word is free, while only the transitions from one edge to its adjacent edges are possible. In other words, the state transition of trajectory is strictly constrained by the topology of road network. Nevertheless, we still can hope RNN to be able to learn the topological constraints and assign close-to zero probabilities to the transitions from one edge *ri* to any edge *rj* that is not adjacent to *ri*. In the following, we will prove that, in order for RNN to achieve above objectives, the number of its hidden units has a lower bound that depends on the state size |*E*|, the required error and the *l*2-norm of the weights.

Problem Formulation

Our objective is to predict future locations and contexts of users. Without loss of generality, we normalize the activity information into the keyword representation.

Given the context keyword set *C* = { c(1)*;* *c*(2)*; : : : ; c*(*/C*)*}*,

User set *U* = { *u*(1)*; u*(2)*; : : : ; u*(*/U/*)*}*

and location set *L = {l*(1)*; l*(2)*; : : : ; l*(*/L/*)},

Thus, the check-in data required data can be defined as a quadruple *r* = (*u; l; c; t*), indicating that user *u* visits location *l* with context c at time *t*.

Here, for the ease of calculation, we discretize continuous time *t* to hour of day and day of week. With these notations, our problem can then be formulated as: Our goal is to predict user *u*'s next location *ln* and preserve the sensitive context c, given the next check-in time *tn* and the historical check-in sequence.

T_{n-1} = {r_1, r_2 …….. r_{n-1} }

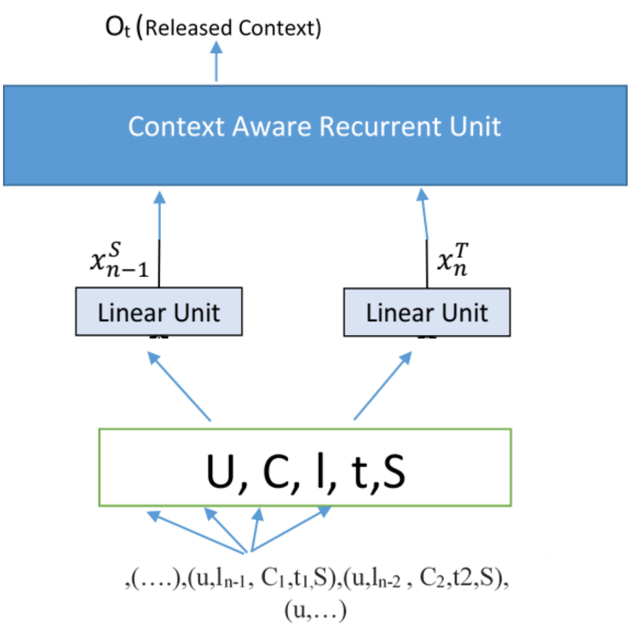

Figure 3: Proposed RNN model

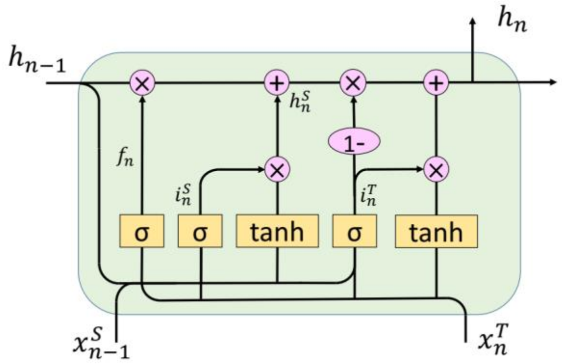

Figure 4. Context-aware Recurrent Unit

In Figure 3, Users denoted by Locations denoted by L, Contexts denoted by C,Time denoted by T and S={0,1} denote the sensitivity of contexts. Thus, the inputs to Linear Unit of RNN can be a set of (U, l, C, t, S). If S=1, the input is marked sensitive and thus released contexts must be deceiving. As it is infeasible to take all 5 features as input so, 2 inputs representing, sequential features and temporal contexts are sent. Based on these features, we adopt gated RNN as the shared hidden layer for modeling spatial-activity topics. As we have discussed, it is infeasible to take all five features together as the input of existing gated RNNs. Thus we decompose input features into sequential features ***x****S n*-1 (linear combination of ***u****;* ***a****n*-1 and ***l****n*-1) and temporal context ***x****T n* (linear combination of ***u****;* ***t****n* and ***s****n*). Then we propose a novel Context Aware Recurrent Unit (CARU) to integrate sequential feature ***x****S n*-1 and temporal context ***x****T n* dynamically.

Context-Aware Recurrent Unit

The spatial-activity topics are influenced by not only the sequential feature but also the temporal context. What's more, the sequential feature and temporal context cannot be controlled by a single sigmoid gate. For example, when sensitive contexts of user are applied the sigmoid function must be different while the temporal context should play an active role. Therefore, we propose the Context Aware Recurrent Unit as in Figure 4. to integrate temporal and sequential contexts dynamically.

Specifically, to capture the sequential pattern, we calculate the sequential hidden state as follows:

$$i_n^S = \sigma(W^S x_{n-1}^S + U^S x_n^T + V^S h_{n-1} + b^S) \qquad (1)$$

$$f_n = \sigma(W^f x_{n-1}^S + U^f x_n^T + V^f h_{n-1} + b^f) \qquad (2)$$

$$h_n^S = f_n * h_{n-1} + i_n^S * g(W^h x_{n-1}^S + V^h h_{n-1} + b^h) \qquad (3)$$

where *n* denotes the time step, *h* is the hidden state of CARU, *hS* is called as sequential hidden state, and *i; f* are sigmoid gates. Here, *W; U; V* and *b* represent the weight matrices and bias vectors, ∗ represents the element-wise product of two vectors, *σ*(·) denotes the sigmoid function and *g*(·) is the activation function (the hyperbolic tangent function in our work). The calculation of the sequential hidden state is similar to the calculation of memory state of LSTM cell. Here, the major difficulty in our problem is not the long-term dependency but the vanishing of sequential dependency. Instead of the output gate in LSTM, we integrate the sequential hidden state and temporal context via a sigmoid gate *iT n* as follows:

$$i_n^T = \sigma(W^T x_{n-1}^S + U^T x_n^T + V^T h_{n-1} + b^T) \qquad (4)$$

$$h_n = i_n^T * g(x_n^T) + (1 - i_n^T) * h_n^S \qquad (5)$$

The sigmoid unit iT n sets the weight of the sequential hidden state and the temporal context to a value between 0 and 1. Especially, the proposed gated RNN cell degenerates to a simplified LSTM cell when iT n = 0, or a common non-linear neuron with temporal context as the input when iT n = 1.

Note that when calculating spatial activity topic with time step n, the sequential feature xS only involves time step n-1, while the temporal context xT depends on time step n. That is why we call xT as “context”. Generally, the context can be any information associated with time step n.

To learn the location embedding, we leverage both the geo-spatial distance and activity semantic of locations to represent the location similarity. We build a location-location graph Gl. Two locations are connected if they share same activity keywords or they are closer than a distance threshold. Then we employ the graph embedding method [13], which generates “sentences” by random walk on the graph and applies Skipgram[14] to learn embedding. The similarity of activity keywords is difficult to define. Instead, we map activity keywords to correlative embedding vectors with corresponding locations in the same vector space, which is beneficial to learning shared parameters. We construct a bipartite activity-location graph Ga with the corresponding of activity and location as edges. A bipartite network embedding method [14] is adopted for learning activity embedding. This method randomly selects a activity keyword as “input word”, and locations linked to this activity as “context” in each step for implementing Skipgram.

Experiment

For the validation of RNN LSTM we have used the following dataset, so as to test the actual performance of the proposed approach.

This GPS trajectory dataset was collected in (Microsoft Research Asia) Geolife project by 182 users in a period of over five years (from April 2007 to August 2012). A GPS trajectory of this dataset is represented by a sequence of time-stamped points, each of which contains the information of latitude, longitude and altitude. This dataset contains 17,621 trajectories with a total distance of 1,292,951kilometers and a total duration of 50,176 hours. These trajectories were recorded by different GPS loggers and GPSphones, and have a variety of sampling rates. 91.5 percent of the trajectories are logged in a dense representation, e.g. every 1~5 seconds or every 5~10 meters per point.

We have performed the experiment on the tensorflow plugin of python environment and used various mathematical tools available to simulate the inputs and generate output.

IV. EXPERIMENTAL RESULTS

We have performed number of simulations on the tensorflow environment. But due to some technical problems the final result has not been yet obtained. But we can provide the number of reasons that our simulations can be successful to obtain the best model for privacy preservation of the location based services using RNN-LSTM.

V. CONCLUSION

Thus, we proposed a novel approach for context-aware privacy preservation model using recurrent neural network. Our proposed approach can be the best one as it includes long-term dependency and can accommodate huge amount of data for generating contexts and the secure one as it preserves privacy without exploiting the utility of data. For further works we can increase the efficiency of the system by reducing the time complexity.

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E-waste management in Nepal: An Approach for Minimizing E-waste to Ensure a Safe Environment.

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ABSTRACT

Electrical and electronic waste– e-waste – has become a global environmental pollution problem in developed and developing countries. Moreover, management of these waste is a challenge for developing countries like Nepal. The study covers the effects of e-waste generation in the global scenario. Meanwhile, current recycling practices, challenges and the impact of e- waste in Nepal have been comprehensively presented. On the basis of a comparison between e- waste management in the developed countries and Nepal, sustainable e- waste management solutions have been proposed. The aim of the research is to understand the importance of e-waste management and to advise a sustainable e-waste management system, which is used in developed countries, to improve the quality of e- waste management in Nepal.

