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Sentiment Analysis of Social Networking Data Using Categorized Dictionary

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Abstract

Sentiment analysis is the process of analyzing a person's perception or belief about a particular subject matter. However, finding correct opinion or interest from multi-facet sentiment data is a tedious task. In this paper, a method to improve the sentiment accuracy by utilizing the concept of categorized dictionary for sentiment classification and analysis is proposed. A categorized dictionary is developed for the sentiment classification and further calculation of sentiment accuracy. The concept of categorized dictionary involves the creation of dictionaries for different categories making the comparisons specific. The categorized dictionary includes words defining the positive and negative sentiments related to the particular category. It is used by the mapper reducer algorithm for the classification of sentiments. The data is collected from social networking site and is pre-processed. Since the amount of data is enormous therefore a reliable open-source framework Hadoop is used for the implementation. Hadoop hosts various software utilities to inspect and process any type of big data. The comparative analysis presented in this paper proves the worthiness of the proposed method.

Keywords: Hadoop, Big data, HDFS, Map-Reduce, Facepager, Sentiment Analysis.

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Introduction

Big Data can be described as an extremely large database that can be analyzed to discover patterns, trends, and associations. The analysis of big data requires high computation power as it cannot be handled by the traditional database management applications. Clearly, when considering the question “What is big data?” the first characteristic that comes to mind is size. However, recently there are other characteristics of big data that have emerged. There are many definitions of big data that have emerged. For example, Gartner has defined big data in similar terms as “Big data is information that is high-volume, high-velocity and high-variety assets that demand cost-effective, innovative forms of information processing for decision making and enhanced insight ” (Gandomi & Haider, 2015). This large data have underlying patterns and trends. If these patterns and trends are discovered effectively they can be used in many applications for predictions and classifications. Thus, effective management of this data is required. Big data management refers to the process of filtering, analyzing and reporting facts from raw data by correlating and filtering it. The main goal is to ensure the best level of quality and accessibility of data for the purpose of business intelligence and data analytics. All huge organizations employ methods that help them to understand the growing pools for business decisions and improvements. Big data management helps the companies to understand the valuable information in big sets of data that is not structured as well as semi-structured data from all the variety of sources (Chawda & Thakur, 2016). Previously when data was generated at a steady rate, the main aim was to increase the processing power of the system. Different scheduling algorithms were used to increase the computational power of the systems. Then a distributed system came up in which a single job runs on multiple machines. Hadoop was one such invention, which has the capability to store and process huge amounts of data. HDFS (Hadoop Distributed File System) is the distributed file system used for efficient storage of data inside Hadoop. One of the key components inside the Hadoop framework is Map-Reduce which is used to analyze big datasets. Traditional databases such as relational databases can handle only a few gigabytes of data where Hadoop can handle terabytes or petabytes of data. Also, the relational databases work on structured data only, in which there is a static schema (Kumar, 2015). Sentiment analysis greatly helps us in knowing the customer behavior. The biggest challenge is to process the social data which exists in unstructured or semi-structured form. The present technologies are inefficient to process such big data in the desired way. Map Reduce is suitable for data which is unstructured data such as text file as well as for the semi-structured data (Patidar & Sharma, 2015). The sentiment is defined as an expression of opinion by a person about any object or any aspect. Sentiment analysis refers to analyzing, investigating, extracting user’s opinions, sentiment and preferences from the subjective text. Almost all human activities are opinions that are key influencers of human behaviours (Ortigosa et al., 2014). We often seek out the opinions of others when we need to make a decision. This is not only true for organizations but also true for individuals. Opinions and its related concepts such as sentiments, evaluations, attitudes, and emotions are the subjects of the study of sentiment analysis and opinion mining (Dasgupta et al., 2015). In this paper, social networking sites data is collected to perform sentiment analysis. The proposed work develops a categorized dictionary for different categories of entities. The development of a categorized dictionary increases the efficiency of sentiment classification. The search space is reduced due to the division of the dictionary into subparts. Further, this categorized dictionary is used for sentiment analysis and classification for different objects.

