Identifying a Review Analysis Technique for a Mobile App which analyzes customer reviews

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***Abstract*— At present due to the high competition among e-commerce companies, customer satisfaction has become a vital factor on the success of a business. Customers mainly pay attention to product or shop reviews and ratings, before purchasing a product. So, customer reviews have become a very important factor in the business. Review can be a rating or text-based summary which describes their perception or experience on the shop. It is advantages for the merchants if they can get an insight about customer reviews on their business. In order to do this, identifying a review analysis technique is important. Authors used Sentiment Analysis approach which is provided by Natural Language Processing library called Natural Language Tool Kit, to analyze customer reviews which can be positive or negative. In this research authors try to find out a best fitting most accurate algorithm for completing this task. The result of this research will be used by the merchant dashboard feature of the author's proposed cross platform mobile application, which is used to send location-based notifications to customers about promotions and offers by merchants. Through the merchant dashboard merchants are provided feedback in the form of statistical charts, summaries and recommendations to improve their business.**

Keywords*— *Natural Language Processing, NLTK, Review Analysis, Sentiment Analysis

I. INTRODUCTION

In today's world online shopping is used by millions of users to fulfil their various needs. According to estimated statistics by 2040 around 95% of all purchases are expected to be via e-commerce [1]. So, customers reviews are an important aspect for every e-business. Around68% of customers trust opinions which are posted on internet and around 85% of customers trust online reviews as much as personal recommendation [2]. So according to statistical data, on average reviews produce an 18% uplift in sales [3][4]. In order to attract more customers, merchant's provide more sales offers to their customers. But most of the people have a busy life style because of their daily works. So, they might miss some great offers and promotions. To overcome this problem, we proposed the cross platform mobile application which is capable to run on both android and iOS mobile devices. Basically, what we are planning is to track the current location of users and send location-based notifications to customers with great offers and promotions. Furthermore, customer are able to provide a feedback in the form of rating or comment about their experience. Among other features, this research is focused on the merchant dashboard feature of the proposed mobile app. Basically, merchant dashboard provides recommendations to the merchant based on the available customer reviews. Through the merchant dashboard merchants can view the status of their business and take necessary actions to improve their business.

Customers always look for a better service. So, merchants must consider about their customer needs. Otherwise merchant's business is going to decrease always in the sales market. Customers mainly discuss topics like price, offers, customer service and so on. Because of that knowing about their business is a must for merchants. If the customer is unsatisfied merchant should know the

reason for unsatisfactory. Success of the business is depending on the number of customers who are satisfied with the business.

The main objective of this research is to provide recommendation to merchants for improvement of the business. To give those recommendations customer reviews will be analyzed. Both positive and negative reviews should be analyzed to give suggestions. And give statistical chart representing trending offers, less value offers and so on. Then also merchants can target those offers. Find out most accurate algorithm for review analysis and generating suggestions will be done through this research component.

This paper organized in the following way. While next section explains about related works in this context next section provide a methodology. After that shows results and discussion.

II. Related Work

In year 2015 T. Tsunoda proposed a novel task for utilizing review analysis to suggest product advertisement improvements. They use the review analysis technique. By using review analysis technique, they determine which aspects can be included in a blurb of the product. show aspect candidates that could be incorporated into the blurb ordered by their importance to users for a given product is the goal of their task. As the review analysis technique, they break their tasks into two sub tasks. They are aspect grouping and aspect group ranking. They are assigning aspect expressions to aspect groups to manage aspects at the semantic level. They next score aspect groups to suggest only important aspect groups. For the aspect grouping they used one of the semi-supervised learning methods. Those methods are described by zhai et al in year 2010 [5]. For the aspect group ranking they used aspect ranking method. That method proposed by Lnui et al in year 2013.