(Keywords: E-waste, e-waste management, Nepal, recycling practices, challenges, impact, comparison.)

1. INTRODUCTION

Since new technology is constantly emerging from day to day and more ICT equipment is produced, people are looking forward to better ICT solutions. In the meantime, people ignore the fact that electronic devices contain toxic substances that cause a health nightmare during its disposal and recycling. The electronic products that have reached the end of their lives are known as electronic waste or e-waste. The use of electronic devices has increased dramatically in the past decade and the number of devices disposed of is growing extensively worldwide. E- waste management is perhaps one of the fastest growing pollution problems that can contaminate the environment and pose a threat to human health.

In spite of the fact that e-waste management is a problem for both developed and developing countries, it is a major challenge for many developing countries like Nepal, as e-waste is perhaps obscure to many people in the country. Electronic gadgets which contains toxic chemicals and heavy metals are destroying Nepal's beautiful ecosystem. In order to minimize e- waste in Nepal and ensure a safe environment, this problem must be addressed at both the individual and the government levels.

2. LITERATURE REVIEW

Electric and Electronic waste – e-waste – is electronic devices that are almost at the end of its useful life. For instance, old Cathode Ray Tube (CRT) computers, outdated mobile phones, irreparable laptops and tablets. *"E-waste is an electrically powered appliance that no longer satisfies the current owner for its original purpose"* (Sinha, 2004, p. 3). It contains many different substances consisting of ferrous metals, plastics, glass, concrete, rubber and toxic substances such as barium, mercury, lead, cadmium and flame retardants. The disposal and recycling of these waste is a serious challenge for both developed countries, because it pollutes the environment and causes human beings to suffer frequently.

The world looks forward to e- waste management, but the rate of e- waste generated is far higher than the rate of e- waste recycled. In 2014, around 42.8 million tons of electrical waste were generated worldwide, but only 15- 20 percent of all electrical waste was recycled (Leblanc, 2018). Today, about 40.7 percent of the world 's e- waste is generated in Asia, 27.5 percent in Europe and 25.3 percent in the Americas (Balde et. al., 2017). Many countries including Denmark, Austria, Germany, Australia and the Netherlands have begun to recognize the importance of e- waste, and have bandaged e- waste into landfills. In addition, the rate of e- waste recycled is increasing gradually. Many countries have built e- waste recycling companies that provide more than 296 jobs per year for every 10,000 tons of recycled e- waste (Leblanc, 2018). E- waste management therefore ensures a safe environment, saves energy and makes a significant contribution to the economy of a particular region.

3. E-WASTE IN NEPAL

In Nepal, the rate of imports of electronic devices has been accelerating every day, while the disposal of electronic waste is challenging because it has a negative recycling practices and contains harmful materials. The large portion of the e- waste in Nepal consists of old CRT monitors, washing machines, refrigerators and inverter batteries. According to a study by the Environment Department of Nepal, Kathmandu discarded 18,000 metric tons of e- waste in 2017 (Awale, 2018). Nepal does not have a culture of repair, reuse and recycle, as there are no specific centers for recycling e-wastes.

Moreover, people here are not aware of the impact of e- waste and the importance of e- waste management. In Nepal, according to the survey, only 35 percent of people were aware of e- waste and its harmful effects (Karmacharya et al., 2017). As a consequence, the majority of the old and irreparable electronic goods are disposed of as garbage or sold to scrap dealers.

In addition, Nepal has no separate legislation specifically for e- waste, which allows these scrap dealers to take advantage of it and unsafely dismantle the useful metals then dump the hazardous wastes into landfills.

4. E-WASTE MANAGEMENT SYSTEMS IN DEVELOPED COUNTRIES.

4.1 Public awareness.

The awareness of electronic waste and its environmental and human health impacts must be the first step in the proper management of electronic waste. If many people know the importance of e- waste management, they will become aware of it and encourage the government to manage e- waste and support the individual level as well. In Germany, the government began awareness education using unemployed people to raise public awareness on health and environmental impacts of e- waste (Adeola and Othman, 2011).

4.2 Recycling.

Recycling is the key to reducing electronic waste, as it has environmental benefits at every stage of the electronics production life cycle. Many developed countries have perhaps used various methodologies to recycle e-waste. In Japan, electronic devices that fall under home appliances must be recovered and recycled by manufacturers in order to use resources effectively (Adeola and Othman, 2011).

4.3 Legislations and Policies.

The law of the county binds people and makes them aware of their duties. Systematic management of e-waste will perhaps be effective through strict laws and policies. The government should enforce strict laws against illegal disposal of e-waste. For example, India has now banded e- waste imports from other countries and enforced a law to prevent e- waste landfills.

5. E-WASTE MANAGEMENT IN NEPAL.

As a developing country, Nepal has shipped most of its electronic waste to India, where it is leached chemically to extract valuable elements. However, Nepal will now have to build processing plants, following the bandage of e-waste imports in India.

As stated above, e- waste management ensures a safe environment if e- waste is managed or recycled properly. In the meantime, this is an opportunity to reduce the unemployment problem in Nepal. The establishment of recycling centers and waste collectors provides many unemployed people, in Nepal, with job opportunities. In addition, precious elements such as gold and silver extracted from e-waste can generate a good amount of money that will perhaps contribute to the national economy. The establishment of e-waste management system is like killing two birds with one stone.

6. PROPOSED E-WASTE MANAGEMENT SOLUTIONS.

In comparison with e- waste management systems in developed countries, some of the e- waste management system applicable to Nepal has been discussed below:

6.1 Awareness through ICT.

It was quite clear that most people in Nepal are not aware of the impact of e- waste and the importance of e- waste management. Since most people who use electronic goods are responsible for generating electronic waste, awareness with the help of ICT is more convenient. For example, the government and other organizations in Nepal can advertise and share awareness through all social media, TV and other ICT devices that support video or audio streaming. In addition, awareness campaigns could be carried out to encourage people, in rural and urban areas, to dispose e-waste separately.

6.2 Establishment of recycling plants.

The establishment of recycling plants or centers is the most significant step in solutions for e- waste management, because recycling is the best way to deal with e- wastes. Recycling centers must collect and recycle e-waste generated in various parts of the country appropriately. First, they have to manually dismantle e- wastes. They must then either recycle the waste using the chemicals and biological leaching process or import recycling machines. However, biological and chemical leaching in Nepal would be cost- effective because recycling machines are expensive.

6.3 E-waste Policies and Legislations.

The Nepalese government must study the future of e- waste and the impact that e- waste can have on people and the environment. They must therefore enforce strict rules and regulations that oblige people to be concerned about the generated e- waste. For instance, the government must enforce laws which encourages people to repair, reuse and recycle electronic waste. In addition, they must also make people return e- waste to retailers instead of disposing of it to municipal waste, who must then give it to recycling centers. Strict punishments should also be imposed on people who have improperly disposed electronic waste.

7. CONCLUSION

In conclusion, e- waste is a serious problem both at local and global level. Many developed countries, however, manage their e- wastes properly, but developing countries face it as a challenge. Most of the people in Nepal do not know about e-waste and its management. The government also seems to be unaware of the fact that laws relating to e-waste have not yet been enforced. Lastly, no recycling centers have been established to recycle e-waste appropriately. E-waste in Nepal are therefore treated as solid wastes and dumped into landfills. Despite the fact that Nepal can be the victim of e- waste impacts, it is necessary to manage these waste as soon as possible.

Efforts and research on e- waste recycling are being carried out in different parts of the world in a sustainable manner. Strict laws and regulations may be included in future efforts to overcome e- waste management problems. Moreover, they may also include chemical and biological leaching methodologies for recycling e-waste. Some solutions have been proposed, including recycling plants, strict policies and awareness, to overcome Nepal's unmanaged e- waste. Therefore, the world should be aware of the impacts of e- waste and how it can be disposed of and find a sustainable method of e- waste management to ensure a safe environment and a healthy human life.

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Application aware route optimization in SDN using bandwidth and latency

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Abstract—Software Defined Network (SDN) is a new network architecture for designing, building, and managing networks that separates the network's control plane and forwarding plane to better support the scalability and innovation in a network infrastructure. The overall network performance of an application is mostly affected by the two major factors, bandwidth, and latency. Between each pair of network elements in network infrastructure, there may exist multiple paths connecting them with different properties. A traditional network does not take this knowledge into Consideration and may result in sub-optimal performance of applications and underutilization of a network resource. This research proposes a concept of Application aware routing which could improve the overall performance of a network by categorizing the application in bandwidth oriented and latency oriented and allocate the separate route for each type of traffic based on the application preferences using Software defined network architecture and OpenFlow protocol. The research also proposes a design of an application aware network topology by using software defined network architecture which uses open flow protocol and open flow protocol based controller. Routes for the application packets are chosen based on the application type. To verify the feasibility and practical implementation of the proposed concept SDN topology is implemented in emulated environment using mininet)

Keywords— *Software defined network, OpenFlow, application aware routing, Latency and bandwidth aware network.*

I. Introduction

In the today's modern world, networking is inevitable which plays a very important role in our society and has a tremendous impact on humankind. As a foundation of an information network, a reliable and highly efficient networking infrastructure is a requirement of today's world of cloud computing and big data. With increasing requirement of users and high resource demands of modern applications, it is becoming increasingly difficult for the traditional networking architecture, designed many years ago, to satisfy the current requirements. In traditional network architecture, network functionality is implemented in a dedicated hardware in ASCI chips, which makes nearly impossible to enhance features and fix bugs for the customers on their own. Traditional configuration is time-consuming and error-prone as IT administrator needs to perform many steps to add or remove a single device from network infrastructure [1]. Traditional network infrastructure is a composed of multi-vendor devices as multi-vendor environments require a high level of expertise to complete a configuration, an administrator will therefore need extensive knowledge of all present devices types [2]. The problem also exists in network routing mechanism as most of the routing protocols calculate a single best route, which will ultimately use by all application, which may not be suited for all applications. The purpose of this research is to design a software-defined network based network architecture, which solves applications diverse requirements with different properties to route application packets as per application preferences to enhance the overall utilization of the network resources. SDN is a computer network architecture in which the control plane (routing) is decoupled from the data plane (packet switching) in order to make network and service management simpler, cheaper and more flexible. SDN is dynamic, manageable, cost-effective, and adaptable, making it ideal for high-bandwidth, dynamic nature of today's applications, SDN based architecture gives more information about the state of the entire network from the controller to applications [3]. This is in contrast to traditional distributed network Architecture where intelligence and switching functions coexist within the same physical device, resulting in complex and ”ossified” networks. In SDN Control plane and data plane interaction is done through a communication protocol that is an open vendor-independent API. Open Flow is the first and most dominant standard communication interface for SDN. There are other alternatives of Open Flow like Yang and NetConf. Currently SDN is used for custom routing and service chaining in data centers and controlled environments while experiments on a large scale are being carried out.