Literature Review

A lot of research has been done in the area of Sentiment Analysis. The sentiment analysis of users considering their reviews and feedback on different subjects are used as a source to analyze their sentiments. Most of the research has been done in the area of big data processing (Gandomi & Haider, 2015), where the key dimension of discussion is the dimensionality of big data. The other dimensions of big data such as velocity, variety, veracity, variability, and value are of equal importance. The primary focus is placed on analytics in order to get valid and valuable insights from big data. The authors have highlighted the point that predictive analytics which deals mostly with structured data overshadows the other forms of analytics that are applied to unstructured data. In this section, the analytics techniques for text, audio, video, social media data, and predictive analytics have been reviewed. The 5 V's have been introduced in big data (Chawda & Thakur, 2016). The basic requirement of analyzing big data is to find meaning and discover the unseen relationships in big data. The 5 key approaches which big data tools analyze have been discussed which includes discovery tools, BI (Business Intelligence) tools, In-Database Analytics, Hadoop (High-availability distributed object-oriented platform) and Decision Management. All the tools and frameworks provided by various organization and their comparison table is presented. The best tool so far is Infosphere. The future work included is to develop their own Hadoop system and comparing with Apache Spark, Storm and Map Reduce with performance analysis using K-Means. The concept of big data along with 3 V's which include Volume, Velocity, and Variety of big data (Kumar, 2015). The problems faced in processing big data are also addressed. These challenges have been addressed so that there can be fast and efficient processing of big data. The challenges include lack of structure, error handling, privacy, provenance, visualization, timeliness, and heterogeneity at all the stages from data acquisition to result in interpretation. The analysis tools and techniques for the analysis of big data and components of Hadoop are presented (Patidar & Sharma, 2015). One of the best tools for analysis of big data is Hadoop due to its scattered architecture. Hadoop has proved to be scalable, reliable, fault-tolerant and used to be commodity hardware. In comparison to traditional RDBMS, it is more powerful as it can use functional programming, key-value pairs and is able to support offline batch processing. Numerous machine-learning algorithm has been developed by the researchers for analyzing the movie reviews and getting the rating based on the reviews analysed (Gupta et al., 2016). For processing the review dataset Hadoop has been utilized used. In this paper the rating based mechanism is proposed in which the real dataset is collected from twitter and based on the positive and negative rating given by the reviewers, normal and abnormal posts are distinguished. The results findings show that the proposed approach detects the abnormal posts successfully in a large manner as compared to the existing techniques. In this research article, a new method has been proposed for sentiment analysis which includes extraction of information about the user's sentiment polarity (positive, negative or neutral). The messages written and transmitted by a user are used for identifying the polarity of the sentiments for emotional changes (Ortigosa et al., 2014).

The method is implemented in SentBuk, which is a Facebook application. SentBuk classifies the messages written by users on Facebook according to their polarity, showing the results to the users through an interactive interface. It also supports the detection of emotional change, emotion finding of a friend, classification dependency on how the users interact with messages and their statistics among each other. A hybrid approach is presented in this paper followed by the classification method implemented in SentBuk which includes the combination of the techniques which are based on machine learning and lexical analysis. An illustration is done for sentiment analysis from Facebook data using open source technologies (Dasgupta et al., 2015). A significant advancement in the in-memory computation capabilities can be obtained in the open-source world through Spark with Resilient Distributed Datasets (RDD). The combination of Spark RDD and Hadoop provides significant computational capabilities with low price commodity hardware in a fault-tolerant cluster setup. This platform provides an information analytics layer on top of Hadoop that embraces the MapReduce paradigm and the resilience of Spark RDD's through R along with advanced statistical analysis layer with design-time and run-time optimizations of the open-source stack. Although this paper provides a new approach that mines sentiment information which is unstructured. Refinement in this approach can be made through the iterative process of cleaning /pre-processing, which would ultimately eliminate the data source from outliers and noise.