Customer reviews can have a more impact on business. Because of that most of the researches are mostly focus on that area. Specially in year 2015 C. Yang, Z. Chen, T. Wang and P. sun developed a system call FOBPRAM which stands Feature Ontology Based Product Review Miner [6]. They specially targeting to develop a system which can be based on ontology of a phone. specially they extract an opinion of customers. Mainly for analyzing customers opinions they used three-way process. Firstly, they used ontology tree for data pre-processing and also in their process they used information entropy. And also, an outcome of their process is a summary which contains customer opinions. In their research they haven't used sentiment classification as well as feature extraction. But the technique that they were used is to find an association between the feature and sub-features of a product.

Muhammad Zubair Asghar cited a Review about Feature extraction in sentiment analysis and they discuss about existing techniques and approaches for feature extraction in sentiment analysis and opinion mining [7]. They were analyzed 4 different feature selection techniques. That were NLP, Clustering based, statistical and Hybrid. They analyzed many numbers of papers to identify most used technique. According to their statistics NLP is mostly used technique than others.

Mika V. Mantyla, Daniel Graziotin and Miikka kuutila do a review about the evolution of sentiment analysis [8]. They analyze different research papers published on the internet that are based on sentiment analysis. Around 6996 papers from scopes. They found the basic idea about sentiment analysis is used to detecting and extracting information from natural language. For example, sentiment analysis is mostly used to opinion mining and information extraction. Sentiment analysis do some prediction based on polarity score. The main goal of their paper is to tells what problem each paper tries to address. Mainly based on the types of goals they identified two classes. Application domain oriented is one of them. It focuses about business domain of sentiment analysis and other is human and behavior oriented. It is focus on the areas that could be used in several application domains.

The paper about good vs bad review analysis shows important of the review analysis to the products in e-commerce companies [9]. E-commerce companies mainly consider about customer satisfaction. When customers do online shopping, they look for reviews and ratings of products. They show how sentiment analysis method fits for analyzing customer reviews. They used NRC emotion lexicon to determine the overall responses of the products. To determine that they used eight emotions of the customers. They proposed an approach by analyze different research papers. They use amazon fine food reviews as a dataset which is most suitable dataset to their context. So,

in amazon platform users can be rate to a product from 1 to 5. To do their experiment they analyze two types of reviews of a product that are given by customers. Those are most reviewed and less reviewed products. They also used technique of a word cloud for analyzing two types of reviews.

Finally, because of their proposed approach customers can get better understand about quality of products.

Chang, Jae-Yong proposed a sentiment analysis approach on product reviews classification in on-line shopping mall [10]. Mainly they are analyzing positive and negative reviews using sentient analysis technique. They used opinion mining technique provided by sentiment analysis to classifying subjective opinions of customer reviews.

Basically, according to previous research done by various persons NLP is a most commonly used technique than others. Following figure tells us usage of feature selection techniques. Following chart is a result of a review done by Muhammad Zubair Asghar , Aurangzeb khan , Shakeel Ahmad and Fazal Masud Kundi [7].

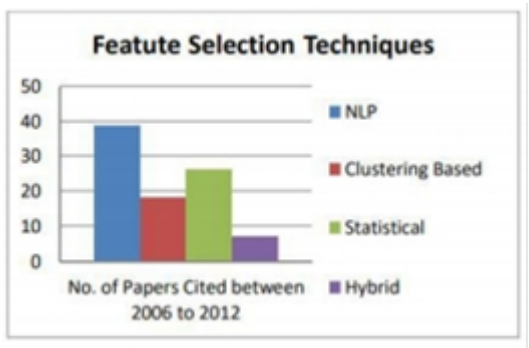

Figure 1: Usage of feature selection Techniques

III. METHODLOGY

Reviews are most important aspect of the business. So, if most of reviews are positive that's much better. That's why review analysis is needed for business. For the merchant perspective also much better to identify number of unsatisfied customers and satisfied customers with their business. Then they can try to do something to improve sales of the business.