II. APPLICATION AWARE ROUTE OPTIMIZATION

To improve the performance of an application running on a shared network. SDN architecture is used In SDN architecture, white box switches are used and white box switches are only used as a forwarding device and all of the decision is done using the SDN controller. The route calculation for each application is done according to rules which controller forward to switches. There is an open flow table placed in each switch. When a packet arrives at the switch, switch checks for the entry and if there is a matching rule it just applies that rule and takes an action. If there is no match, a switch sends the first packet of the flow to the controller to ask what to do with the flow. Controller analyses the packet and creates a rule for the flow. Then, the controller sends the rule to the switch. The switch keeps that rule in flow table and applies it to the flow.

A. Problem statement

The overall network performance of an application in network infrastructure is mostly affected by the two major factors, bandwidth, and latency. Between each pair of network elements in network infrastructure, there may exist multiple paths connecting them having different properties. Traditional networks forward packets from source to destination based on the shortest route possible, which might not be the best route for all application. Router and switches are mostly agnostic to the application packets, due to a high demand for cloud computing, big data and real-time streaming of data, today's networks are forced to be application aware to improve user experience and to reduce operational costs.

B. Research Objectives

The aim of this research is to design a network architecture based on SDN, which solves applications diverse requirements in a network infrastructure by routing each application packets based on their routing preferences such as bandwidth and latency using SDN and open flow protocol.

III. RELATED WORKS

Paper titled on "A network performance-aware routing for multisite virtual clusters" investigated the possibility of allocating routes specific to each connection according to network properties of each path [7]. This paper is geared towards improving virtual cluster performance. However, numerous techniques can be generalized and apply for general situations as presented in this paper. In the paper authored by Breitbart et al., bandwidth and latency were major factors for optimization [8]. However, monitoring the current network utilization was not a straightforward task. Monitoring these values while minimizing the effects in the network was a combinatorial optimization problem that proved to be NP-hard so an approximation algorithm was used instead [8]. A paper by Mohammad Abdul Azim, M. Rubaivat Kibria, and Abbas Jamalipour titled on "Designing an application aware routing protocol for wireless sensor networks" focus on wireless sensors networks (WSN) for energy efficient routing based on battery power, data transaction reliability and end to end delay [9].

A white paper published by Naugent Networks from Nokia titled on "Application aware routing (AAR) a key enabler of SD-WAN and Hybrid WAN automation" enlights the use of AAR on wide area network for optimizing MPLS and Internet broadband wan links [10]. Previous Works on Application aware networking is described by Wamser et al.by leveraging the information from YouTube video streaming to enhance the quality of this particular application in an access network. This concept uses an external entity called "network advisor" to adapt the forwarding inside the network [11]. Google exploits the knowledge about the applications running inside its global data center to optimize and schedule the bandwidth usage inside the network with a centralized SDN-based traffic engineering system [11]. The applications are categorized into priority classes according to their importance, in case of an overload situation, e.g. due to a failure, low priority packets are discarded. However, none of these approaches take the effects of dynamic rerouting on the behavior of individual TCP flows into account [11].
The white paper authored by SARO VELRAJAN from aricent has proposed of using Open Flow and SDN to implement application-aware routing architecture to dynamically provision the network switches based on application characteristics and requirements, leading to a better overall user experience and reduction in bandwidth wastage [12].

Methodology
This research proposes a policy based routing mechanism based on application preferences called "Application aware routing in software-defined network" which take the latency and bandwidth as a reference network parameter to find the best route for each application and forward the application packet based on application behavior (Bandwidth oriented / Latency oriented). Calculated routes are updated dynamically in the flow table to reflect changes in the network condition. In the real network, to measure network properties of a link a fast and accurate network monitoring system is required. This research proposed to use the direct monitoring tool iperf for measuring the bandwidth in an emulation environment.

Conceptual model
To implement an application aware routing network, this research use several technologies such as open Flow protocol and various SDN controller based on experimentation.

1. Open Flow protocol as a southbound API.
2. Bandwidth and latency monitoring tools.

3. Bandwidth and latency aware open flow controller supported application.
4. Bandwidth and latency aware controller based on experimentation.

Whenever the host sends packets from source to destination, first the packets are forwarded to switch, then switch inspect the packet and depending on the policy installed in it, switch forwards the packet on a particular route. If the switch doesn’t have any policy installed, it sends the packet to the controller. The controller inspects the packet header and/or the payload, determines the type of packet, bandwidth oriented or latency oriented and installs a policy/rule on the switch instructing it to forward packets along a particular route. If the packet type is bandwidth oriented, based on source and destination, a controller determines the highest bandwidth route based on the obtained monitoring parameters from the monitoring tools and installed this policy for this host in a switch.

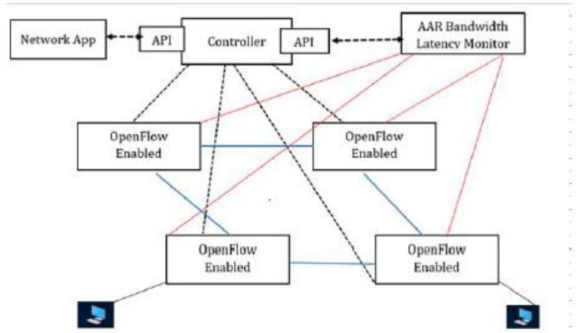
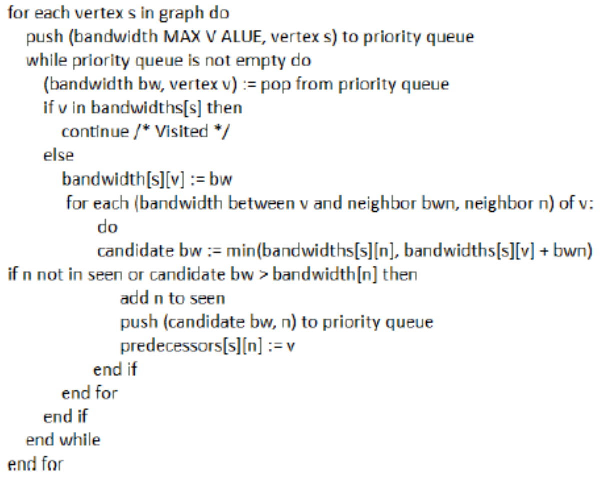


Figure 1 Application aware network architecture

Routes are calculated based on monitored information using Dijkstra algorithm and its variation. To evaluate feasibility and practicality of this work, this research uses the emulated environment using mininet. When an event occurs at the switch, it notifies the controller of the event, then controller takes a decision according to how it is programmed and sends a response back to the switch to tell it how it should behave. The result is sent back in a form of new entry to flow table in the switch. This flow table will be used for a future decision instead of consulting with the controller whenever anything occurs

A. Algorithm



```
for each vertex s in graph do
    push (bandwidth MAX V ALUE, vertex s) to priority queue
    while priority queue is not empty do
        (bandwidth bw, vertex v) := pop from priority queue
        if v in bandwidths[s] then
            continue /* Visited */
        else
            bandwidth[s][v] := bw
             for each (bandwidth between v and neighbor bwn, neighbor n) of v:
                 do
                 candidate bw := min(bandwidths[s][n], bandwidths[s][v] + bwn)
if n not in seen or candidate bw > bandwidth[n] then
                    add n to seen
                    push (candidate bw, n) to priority queue
                    predecessors[s][n] := v
                end if
            end for
        end if
    end while
end for
```

Figure 2 Pseudo code for shortest path calculation

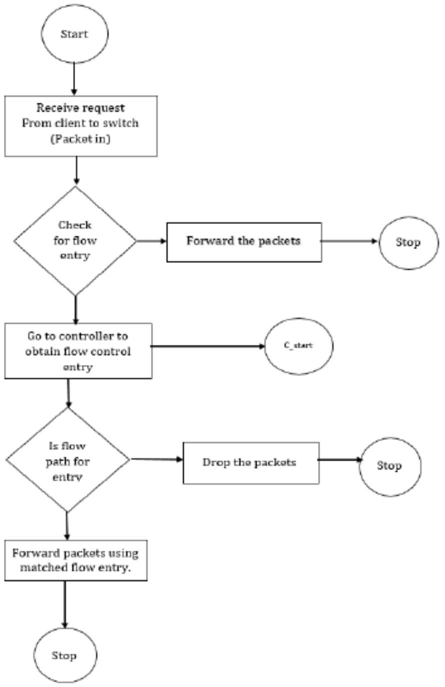


Figure 3 Flow chart of flowing open flow message in white box switches

B. Mininet

Mininet creates a realistic virtual network, running real kernel, switch and application code, on a single machine (VM, cloud or native), in seconds, with a single command. Mininet relies on cgroups and network namespaces to emulate network nodes and links, and tools like tc to shape traffic, meaning that someone who currently wants to use it either must run Ubuntu (or another supported Linux distribution) or run it in a VM where Mininet can be installed and used.