The method is proposed by Gupta et al. (2015) which the opinions of the people have been assigned a positive or negative score. For storing the data, HDFS (Hadoop Distributed file system) is used for performing the sentiment analysis in the MapReduce component of Hadoop. A computational framework is proposed by Selvan & Moh (2015) for opinion mining providing fast feedback. The input to the framework given is a real-time Twitter data stream to filter and analyze the obtained data in order to provide quick feedback through sentiment analysis. Data accuracy is very important for sentiment analysis and the Apache Hadoop framework provides an accurate result of 84% when there is abundant data produced from social media. The services provided exist on the Cloudera version of Hadoop. A demerit of this paper was not giving accurate results for the sentiment dictionary used for text. However, possibly efficient answers were given by the words which were divided into nine categories. Tayal & Yadav (2016) have proposed an approach for faster retrieval of sentiment analysis wherein to store and process the large set of data Hadoop has been used. When Hadoop is implemented with bloom filter the results of sentiment analysis can be retrieved at a faster rate and also in an accurate manner. Bloom filter is a data structure that supports add, find and sometimes delete operation if the element is in a set widely used for testing, especially if the set is huge (Goswami et al., 2019; Alaei et al., 2019). Some other researchers have also performed sentiment analysis based on these methods (Chang, 2018; Kang et al., 2017). In this paper, a categorized dictionary approach for sentiment analysis from social networking data is used. The categorized dictionary includes words defining the positive and negative sentiments related to the particular category. The categorized dictionary includes words defining the positive and negative sentiments related to the particular category.

Proposed Method

A number of people sharing their personal feelings and reviews using social media are increasing day by day. A potential user relies on every minute opinion, reviews that are being expressed online by various users to make decisions with respect to purchasing an item or developing software when it comes to an organization that provides services. It is of utmost importance to analyze these reviews, opinions or feedbacks from time to time. Ideas of people are influenced by the opinions of other people. For the analysis of reviews given by people lot of research has been going on. To obtain customer feedback about their products, many companies face difficulty. The proposed method includes the extraction of data to pre-processing of data for retrieval of a number of positive and negative words which are then used for calculating the sentiment accuracy for providing better feedback to companies about the feedback of their products. Fig 1 presents the general layout of the proposed approach. Discussed below is step by step description of various steps involved in sentiment analysis:

Step 1. The user’s comments/reviews are extracted by using software Facepager in the form of text or csv file format.

Step 2. The input file is loaded to HDFS (Hadoop Distributed File System) and processed in the Mapper phase of Apache Hadoop.