This function is giving overall idea about merchant's business to merchants. This merchant dashboard consists of several sub sections. Such as Review analysis and generating suggestions. Mainly we used natural language processing techniques to deal with text-based reviews. Also, in hear we analyzed ratings that are given by the customers and try to give one common rating to a shop. In order to do that we used k-means clustering algorithm. To give common rating for shop first we group all the ratings that are given by customers to shop based on similarities of ratings. Then we count number of ratings in each cluster. Then finally we identify mostly given rating and assign a rating for a shop. Figure 2 shows screenshot of the merchant dashboard in our proposed solution for merchants in the shops.

Figure 2: Merchant Dashboard of the proposed solution

So, first step of analyzing text review is to divide positive and negative reviews. And this division is helpful to create a statistical chart also. By counting positive and negative reviews we can easily say how many customers are satisfied to their business and how many customers are unsatisfied. That detail can be represented in a statistical chart as statistical data. But reviews can be neural as well. The merchant dashboard is also generating suggestions which is more useful to merchants for improvement of the shop as well. In hear we used summarization

technique provided by deep neural network to generate less complex suggestions.

1. Dataset

To train the algorithm we use hotel reviews dataset from the machine learning and deep learning repository call "kaggle". Datafiniti_Hotel_Reviews.csv file contains 10000 reviews. It has several attributes like id, date added, date updated , address , country , reviews rating , reviews text and so on. Likewise, there are 25 attributes contain in a dataset.

2. Natural Language Processing Natural language processing is the newest

research area which is deal with texts. Basically, computer can't understand human language.

That's why natural language processing has been used. Natural language processing provides several libraries to analyzing texts. The main library that is provided by natural language processing is natural language processing toolkit (NLTK). NLTK provides lot of functionalities like sentiment analysis, name entity recognition and so on.

3. Sentiment Analysis

Sentiment analysis is also a most important function which is provided by NLTK. Basically, what this function does is to categorize texts as a positive, negative and neural texts. Categorization of review is easy to create statistical data as well.

In sentiment analysis there is a method call polarity score which helps us to divide reviews as a positive negative and neural. Following equation [11] shows how polarity score has been calculated.

(□ (Polarity (Word))) / N (Words)

Following figure shows the way that we are calculated compound polarity score.

```
for word in data_list:
  if(sid.polarity_scores(str(word))['compound']) >= 0.5:
    pos_word_list.append(word)
  elif(sid.polarity_scores(str(word))['compound']) <= -0.5:
    neg_word_list.append(word)
  else:
    neu_word_list.append(word)
```

Figure 3: Calculating Polarity Score

4. Long Short Term Memory

Long Short Term Memory (LSTM) is used to summarize all the reviews. This is a technique coming from deep neural networks. Following diagram shows the process of LSTM.

Basically, in here as input we provide all negative reviews to this LSTM network. After that it that it goes through different layers in the LSTM and provide an output as a summary of all negative reviews. We used attention layer, dense layer and so on in the LSTM layers. And also, we used encoder decoder mechanism in LSTM network for text summarization process. As soon as we got a summary we can easily categorize reviews that are mostly negative and, less negative. Based on that we can easily give suggestions for improvement of the business.

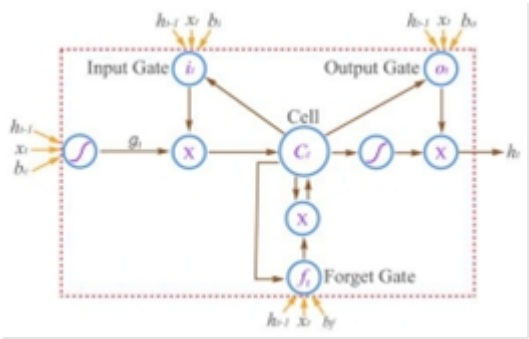

Figure 4 : Process of LSTM network Basically

IV. RESULTS AND DISCUSSION

Finally, we evaluated algorithms to find out performance of the algorithm. To evaluating the algorithms three algorithms has been analyzed. Such as Decision Tree Algorithm, Random Forest Algorithm and Naive Bayes Algorithm. After analyzing those three algorithms we did a comparison of each algorithm. Basically, this comparison is also for find out more accurate algorithm. Evaluating of accuracy has been done in two stages. Only difference is in first stage we used hierarchical clustering for grouping. In stage two we used k-means clustering for grouping. Following table shows comparison results of each algorithms in first stage.