C. *Observation*

The scenario is emulated in Mininet, a popular network emulator for a software defined network. For the emulation, link properties are set manually Mininet sample script is attached below.
Running the topology with remote controller using mininet shown below.

sudo mn --custom aar.py –topology aartopo controller=remote,ip=192.168.0.101,port=6653 switch=ovs –mac

The above command invoke the aar.py topology script and creates the designed topology and connect the emulated network to the central controller which control the flow tables in all of the switches. The controller is running on physical machine having its own IP and listening on port 6633.

D. *Bandwidth Evaluation*

Bandwidth between source and destination pair is measure and average values are calculated for both traditional routing and SDN based application aware routing and the comparison is made between these two network architecture.

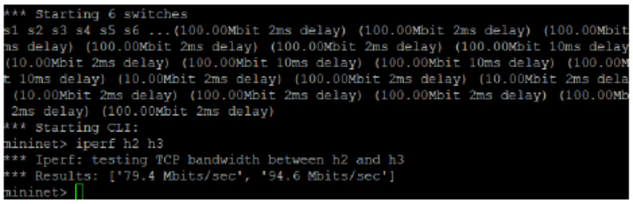
Table 1 End to end bandwidth evaluation in non SDN network for 100 Mbps

From / To	Host 1	Host 2	Host 3	Host 4	Host 5
Host 1	NA	68.33	73.22	69.22	68.932
Host 2	68.586	NA	86.6	78.56	88.34
Host 3	73.88	86.89	NA	83.84	79.54
Host 4	69.48	77.98	82.88	NA	83.56
Host 5	68.612	87.542	80.06	78.33	NA

Table 2 End to end bandwidth in SDN architecture for 100 Mbps

From/To	Host 1	Host 2	Host 3	Host 4	Host 5
Host 1	NA	88.33	93.22	94.543	89.566
Host 2	93.586	NA	97.62	98.156	94.52
Host 3	93.188	16.456	NA	95.36	98.54
Host 4	93.48	97.198	94.04	NA	94.45
Host 5	88.34	97.542	93.06	96.67	NA

The process of bandwidth measurement is repeated several time for consistency and comparison is made between the two network architecture as shown in the figure 5. It is seen that, SDN based bandwidth and latency aware routing perform better for applications with high bandwidth requirement as the packet from bandwidth oriented application are always forwarded through high bandwidth link.



```
*** Starting 6 switches
s1 s2 s3 s4 s5 s6 ...(100.00Mbit 2ms delay) (100.00Mbit 2ms delay) (100.00Mbit
ms delay) (100.00Mbit 2ms delay) (100.00Mbit 2ms delay) (100.00Mbit 10ms delay
(10.00Mbit 2ms delay) (100.00Mbit 10ms delay) (100.00Mbit 10ms delay) (100.00M
t 10ms delay) (10.00Mbit 2ms delay) (100.00Mbit 2ms delay) (10.00Mbit 2ms dela
 (10.00Mbit 2ms delay) (100.00Mbit 2ms delay) (100.00Mbit 2ms delay) (100.00Mb
 2ms delay) (100.00Mbit 2ms delay)
*** Starting CLI:
mininet> iperf h2 h3
*** Iperf: testing TCP bandwidth between h2 and h3
*** Results: ['79.4 Mbits/sec', '94.6 Mbits/sec']
mininet> ▯
```

Figure 4 Bandwidth measurement using mininet in SDN architecture

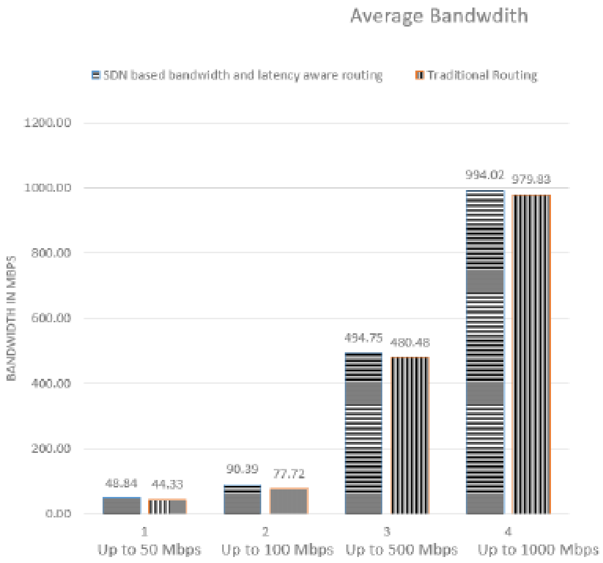


Figure 5 Average bandwidth evaluation

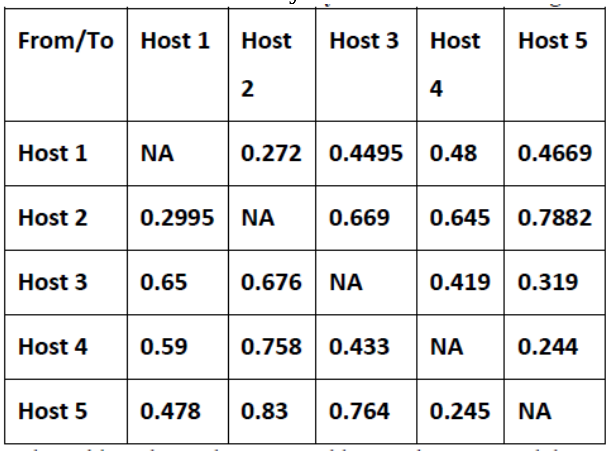
E. *Latency Evaluation*

The aim of this experiment is to evaluate the performance of SDN based bandwidth and latency aware network with the traditional network in term of latency. With mininet based virtual environment setup, the average latency is calculated from source to destination while forwarding the packets and latency is measured. Average latency is noted by pinging the source and destination. For latency measurement for different types of protocol curl protocol is also used which is shown below.

The command shown below using curl measure the latency from host 1 to host 2 for http protocol where 10.0.0.2 is an IP address of host 2.

```
mininet> h1 curl -o /dev/null -w
"%{time_connect}\n" -s http://10.0.0.2
```

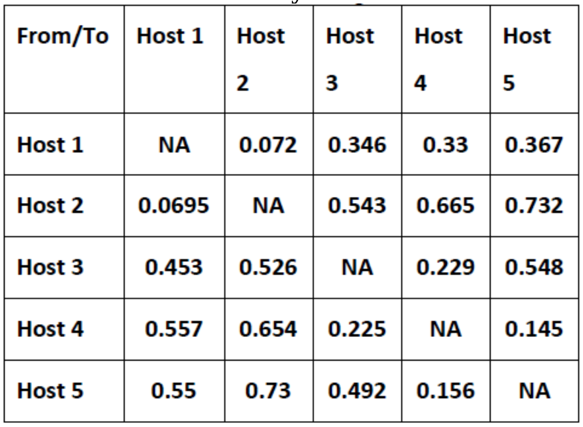
Table 3 End to end latency in non SDN network



From/To	Host 1	Host 2	Host 3	Host 4	Host 5
Host 1	NA	0.272	0.4495	0.48	0.4669
Host 2	0.2995	NA	0.669	0.645	0.7882
Host 3	0.65	0.676	NA	0.419	0.319
Host 4	0.59	0.758	0.433	NA	0.244
Host 5	0.478	0.83	0.764	0.245	NA

The Table 3 shows the measured latency between each host in traditional network.

Table 4 End to end latency in SDN architecture



From/To	Host 1	Host 2	Host 3	Host 4	Host 5
Host 1	NA	0.072	0.346	0.33	0.367
Host 2	0.0695	NA	0.543	0.665	0.732
Host 3	0.453	0.526	NA	0.229	0.548
Host 4	0.557	0.654	0.225	NA	0.145
Host 5	0.55	0.73	0.492	0.156	NA

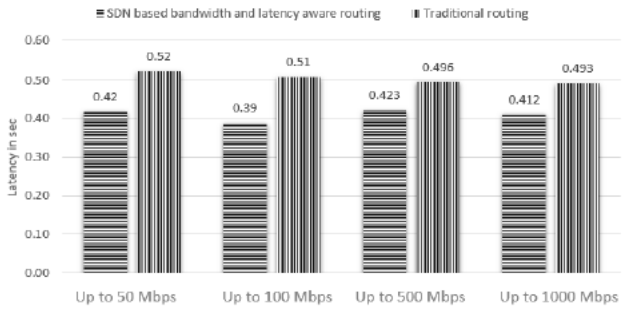


Figure 6 Average latency graph

IV. Conclusion

This research proposed the concept of improving an application performance in any network as well as overall utilization of the network by aligning application requirements with network properties. It showed that this proposed concept could be achieved by using OpenFlow protocol and software defined network architecture. The research focused on two network properties, bandwidth, and latency, as they are the two major factors contributing to network performance. In this research, application are categorized into bandwidth oriented and latency oriented. By creating a network topology for SDN using mininet it is shown that multiple path between any pair of nodes in a network exist and. each of these paths has different properties which varied due to many factors such as instability of the Internet or by various policies and configuration used in network devices. With this knowledge, an application aware route optimization technique based on SDN architecture has been proposed to use network resources efficiently. Proposed architecture aligns application preferences with high bandwidth path and low latency path in a network. To realize the bandwidth and latency aware routing, a network system with four components. OpenFlow switches, bandwidth and latency monitor, bandwidth, and latency aware OpenFlow controller and bandwidth and latency aware controller supported application has been design and implemented. Average bandwidth and latency were calculated on two different networks. To evaluate eligibility, feasibility, and practicality of bandwidth and latency aware network, average bandwidth and average latency were calculated from an experiment in two different architecture. The result of experiment which is already discussed in Results and discussions and it is seen that SDN based architecture optimize the packet forwarding process in a network for the efficient use of network resources bandwidth and latency.