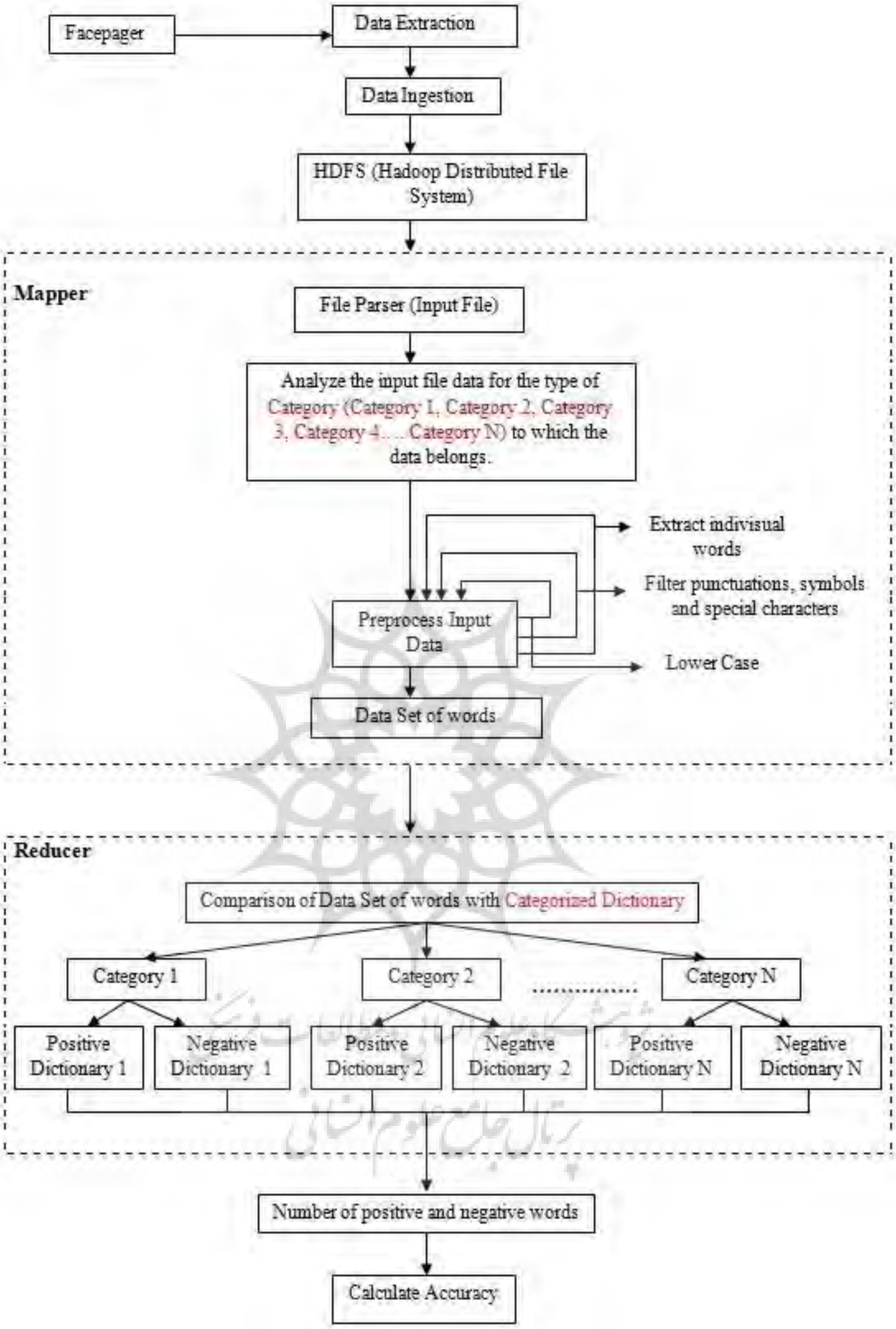


Figure 1. General Layout of the proposed method

Step 3. In Mapper function, the input file is scanned for identifying the category to which the data belongs. This is done by comparing the words in input file consisting of posts and comments on product of a particular brand which will also include the brand name with the data sets of all the brand names which have their accounts on Facebook.

Step 4. From above (step 3) the brand name can be used to identify the category to which the data belongs, which will be used by the Reducer.

Step 5. Then the input data file is preprocessed to lower case, removing punctuations, special characters, symbols and emoticons to get the file consisting of data set of individual words.

Step 6. The result data set file obtained from above step is used as an input to the Reducer phase.

Step 7. In Reducer function, the data set of input file obtained from Mapper is compared with the categorized positive and negative words dictionary consisting of the words which are specifically related to a particular category. The category is obtained from the Mapper.

Step 8. On comparison from above step the number of positive and negative words is obtained, which can be used to calculate the sentiment accuracy.

Data Extraction

The data extraction is done for retrieving the customer's feedback/response about a brand of product from Facebook. For this activity, software named Facepager is used for retrieving comments or posts from Facebook.