Algorithm	Incorrect Predictions	Correct Predictions	Accuracy
Decision Tree	134	2023	0.86
Random Forest	68	2142	0.88
Naive Bayes	172	1296	0.58

Following table shows comparison of each algorithms in second stage.

TABLE 2 : COMPARISON OF ALGORITHMS IN SECOND STAGE

Algorithm	Incorrect Predictions	Correct Predictions	Accuracy
Decision Tree	92	2202	0.91
Random Forest	21	2300	92.84
Naive Bayes	75	1669	0.67

So according to testing results Random forest algorithm is much better than other algorithms. Then according to those testing results finally we decided to build a Random Forest classifier.

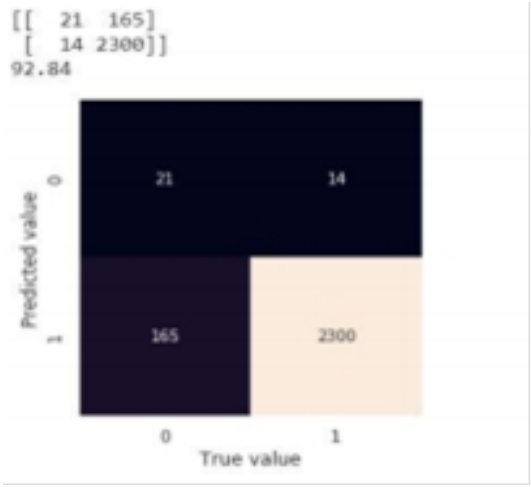

Figure 4: Accuracy of a Random Forest Algorithm

2. K-Means Clustering

K-Means is an algorithm which is used for clustering. This is an unsupervised learning technique and basically there are no exact output. We used this clustering algorithm for grouping relevant fields. In K-means clustering algorithm we used elbow method to find out optimal number of k values. Following chart shows an elbow method.

According to testing results K-means is also a more accurate algorithm for clustering than hierarchical clustering.

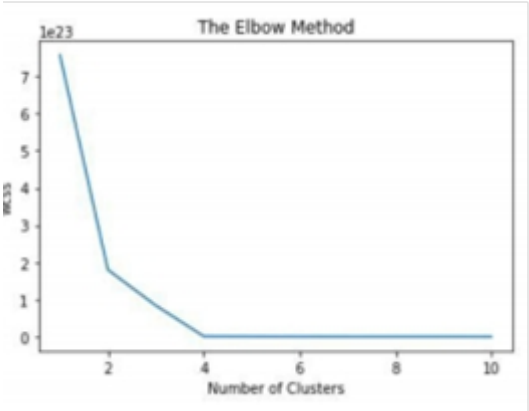

Figure 5: Elbow method

V. CONCLUSION AND FUTURE WORK

We are targeting to improve sales of ane-business by giving suggestions to merchants. To give suggestions we used review analysis technique provided by NLP. Merchants can also see their shop progress representing in the statistical chart. Statistical chart consists number of unsatisfied customers and number of satisfied customers to business. Also, suggestions are generated automatically from the system. Based on suggestions merchants can take decision for their business.

As a future work we will trying to give negative words which are mostly affect to merchant's business to merchants with the percentage (The percentage that word negatively affect to merchant's business). Also, we will improve the system to generate statistical data based on system generated suggestions. This statistical data represents changes to sales of the business if the merchant improves the business according to suggestions

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