V. FUTURE WORKS

This research discussed the concept of improving the network performance and packet forwarding mechanism using newly emerged SDN architecture. The proposed SDN architecture categorize application packets based on network properties. Applications packets having low latency are forwarded using low latency link and the application that require high bandwidth are forwarded using high bandwidth link programmatically using SDN controller and open flow protocol enabled switches. In this research, for the categorization of a packets ports numbers are taken into consideration. However in the world of big data and cloud computing with the diversity in packets, It is necessary for efficient and accurate categorization of application packets (bandwidth oriented, latency oriented) in real time. For efficient and accurate categorization a deep packet inspection mechanism can be used based on machine learning algorithm by leveling the packets types as latency oriented and bandwidth oriented and also other many network parameters can be taken into consideration to create application aware network.

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Optimization of Range Queries Using Segment Trees

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Abstract—**Range queries are the queries where a function needs to be computed on a range of numbers. As the number of such queries gets high, the simple sequential scan method that has linear time complexity isn't efficient. The use of segment trees can answer the same queries in logarithmic time. In this paper, the method of using segment trees for answering range queries is discussed with reference to an example of calculating the sum of a range of numbers.**

Keywords—range queries, range sum query, segment tree

1. INTRODUCTION

A range query is an operation of computing a function of interest on a range of numbers enclosed within two indices of a given number array. There are a wide variety of range queries distinguished by the nature of function in interest, some of which are range minimum/maximum queries and range sum queries.

A typical example of the range query, also called as the range sum query is used as an example throughout this paper, unless stated otherwise. A range sum query problem can be formulated as follows.

Problem: Given an unsorted array $A = [a_1, a_2, a_3, \dots a_n]$, denoted by $A[1, n]$ and two indices i and j such that $0 \le i \le j \le n$, the following operations need to be carried out.

1. Query the sum of the numbers in the subarray $A = [a_i, \dots a_j]$, denoted by $A[i, j]$.
2. Update the value of i^{th} element of the array to a new value.

The most naïve solution to the problem stated earlier is to use a linear list to store the given numbers. Each update on this list can be carried out in $O(1)$ time. The query operation can be carried out by traversing through the array from i^{th} index to j^{th} index, computing the sum for every single query. This naïve solution has the query cost of $O(n)$. As simple as it may seem, $O(n)$ time for a single query is not promising when there are millions of queries present. Although the queries can be optimized by batch processing [1], especially when the queries need not be handled in real-time, by processing multiple queries with one sequential pass throughout the file, algorithms with complexity $O(logn)$ are preferred over this naïve solution.

There are several other data structures like cells, projections, k-d trees and range trees for implementing range queries [1]. This paper presents the idea of using segment trees which can return range queries in $O(logn)$ time complexity.

2. TREE TERMINOLOGIES

A tree is a non-linear data structure that stores the data in recursive hierarchical entities called *nodes*. A node is a structure that holds the data. A node in the tree can have zero or more *child nodes*, which are connected to them by *edges*. A node is called a *parent node* if another node is derived directly from it. The *root node* is the node which has no parent, and at which the tree starts. The nodes which have no child derived from them are called the *leaf nodes*. All other nodes apart from the leaf nodes are called *internal nodes*.

A *binary tree* is a type of tree where a node can have at most two children. The tree of Figure 1 is a binary tree with six nodes. The two children of a node are termed *left child* and *right child* respectively.

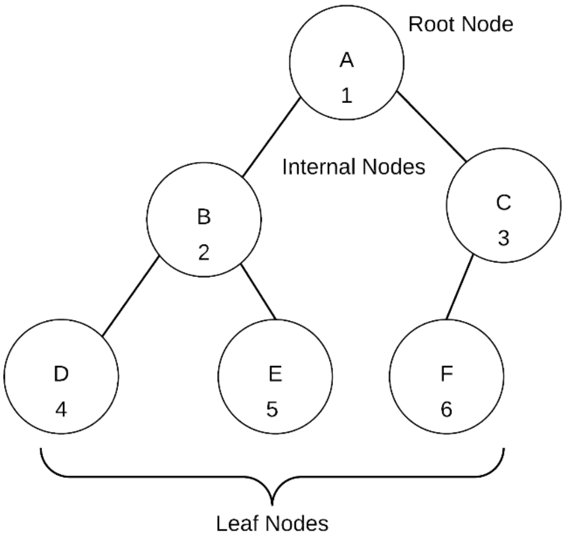

Figure 1. A typical binary tree structure. The numbers in the nodes represent their respective indices in the array representation of the tree.

A binary tree having n nodes can be represented by using a linear array of size n, where each location of the array corresponds to a node in the tree. The initial location of the array corresponds to the root node of the tree. If i is the index of a node in the array representation, then its left and right children are at indices $2i$ and $2i + 1$ respectively[1]. The parent node of a node at index i is at index $\lfloor i/2 \rfloor$, provided that the node is not a root node.

3. SEGMENT TREE

A segment tree is a binary tree data structure that stores information about the segments of an array. Every node of a segment tree represents a functional value computed on an interval of an array. The given set of numbers is always stored

[1] It is assumed throughout this paper that the index of the array starts from 1. All the interpretations and expressions are derived accordingly.

on the leaf nodes, and the interval size goes on increasing as one moves upwards in the segment tree.

While constructing a segment tree, the given array of numbers $A[1,n]$ is stored on the leaf nodes of the segment tree. An example segment tree for storing an array of four numbers is shown in Figure 2. Each node of the segment tree stores a value $F[i:j]$ – the function of interest computed of the range of numbers from i^{th} to j^{th} index of the given array. In other words, $F[i:j]$ is the value of function of interest operated on the values contained in all leaf nodes that are in the subtree rooted at that node. The function computed can be sum, minimum, maximum, mean, median, etc. It may be noted that $F[i:i]$ is equivalent to $A[i]$. If the left child node and right child node have values $F[i:j]$ and $F[p:q]$ respectively, then the value of parent node is $F[i:q]$.

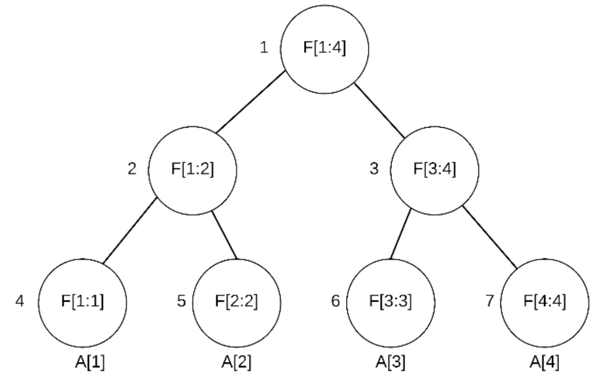

Figure 2. Structure of a segment tree built for given number array of size 4

As it can be observed in the figure mentioned above, a segment tree constructed for an array of size four consists of seven nodes. In general, if the size of the given array is n, the number of nodes in the segment tree constructed will be $2n-1$. Since the height of the tree with n leaf nodes will be $\lceil \log_2 n \rceil$, this tree will be represented as an array, the required size of the array to store this tree is $2 \times 2^{\lceil \log_2 n \rceil} - 1$ [2].

4. OPERATIONS ON A SEGMENT TREE

The data structures used for facilitating range queries typically have three operations associated with them namely preprocessing, query and update [1]. Preprocessing is the initial step of preparing the data structure out of the given raw data. The query operation will return a result when provided with two indices as the parameters. The update operation is the process of updating the value of data stored at specific location in the data structure. These three operations are discussed in more detail in the following subsections.

4.1 Construction

The preprocessing carried out to build a segment tree is better understood in reference to the range sum problem stated earlier. In all subsequent algorithms and explanations, the same problem is taken as reference, unless stated otherwise. In range sum problem, each node of the segment tree will store the sum of the numbers stored in all leaf nodes which are in the subtree rooted at that node.

The method used for building a segment tree is recursive in nature which begins by initializing an array of size $2 \times 2^{\lceil \log_2 n \rceil} - 1$, where n is the size of the given number array. This newly initialized array is used to represent the segment tree. Starting from the root node, a node is first checked to find whether it is a leaf node. If yes, that leaf node is initialized with the corresponding value from the given array. If not, then the left and right children are built recursively.

Once all the leaves are constructed, the recursive method returns all the way to the root node, updating all the nodes in the return path. While updating the internal nodes, the value stored in the node is calculated as the sum of values in the left and right children respectively. The method used for building a segment tree is summarized in pseudocode as follows [3]:

```
Given : T is an array of size 2*2^log2n -1, declared for
storing the segment tree, A is the given array of numbers
of size n.

void construct(int node, int l, int r){
   if (l == r) {
         //the node is leaf node
         T[node] = A[r];
   }else{
         int mid = (l + r)/2;
         int lchild = 2*node;
         int rchild = 2*node+1;
         //recursively construct left child
         construct(lchild, l, mid);
         //recursively construct right child
         construct(rchild, mid, r);
         T[node] = T[lchild] + T[rchild];
   }
}
```

The method presented in pseudocode is a recursive method. The complete segment tree from an array is constructed by calling construct(1, 1, n).