Introduction to Facepager

Facepager is a software that is used to extract user's comments and reviews from Facebook. In this work, the data for the 4 categories have been fetched using Facepager and is used for sentiment analysis. The categories include food, automobiles, clothing, and electronics. The brands include Star Bucks, Hyundai, Levis, and Samsung.

Preprocess Data

Once the data is retrieved for different categories in the form of text file or csv file, it is loaded onto HDFS (Hadoop Distributed File System). Then it is pre-processed by the Mapper and Reducer phase of Apache Hadoop to get the number of positive and negative words which are used to calculate the sentiment accuracy.

Mapper Phase

The Mapper gets the data file consisting of comments and posts fetched from Facebook. The first step is to analyse the category to which the data file belongs. For this a set of all the brands names which have their Facebook accounts are taken in a data set and compared to the data file consisting of posts or comments for a particular brand. On comparing the brand name from input file which will be consisting of the brand name in posts of the brand will be matched with the data set of all the brand names with Facebook accounts. This will give the match for the brand to which the input data file belongs. The brand name will then be compared to the category to which that brand belongs. This category will be used in the Reducer phase to compare the data set with the categorized dictionary which will be introduced in the Reducer phase. The second step includes pre-processing the input data file for filtering the data by converting the words to lower case, removing punctuations, emoticons, special characters and symbols. The stop words are not removed in this method considering the case of comparison of dictionary words with the data set retrieved from the input file after pre-processing. So the stop words will automatically be skipped on comparisons and will be neglected. A data file is generated by the Mapper which consists of a set of individual words which can be positive, negative or neutral which is used by the Reducer as an input. Fig 2 presents the mapper algorithm utilized in the proposed approach.

```
class MAPPER
    method MAP(LongWritable key, Text value, Context context)
        Set line ← convert 'value' to string
        Set itr ← convert 'line' to token
        Start while loop
        while 'itr' has tokens do
            Set token ← convert 'itr' to lowercase
                if 'token' has first character equal to alphabet
                    Set token ← remove special characters
            if 'token' is equal to list of Food category words
                Set foodFlag ← 1
            else if 'token' is equal to list of Clothing category words
                Set clothingFlag ← 1
            else if 'token' is equal to list of Electronics category word
                Set electronicsFlag ← 1
            else if 'token' is equal to list of Automobiles category word
                Set automobilesFlag ← 1
            Set word ← token
            Set context ← word
        EMIT(key, value, context)
        End While loop
    method getFoodFlag
        EMIT(foodFlag)
    method getclothingFlag
        EMIT(clothingFlag)
    method getelectronicsFlag
        EMIT(electronicsFlag)
    method getautomobilesFlag
        EMIT(automobilesFlag)
```

Figure 2. Mapper algorithm for proposed method

Reducer Phase

In the Reducer phase, the file generated as result from the Mapper is compared with the categorized dictionary based on the type of category identified for the input data in Mapper phase. The categorized dictionary consists of the positive and negative words for different categories which makes it more specific in the type of words used more likely for giving comments/reviews by the user for a specific category of product. For each category presently approximately 600-700 words have been used. Since slang words are also used nowadays, so slang words are also added to the dictionary. On comparison of the dataset of words from the positive and negative dictionaries of the categorized dictionary the number of positive and negative words are obtained. From the number of positive and negative words obtained the sentiment accuracy can be calculated. The reducer algorithm used in the proposed approach has been discussed in Fig 3.

```
1: class REDUCER
2:    method REDUCE(Text key, IntWritable values[v1,v2,v3….], Context context)
3:          Set sum ← 0
4:          Set foodFlg ← CALL getFoodFlag
5:          Set clothingFlg ← CALL getclothingFlag
6:          Set electronicsFlg ← CALL getelectronicsFlag
7:          Set automobilesFlg ← CALL getautomobilesFlag
8:          for all term value ∈ values do
9:                Set sum+ ← value
10:               Set keyValue  ← covert ‘key’ to string
11:               if foodFlg = 1
12:                     CALL wordCheckFood(keyValue)
13:               else if clothingFlg =1
14:                     CALL wordCheckClothing(keyValue)
15:               if electronicsFlg =1
16:                     CALL wordCheckElectronics(keyValue)
17:               if automobilesFlg =1
18:                     CALL wordCheckAutomobiles(keyValue)
19:         End For loop
20:   EMIT(value,sum)
21:   method wordCheckFood(String key)
22:         for all term j ∈ negWordsFoodDictionary do
23:               if negWordsFoodDictionary[j] equals to key
24:                     negative = negative+1
25:                     PRINT negative
26:         End for loop
27:         for all term k ∈ posWordsFoodDictionary do
28:               if posWordsFoodDictionary[k] equals to key
29:                     positive = positive+1
30:                     PRINT positive
31:   Steps 21 to 30 will be similar for wordCheckClothing,
     wordCheckElectronics and wordCheckAutomobiles methods
     including their positive and negative words dictionaries
```