For instance, consider that an array $A = [2,4,6,8]$ is given. The array initialized to represent the segment tree will have size of 7. As per the algorithm stated earlier, the leaf nodes are first constructed with the numbers 2, 4, 6 and 8. The internal nodes are in turn created by adding the values of left and right child respectively. As a result, a tree like Figure 3 is obtained.

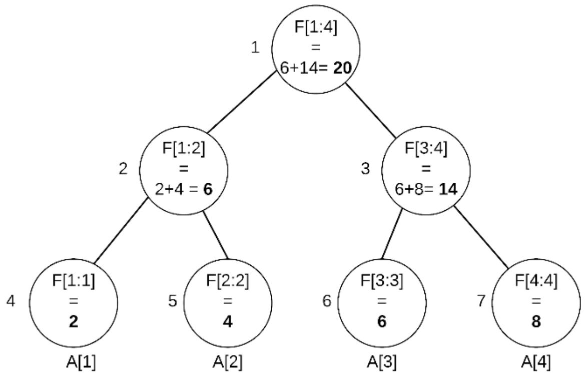

Figure 3. Segment tree constructed for array A = [2,4,6,8]

Since each and every node must be traversed while building a segment tree, the time complexity of the method construct () is $O(n)$ [4].

4.2 Range Sum Query

The idea behind the query to find the sum of a range is simply to search through the tree to find the required interval range, and then return the value stored in the node representing that interval. If the objective is to find sum of the numbers in index range $[i,j]$, and the node just visited has value $F[m,n]$, then any one of these three cases may arise:

1. The range $[m,n]$ lies completely inside the range $[i,j]$. That is, $i \leq m \leq n \leq j$.
2. The range $[m,n]$ lies completely outside the range $[i,j]$. That is, $[m,n] \cap [\mathrm{i},\mathrm{j}] = \phi$.
3. The range $[m,n]$ lies partially inside and partially outside the range $[i,j]$.

In case 1, the recursive function can simply return the value $F[m,n]$ of that node, which is the sum of the numbers in the range $[m,n]$. In case 2, the function can simply return zero, since the node just visited is of no interest and doesn't contribute in any way to the result. In case 3, however, both left and right children are queried recursively until the child node satisfies condition 1 or 2. The return values of the functions as they return are added up to return the final result in this case.

The method used for querying the sum of a range in a segment tree is summarized in pseudocode as follows [3]:

```
Given : T is an array storing the segment tree.

int query(int node, int m, int n, int i, int j){
   if (j < m or n < i) {
        //[m,n] completely outside [i,j]
        return 0;
   }
   else if (i <= m <= n <= j) {
        //[m,n] completely inside [i,j]
        return T[node];
   } else{
        int mid = (m + n)/2;
        int lchild = 2*node;
        int rchild = 2*node+1;
        //recursively query left child
        int lsum = query(lchild, l, mid);
        //recursively query right child
        int rsum = query(rchild, mid+1, r);

        return lsum + rsum;
   }
}
```

As an example, consider the segment tree in Figure 3 again. Suppose that the query is to find the sum of numbers in the range [3,4]. The method query(1,1,4,3,4) is called initially. The root node represents the interval [1,4], which results in the third case among the cases noted earlier. So, the left child and the right child are queried recursively one after another. The left child in this example, falls under case 2, and returns zero. The right child which falls under case 1, will return the value $F[3:4] = 14$. The final result $0 + 14 = 14$ is returned to the calling module.

The function for querying the sum of a range has complexity $O(logn)$, similar to that of binary search algorithm [3].

4.3 Update Query

The update of the value of a node of a segment tree not only involves the change in value of that particular node, but also to the values of its ancestors, since the sum of the range of numbers including that updated value also changes. Thus, the update operation should recursively update the values of all its ancestor nodes.

The method used for querying the sum of a range in a segment tree is summarized in pseudocode as follows [3]:

Given : T is an array storing the segment tree.

```
void update(int node, int m, int n, int index, int val){
   if (m == n) {
        // node is a leaf
        T[node] = val;
   } else{
        int mid = (m + n)/2;
        int lchild = 2*node;
        int rchild = 2*node+1;

        if(m <= index <= mid ){
                //index is in left child
                update(lchild, m, mid, index, val);
        }else{
                //index is in right child
                update(rchild, mid+1, n, index, val);
        }

        T[node] = T[lchild] + T[rchild];
   }
}
```

The algorithm starts from the root node and recursively progresses towards bottom until a leaf node is found. For every node visited, the index of the number that needs to be updated is checked with the interval $[m,n]$ represented by that node. Depending upon whether the required index is on left subtree or the right subtree, the algorithm progresses recursively on that direction. Figure 4 shows the structure of the segment tree of Figure 3 after updating the value of $A[2]$ to 5. Note that the shaded nodes are the only nodes that are visited and updated during the update operation. The leaf node is first updated to new value, and then all the ancestors are updated to reflect the change in the sum of the range of numbers that included the number just updated. This algorithm has complexity $O(logn)$ [3].

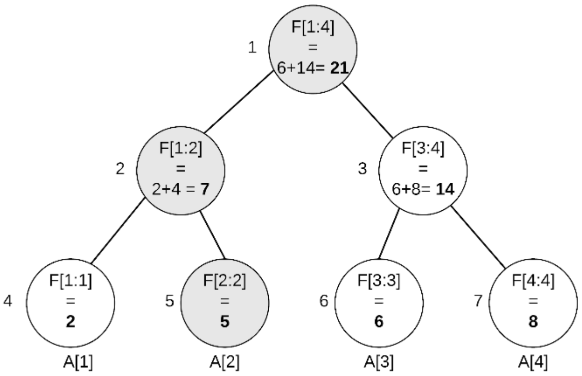

Figure 4. Segment tree in Figure 3 after updating the value of A[2] to 5. The shaded nodes are the nodes whose value gets updated due to the operation.

5. EVALUATION

The use of segment trees has improved the query cost to $O(logn)$ as opposed to $O(n)$ in simple sequential scan method [1][3][4]. $O(logn)$ is far better than $O(n)$, especially when order of number of queries is quite large. The update operation in the segment tree is $O(logn)$ which isn't that much costlier compared to $O(1)$ in the sequential scan method. However, the storage required for storing a segment tree is obviously larger than that required for a sequential array of numbers.

6. CONCLUSION

The use of segment trees while answering to range queries have drastically reduced the complexity of the query when the number of queries is in large order. Except the cases where there are very few query operation and very frequent update operations, or the cases where the memory usage is very critical, use of segment trees is the recommended way to answer to range queries.

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***Abstract*: An Ad Hoc remote system is a pool of remote versatile hubs that design consequently to build a system without the prerequisite of any customary framework. Specially appointed systems utilize portable hubs to empower correspondence outside remote transmission run. Outlining a foolproof security convention for specially appointed remote is an exceptionally difficult undertaking. Some certain and selective highlights of specially appointed remote systems to be specific, shared communicate radio channel, shaky working condition, absence of focal expert, absence of relationship among hubs, limited accessibility of assets, and physical powerlessness assume a noteworthy hindrance part in planning this foolproof security. Amidst all correspondence MANET is a developing exploration zone with monstrous reasonable applications. Be that as it may, remote MANET is especially stranded because of its substantial abilities, for example, open standard, powerful topology, circulated participation, and obliged ability. Mobile Ad Hoc Networks (MANETs) have gotten extremely expanding interest, mostly attributable to the planned pertinence of MANETs to various applications. Since every one of the hubs in the system cooperate to forward the information, the remote channel is slanted to dynamic and simple assaults by malicious hubs, for example, Denial of Service (DoS), eavesdropping, spoofing, and so forth. Actualizing security is in this way of prime significance in such system, As MANET is rapidly spreading for the property of its capacity in shaping impermanent system without the guide of any settled framework or incorporated organization, security challenges has turned into an essential worry to give anchor correspondence. Guiding the network through different channels plays an important role in handling the security aspects of the entire system. Taking every aspect into consideration it is found that security is something that cannot be overlooked while working with MANETs. In this paper we endeavor to break down the dangers looked by MANETs and spotlight on the discoveries and future work that might enthusiasm for analysts.**

***Keywords*: Ad Hoc Network, MANETs, Security, Malicious hubs**

I. INTRODUCTION

On remote PC systems, ad hoc approach is a technique for remote gadgets to specifically connect with each other and transfer data from one end to another. Whenever a connection is established in an ad-hoc environment, all remote devices lying in a specific distance from one another are able to share the data and set up a working communication protocol without affecting the entire system. There has been precarious development in the utilization of remote correspondences over the most recent couple of years, from satellite transmission to home remote individual region systems [1]. The essential preferred standpoint of a remote system is the capacity of the remote hub to speak with whatever is left of the world while being versatile. Two fundamental framework models have been created for the remote system worldview. The settled spine remote framework demonstrate comprises of countless hubs and moderately less, yet more intense, settled hubs. These settled hubs are hard wired utilizing landlines [2]. Mobile Ad Hoc Network (MANET) is a collection of dedicated devices or hubs that wish to transport with no established framework and pre-decided association of connections. The hubs in MANET themselves are in charge of powerfully finding different hubs to impart. It is a self-designing system of portable hubs associated by remote connections the association of which shape a discretionary topology [3]. The portable hosts are not bound to any brought together control like base stations or versatile exchanging focuses. In spite of the fact that this offers unhindered portability and availability to the clients, the responsibility of system administration is currently altogether on the hubs that frame the system. Because of the constrained transmission scope of remote system interfaces, various bounces might be required for one hub to trade information with another over the system. In such a system, every mobile hub works as a host as well as a switch, sending parcels for other portable hubs in the system that may not be inside direct remote transmission scope of each other [2]. The idea of MANET is additionally called framework less systems administration, since the portable hubs in the system powerfully build up steering among themselves to shape their own system on the fly. Before we find out about the working of MANETs, we should comprehend the summed up idea of Wireless Ad Hoc Networks.

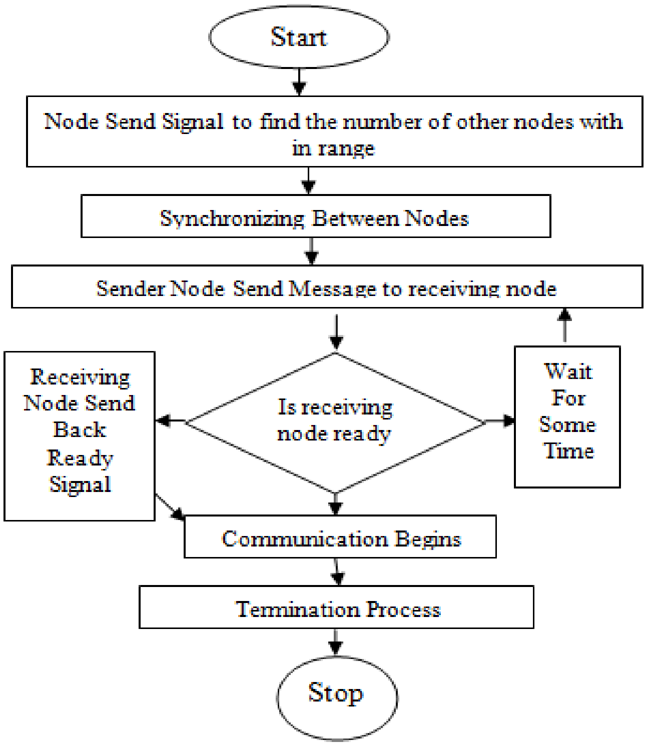
Start
Node Send Signal to find the number of other nodes with in range
Synchronizing Between Nodes
Sender Node Send Message to receiving node
Receiving Node Send Back Ready Signal
Is receiving node ready
Wait For Some Time
Communication Begins
Termination Process
Stop

Fig 1. Working of a general Wireless Ad Hoc Network

A detailed discussion on how different characteristics cause difficulty in providing security in ad hoc wireless networks particularly in MANETs is given below.

• **Shared broadcast radio channel:** Dissimilar to in wired systems where a different devoted transmission line can be given between a couple of end clients, the radio channel utilized for correspondence in ad hoc remote systems is communicated in nature and is shared by all hubs in the system. Information transmitted by a hub is received by all hubs inside its immediate transmission go. So a malicious hub could without much of a stretch get information being transmitted in the system. This issue can be limited to a specific degree by utilizing directional reception apparatuses.

• **Insecure operational environment:** The working conditions where specially appointed remote systems are utilized may not generally be secure. One critical utilization of such systems is in front lines. In such applications, hubs may move all through unfriendly and shaky foe region, where they would be exceedingly defenseless against security assaults.

• **Lack of central authority:** In wired systems and framework based remote systems, it is conceivable to screen the activity on the system through certain essential main issues, (for example, switches, base stations, and passages) and actualize security instruments at such focuses. Since impromptu remote systems don't have any such essential issues, these instruments can't be connected in specially appointed remote systems.

• **Lack of association:** Since these systems are dynamic in nature, a hub can join or leave the system anytime of the time. On the off chance that no appropriate validation system is utilized for partner hubs with a system, an interloper would have the capacity to join into the system effortlessly and complete his/her attacks.

• **Limited resource availability:** Resources, for example, transfer speed, battery control, and computational power (to a specific degree) are rare in impromptu remote systems. Consequently, it is hard to execute complex cryptography-based security components in such systems.

• **Physical vulnerability:** Hubs in these systems are typically minimal and hand-held in nature. They could get harmed effortlessly and are likewise defenseless against theft.

II. MANETs and its Applications

There are at present two sorts of Mobile remote systems. The first is known as framework systems with fixed and wired gateways. Run of the mill uses of this sort of "one-jump" remote system incorporate remote neighborhood (WLANs).

The second sort of portable remote system is the framework less versatile system, generally known as the MANET. MANET is normally a self-arranging and self-designing "multi-bounce" organize which does not require any settled foundation. In such system, all hubs are progressively and self-assertively found, and are required to transfer bundles for different hubs with a specific end goal to convey information over the system [4]. Following are a portion of the attributes of MANETs

i. Autonomous and infrastructure less
ii. Multi-hop routing
iii. Dynamic network
iv. Device heterogeneity
v. Energy constrained operation
vi. Bandwidth constrained variable capacity links
vii. Limited physical security
viii. Network scalability
ix. Self-creation, self-organization and self-administration

Application	Possible Scenarios/Services
Strategic networks	• Military communication and operations • Automated battlefields
Emergency services	• Search and rescue operations • Disaster recovery • Replacement of fixed infrastructure in case of environmental disasters • Policing and firefighting • Supporting doctors and nurses in hospitals
Commercial and civilian environments	• E-commerce: electronic payments anytime and anywhere • Business: dynamic database access, mobile offices • Vehicular services: road or accident guidance, transmission of road and weather conditions, taxi cab network, inter-vehicle networks • Sports stadiums, trade fairs, shopping malls Networks of visitors at airports
Home and enterprise networking	• Home/office wireless networking • Conferences, meeting rooms • Personal area networks (PAN), Personal networks (PN) • Networks at construction sites
Education	• Universities and campus settings • Virtual classrooms • Ad hoc communications during meetings or lectures
Entertainment	• Multi-user games • Wireless P2P networking • Outdoor Internet access • Robotic pets
Sensor networks	• Home applications: smart sensors and actuators embedded in consumer electronics • Body area networks (BAN) • Data tracking of environmental conditions, animal movements, chemical/biological detection

Table1: Applications of MANETs

When a new network is to be established, the only requirement is to provide a new set of nodes with limited wireless communication range. Following properties may help us understand the working of MANETs;

- Seamless connection and pervasive versatile figuring condition
- Neighbor discovery— one of the imperative qualities of a MANET hub
- Data steering capacities — information can be directed from a source hub to a neighboring hub
- Flexible system engineering and variable steering ways — to give correspondence if there should be an occurrence of the restricted remote network territory and asset limitations
- Flexibility— empowers quick foundation of systems
- A hub has constrained capacity, that is, it can associate just to the hubs which are adjacent and in this manner devours restricted power
- Peer-to-Peer availability
- Computations decentralization free computational, exchanging (or steering), and correspondence abilities
- Weak availability and remote server idleness
- Unreliable connects to base station or door — disappointment of a middle of the road hub brings about more noteworthy inactivity in speaking with the remote server
- Resource constraints— Limited data transmission accessible between two moderate hubs. Node may have limited power and thus computations need to be energy-efficient
- No need of access-point
- Need to solve exposed or hidden terminal problem
- Diversity in nodes— iPods, palm handheld computers, Smartphones, PCs, smart labels, smart sensors, and automobile-embedded systems
- Protocol diversity— Nodes can use different protocols, for example, IrDA, Bluetooth, ZigBee, 802.11, GSM, or TCP/IP
- Data caching, saving, and aggregation at node

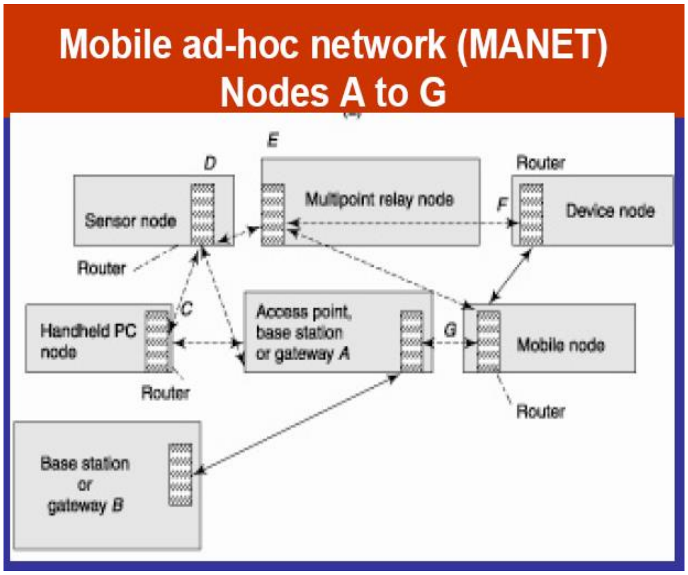

Fig 2: Spectrum requirement at Nodes in MANET

III. SECURITY GOALS

There are five major security goals that need to be addressed in order to maintain a reliable and secure ad-hoc network environment. They are mainly;

Confidentiality: Assurance of any data from being presented to unintended substances. In specially appointed systems this is harder to accomplish in light of the fact that intermediates hubs (that go about as switches) get the parcels for different beneficiaries, so they can without much of a stretch listen in the data being directed.

Availability: Services ought to be accessible at whatever point required. There ought to be an affirmation of survivability regardless of a Denial of Service (DOS) attack. On physical and media get to control, layer assailant can utilize sticking systems to meddle with correspondence on physical channel. On physical layer the aggressor can upset the directing convention. On higher layers, the attacker could cut down abnormal state administrations e.g. key administration assistance [5].

Authentication: Confirmation that an element of concern or the source of a correspondence is the thing that it claims to be or from. Without which an attacker would imitate a hub, in this way increasing unapproved access to asset and delicate data and snooping with task of different hubs.