Figure 3. Reducer algorithm for proposed method

Sentiment Accuracy

From the number of positive and negative words obtained the sentiment accuracy can be calculated. The overall accuracy percentage of the analysis for the categorized data is computed as:

$$Accuracy = \frac{(m^{+} + m^{-})}{(a^{+} + a^{-})} * 100 \qquad (1)$$

Where the actual number of positive and negative words is verified from the comments as positive words (a^{+}) and negative words (a^{-}).The positive words in the comments which matches with the prediction can be represented as m^{+}. The negative words in the comments which matches with the prediction is represented as m^{-}.

Dataset Used

The data is fetched using Facepager for approximately 200 posts and comments, which retrieves data from Facebook accounts online. This feature of the software is used to fetch the comments and posts of customers on product brands online. The data fetched can be saved in the form of a text or CSV file. This file can be used for further pre-processing the data to get the desired results. Specifically for this work, the data has been fetched for 4 categories which include food, clothing, electronics, and automobiles. In Facepager specific number is given for the number of comments to be fetched. The data retrieved consists of the fields which include id, parent_id, level, objected, object type, query status, query time, query type and message. The required field is the message field which consists of the posts and comments. The rest of the fields are ignored and not considered for further preprocessing the data. For the 4 categories the different brands considered are as follows:

- Food: Haldirams
- Clothing: Levis
- Electronics: Samsung
- Automobiles: Hyundai

Experimental Results

The results are provided for the data fetched from Facebook which is related to the different categories. This data is then compared with the categorized dictionary consisting of positive and negative words which are related to the sentiments of a particular category to which the data belongs to.

Steps for Execution process in Apache Hadoop

Step 1: The data fetched from Facepager is in the form of csv file format which is loaded into the HDFS from the local file system using the following command:

```
hadoop fs –copyFromLocal Haldirams.csv
```

Step 2: The data file gets loaded in HDFS and can be viewed in its directory using the command:

```
hadoop fs –ls
```

Step 3: Once the file gets loaded in HDFS, it is used for pre-processing firstly by the Mapper class and then by the Reducer class. In the Mapper phase, the input file is pre-processed for filtering the data such as converting the entire data to lower case, removing punctuations, special characters and symbols and finally getting a dataset of individual words with their count on the number of occurrences. The entire program for this logic is written in Java programming language using the Eclipse interface. The entire logic on saving gets saved as a jar file at the specified location. This jar is executed to get the desired results. The command used for the execution of the jar file is:

```
hadoop jar Haldirams.jar WordCount Haldirams.txt out
```

Step 4: In the Reducer phase, the result file from Mapper phase, is used as an input file which is compared with the categorized dictionary based on the type of category to which the data belongs which will be retrieved from the Mapper phase. The final result of the Reducer phase is given by the count on the number of positive and negative words after comparison from the categorized dictionary.

Step 5: From the number of positive and negative words received from the Reducer phase the sentiment accuracy is calculated from the specified formula (1). Further the results are discussed with examples on the calculation of sentiment accuracy.

Illustration Using Example

To calculate the accuracy a stratified random technique is used according to which any 25 random comments are taken from the data fetched for the categories and results are obtained manually and from the proposed method. The results are then used to calculate the sentiment accuracy from the given formula.

$$Accuracy = \frac{(m^{+} + m^{-})}{(a^{+} + a^{-})} * 100 \tag{2}$$

The actual number of positive and negative words is verified from the comments as positive words (a+) and negative words (a-). The positive words in the comments which match with the prediction can be represented as m+. The negative word in the comments which matches with the prediction is represented as m -.

Considering the case of data related to the food category where the comments are fetched from Facebook for Haldirams (which is a brand for food). We have got the following results:

Total number of random comments considered = 25

Total number of positive words verified manually (a+) = 10

Total number of negative words verified manually (a-) = 5

Number of positive words which matched with categorized dictionary (m+) = 11

Number of negative words which matched with categorized dictionary (m-) = 2

Sentiment Accuracy = (11+2) / (10+5) *100

= 86.66%

Table 1 presents the sentiment accuracy achieved for different categories used for sentiment analysis. It can be seen that the highest accuracy is found for clothing (88.21%) and least for automobiles (86.50).

Table 1. Sentiment Accuracy for categories

Category	Accuracy(%)
Food	86.66
Clothing	88.21
Automobiles	86.50
Electronics	87.56

Results for different Categories

On applying the stratified random sampling technique on random samples of comments or reviews of customers, the sentiment accuracy is calculated by using data belonging to different categories. The results are calculated as per positive word samples taken from categorized dictionaries (Table 2). The positive sentiment comment data for different categories have been shown in Table 3.

Mean value of accuracy achieved = 87.23%

Table 2. Positive words samples from categorized dictionaries

Food	Clothing	Automobiles	Electronics
Yummy	Fashionable	Speedy	Durable
Tasty	Comfortable	Powerful	Stylish
Flavorful	Elegant	Safe	Sleek

Table 3. Sample data from Facebook comments for different categories

Categories	Sentiment	Facebook Comments
Food	Positive	Yummy we love this !!!
Clothing	Positive	I have always like the levis brand .best brand ever
Automobiles	Positive	realy a nice car it is just like a spice jet journey
Electronics	Negative	Very bad experience gear s3 watch don't bye bad back glass not Gorilla easily crack

Results for different categories

The results obtained from different categories such as food, clothing, automobiles, and electronics can be represented graphically using a bar graph. The four categories used for the calculation of sentiment accuracy show results better than the previous techniques and have improved the percentage of accuracy. The bar graph in Fig. 4 displays the category on the x-axis and the sentiment accuracy calculated for 4 categories on the y-axis. Since the Stratified random sampling technique is used so the data is selected randomly in sets of 25 each from approximately 1000-2000 comments/reviews given by customers on different brands Fig. 5.