Integrity: Message being transmitted is never altered.

Non-repudiation: Ensures that sending and receiving parties can never deny ever sending or receiving the message.

TYPES OF ATTACKS IN MANETs

Attacks on ad hoc wireless networks can be classified into two broad categories, namely, *passive* and *active* attacks.

A. PASSIVE ATTACK: A *passive* attack does not upset the task of the system; the adversary snoops the information traded in the system without adjusting it. Here, the prerequisite of secrecy can be abused if a adversary is likewise ready to decipher the information assembled through snooping. Location of detached attacks is exceptionally troublesome since the activity of the system itself does not get influenced. One method for defeating such issues is to utilize intense encryption systems to scramble the information being transmitted, consequently making it inconceivable for busybodies to acquire any helpful data from the information caught.

B. ACTIVE ATTACK: An active attack endeavors to change or decimate the information being traded in the system, in this manner disturbing the typical working of the system. Dynamic attacks can be ordered further into two classifications, to be specific, external and internal attacks. External attacks are done by hubs that don't have a place with the system. These assaults can be anticipated by utilizing standard security systems, for example, encryption strategies and firewalls. Internal attacks are from traded off hubs that are very of the system. Since the enemies are now part of the system as approved hubs, inner assaults are more extreme and hard to identify when contrasted with outer attacks.

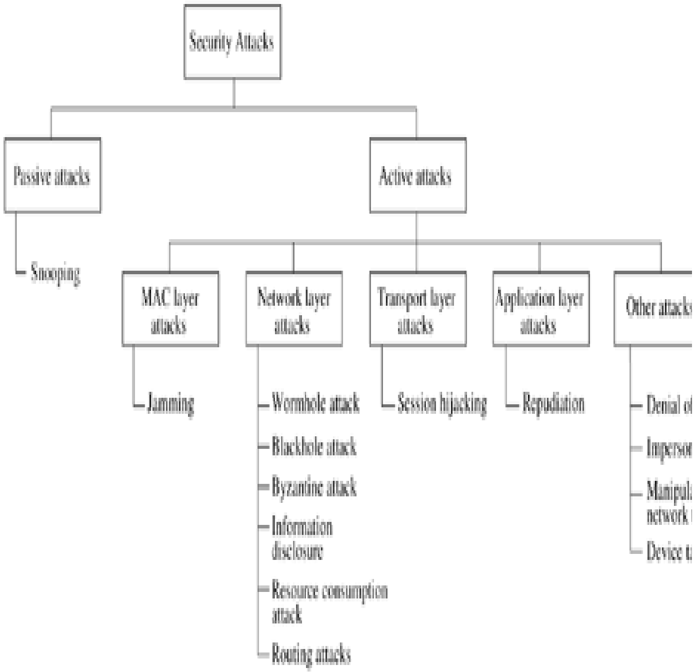

Fig 3: Classifications of attacks

C. INTERNAL ATTACKS: Internal attacks are directly leads to the attacks on nodes presents in network and links interface between them [10]

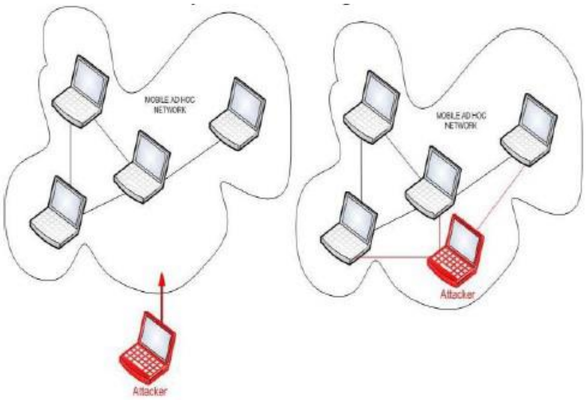

Fig. 4: External and internal attacks in MANET

D. *WORMHOLE ATTACK*

In this attack, an attacker receives packets at one location in the network and tunnels them to another location in the network where the packets are again injected into the network. This tunnel between two colluding attackers is called a wormhole. Wormhole is an attack on MANET routing protocols in which similar nodes create an impression that two distant sections of a MANET are connected through nodes that seem to be adjacent but are actually distant from one another [7][8]. Due to the broadcast nature of the radio channels the attacker can create a wormhole even for packets not addressed to itself. In figure5 node A sends RREQ to node B and nodes X and Y are infectious nodes having an out-of-band connection between them. Node X tunnel the RREQ to Y, which is actual neighbor of B. B gets two RREQ – A-X-Y-B and A-C-D-E-F-B. Though no harm is done if the wormhole is used properly for efficient relaying of packets, it puts the attacker in a powerful position in comparison to other nodes in the network which the attacker can use in order to compromise the security of the network.

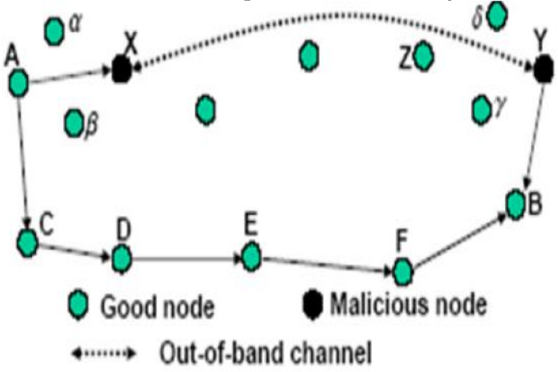

Fig 5: Wormhole Attack

E. *BLACK HOLE ATTACK*

In this attack, an infected node falsely advertises helping paths e.g. shortest path or stable paths to the root node during the path finding processor during the updating process in table- driven routing protocols. The intention of these infected nodes could be to interrupt the path finding process or to distract the nodes from reaching the destination. For instance, in AODV, the attacker can send a fake RREP (counting a phony goal arrangement number that is created to be equivalent or higher than the one contained in the RREQ) to the source hub, confirming that it has found a new and dependable path in order to achieve the destination making the source to select the path suggested by the attacker.

F. *RESOURCE CONSUMPTION ATTACK*

The aim of this attack is to consume/ waste away the resources of other nodes in the network, such as bandwidth, computational ability and battery power or to interrupt the transmission to cause severe degradation in network performance. The attacks can be in the form of unnecessary requests for routes, very frequent generation of beacon packets or sending wrong information to the nodes. It tries to keep the network bust in order to consume the battery power and exhaust the network.

G. *SPOOFING ATTACK*

A spoofing attack is when an attacker or malicious program successfully acts on another person's behalf by impersonating the data. This method is usually used to trick the people or devices to perform actions that may lead them to disclose important information. There are three types of spoofing attacks namely; ARP Spoofing, DNS Spoofing and IP Spoofing attacks. In the ARP Spoofing attack the attacker links the hacker's MAC address with the IP address of the victim's network which allows the attacker to snatch the data intended for the victim's computer. In the DNS Spoofing attack the attacker reroutes the DNS translation so that it points to a different server which is infected with malware and can be used to spread virus. The IP Spoofing attack takes place when an attacker copies a correct IP address in order to send out IP packets via a trusted IP address.

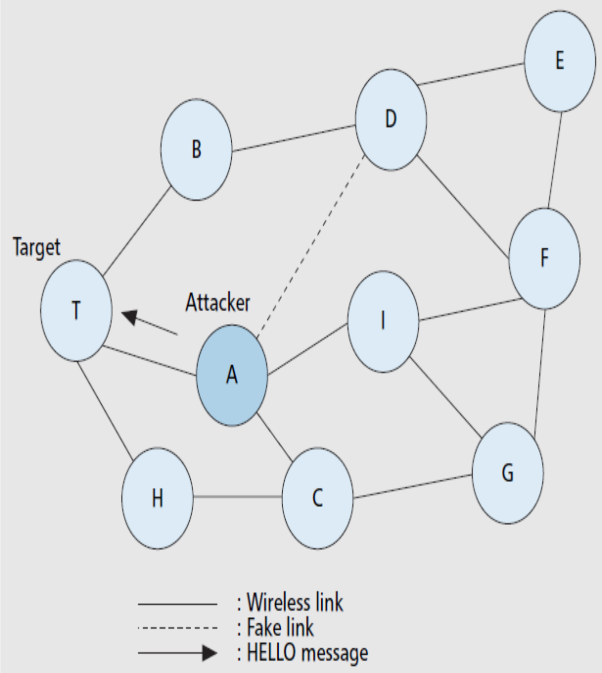

Fig 6: Example of Spoofing Attack

IV. CONCLUSION

The MANET is a rising exploration zone with down to earth applications. Be that as it may, a remote MANET exhibits a more prominent security issue than traditional wired and remote systems because of its key attributes of open medium, powerful topology, and nonattendance of focal specialists, dispersed collaboration, and obliged ability. Directing security assumes an essential part in the security of the whole system. As a rule, directing security in remote systems has all the earmarks of being a nontrivial issue that can't without much of a stretch be unraveled. It is difficult to locate a general thought that can work productively against a wide range of assaults, since each assault has its own unmistakable qualities. As it is much evident that the entire security arrangement requires the prevention, discovery and response.

Preventive measures: As a preventive measure, the ordinary methodologies, for example, confirmation, get to control, encryption and advanced mark are utilized to give first line of barrier. Some security modules, for example, tokens or shrewd card that is open through PIN, passphrases or biometrics confirmation are additionally utilized as a part of option.

Discovery measure**:** In Discovery measure, It specifics arrangements that endeavor to recognize pieces of information of any malevolent movement and the malignant hub that is in charge of the pernicious action in the system.

Response measure: In Response measure, it takes reformatory activities against malicious hub that is in charge of the malicious movement in the system.