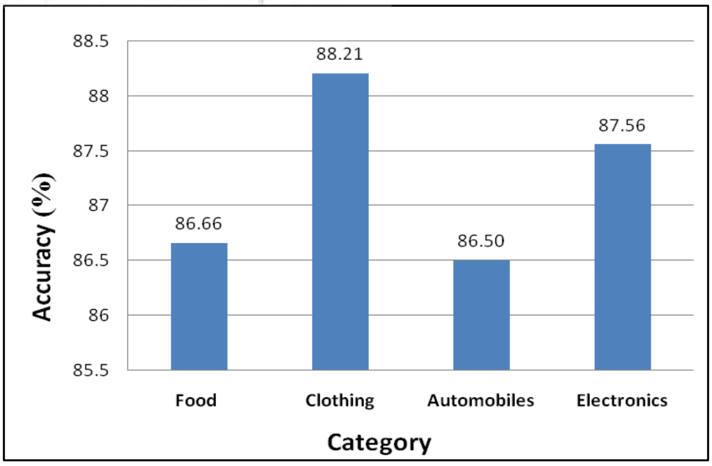
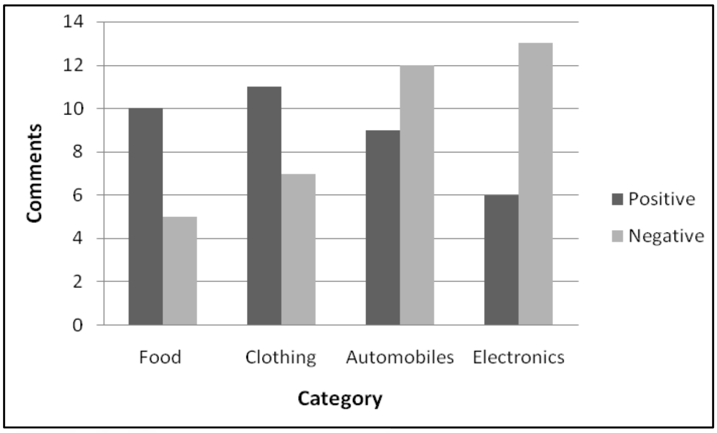


Fig 4. Graphical representation of sentiment accuracy for different categories

The random data selected provided with varied results. The mean accuracy calculated proved to give better results since the comparisons on the positive and negative sentiments of words were specific to the provided categorized dictionary.

Fig 5. Graphical representation of positive and negative sentiments for different categories using stratified random sampling technique



Discussions and Implications

Predictive Analysis from Results

The results obtained reveal that the accuracy calculated gives an insight to the producer or company of the brand. This can be used as a feedback of their products which are being used and how many products are getting popular and widely getting used by the customer. These results can be used as information by various brands to improve the quality of their products in case of less number of positive comments or reviews obtained. The total number of positive and negative comments obtained as a result can be used to predict the positive and negative feedback to the users. Based on the results the companies can get feedback and take necessary actions in the future.

Comparison with existing techniques

The results show that the proposed method has increased accuracy in comparison to the previous techniques available in the literature. The categorized dictionary provides a comparison of the data from the user’s reviews/comments for a product belonging to a particular category. This makes the comparison more specific and provides more efficient results for the number of positive and negative words to be obtained hence increasing sentiment accuracy. The improved accuracy provides better feedback to the companies about their products and gives them an insight into how improvements can be made to improve their reviews and provide customer satisfaction. The comparison from previous techniques shows improved accuracy with the proposed method in Table 4.

Table 4. Performance Accuracy

Method	Accuracy(%)
SVM + Lexicon-based tagging (Ortigosa et al., 2014)	83.27
Hadoop based open source technology (Dasgupta et al., 2015)	67.6
Proposed Method	87.23

Conclusion and Future Work

Various sentiment analysis techniques have been proposed and implemented by researchers in the literature aimed at providing better sentiment analysis with a minimum error rate. The limitations of these techniques affect the retrieval of feedback and there by decreases user's satisfaction. The major contributions of the proposed work are to provide an efficient method capable of increasing sentiment accuracy and give better results to the companies in terms of feedback from users online. In this work, an effort is made to improve the sentiment accuracy by making an addition of the concept of categorized dictionary in the previously implemented techniques, which resulted in improved accuracy. The concept of categorized dictionary involves the creation of dictionaries differently for different categories making the comparisons specific. The categorized dictionary employed words defining the positive and negative sentiments related to the particular category. The result findings prove the worth of the proposed method in increasing sentiment accuracy. The future work would be to improve the proposed approach by improving the categorized dictionary by adding emoticons, including spelling checks and trying to add the negation checker which will further increase the results with better accuracy.

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