

# Sentiment Analysis Using Product Reviews

Iranna S Choukimath<sup>1</sup>, Dr. T. Senthil Kumaran<sup>2</sup>, Dr. B.S Pradeep<sup>3</sup>

<sup>1</sup>M.Tech Student, Department of CSE, ACSCE, Bengaluru-560074, iranna.cmath@gmail.com

<sup>2</sup>Associate Professor, Department of CSE, ACSCE, Bengaluru-560074, senthilconference@gmail.com

<sup>3</sup>Professor & HoD, Department of CSE, ACSCE, Bengaluru-560074, pradeepbs78@yahoo.com

**Abstract** - Sentiment analysis or opinion mining is a computational study of people's opinions, attitudes, and emotions expressed in written language for a product. One of the major problem in sentiment analysis is to figure out the polarity of the sentiment. It is required to summarize all the sentiment expressed for a product as positive/negative/neutral to take a quick decision on whether to go for a product or not. This paper uses comments given for the product in the blogs, ecommerce- site, comments from Facebook and the review rating as an input and polarity of the sentiment will be calculated based on the sentiment score obtained for the sentimental words. Step by step procedure to identify the polarity of the sentiment is explained in this paper and sentiment score obtained for each product is represented in Bar Graph for quick understanding. Results of the different approaches are compared using F1 score.

**Keywords** - E-commerce analysis, Product review analysis, Sentiment analysis, Sentiment Polarity Categorization, Sentiment Score.

## I. INTRODUCTION

Sentiment Analysis is known as opinion mining and it is a field of analyzing user's reviews, emotions, sentiments, appraisals etc. towards objects such as organization, product, individual, services, topics, events etc. People can express their opinion through social networking sites like Facebook, Twitter, blogs, public forums, websites etc. People's opinions are summarized and categorized into positive/negative/neutral. It is one of the key jobs of Natural Language Processing (NLP).

Sentiment analysis is categorized into 3 types:

1. Manual Processing – Human can interpret the sentiment and that will be the most correct judge of sentiment.
2. Keyword processing – In this processing, algorithm assigns a score to the specific word based on positivity or negativity, then it computes total percentage of the post.
3. Natural Language Processing – It is used for processing sentence level categorization. It is used in many areas like language translation, transforming speech to text and grammar checks.

One of the major problem in sentiment analysis is to determine the polarity of the sentiment expressed for a product. Consolidating huge review comments and ratings given for the product and processing it to determine the polarity of the sentiment into positive/negative/neutral is a challenging task.

This paper tackles the problem statement in an efficient way using bang-of-word model and TSI (total sentiment index) approach. It also uses NLP features for fine graining the result such as POS tagging and sentiment phrase identification.

## II. OBJECTIVE

Main objective of this paper is to categorize the polarity of the sentiment. Sentiment on the product can be expressed through rating, review, emoji's etc. This paper consumes review comments and rating given for a product to derive the polarity of the sentiment such as positive/negative/neutral.

### III. LITERATURE SURVEY

One of the major problem in sentiment analysis is categorizing the polarity of the sentiment which means categorizing the sentiment expressed for a product through their comments into a specific polarity like positive, negative or neutral. Current application research is essentially based on the previous work that has been done by the researches Liu B, Hu and Liu and Gann et al. Liu B has done some research on sentiment analysis and classified sentiment polarity categorizations into 3 levels. First one is Document level. In this level, survey has been made on brand/product and its result will be published as a document/article. Here whole document will describe whether the polarity is positive/negative/neutral. Second level is Sentence level. In this level, sentiment on a given product is expressed through comments in a public forum, social networking sites, private websites, blogs etc. Based on the comments/sentence polarity can be categorized. Third level is Entity and Aspect level. This level targets on the opinion of the people, whether people liked or disliked the product.

Hu and Liu have done some survey to collect customer's reviews. Based on the review they categorized list of positive words and negative words. They listed 2,006 positive words and 4,783 negative words. They also listed frequently used misspelled words that are used in the comments/reviews given in the social media/forum/blog.

Pang and Lee worked on the identification of the sentiment information and came with an approach of retaining subjective sentence by filtering objective sentence. They suggested text classification technique to find subjective content in a sentence using minimum cuts. Gann et al collected Twitter data and listed 6799 tokens and assigned sentiment score for each token called TSI (Total Sentiment

Index), this itself will be featured as positive words and negative words. Total Sentiment Index (TSI) for certain token will be calculated as

$$TSI = \frac{P - \left(\frac{tp}{n}\right) * n}{P + \left(\frac{tn}{n}\right) * n} \quad (1)$$

Where P is the positive work in the comment. N is negative word count is comment.  $\frac{tp}{n}$  is ratio of total positive word count and negative word count.

### IV. IMPLEMENTATION

#### A. Data Collection

1) *Data Collected from E-Commerce:* Large amount of data needs to be collected to find out the user sentiment of the product. Review data used in this application is collected from Amazon. User comments are collected for three different categories those are Mobile, TV and Washing machine and chosen some well know brand name for each category. Table 1 shows the number of comments collected for each category and brand wise. Based on this data, application will find out the trusted brand from user. That is user sentiment given to those brands.

TABLE I  
BRAND WISE DATA COLLECTION INFORMATION

Category	Brand	Comment Count
Television	LG	234
Television	Oneida	422
Television	Panasonic	150
Television	Sony	187
Television	VU	349
Washing Machine	Hair	436
Washing Machine	IFB	604
Washing Machine	Whirlpool	537
Washing Machine	BPL	310
Cell Phone	Lenovo	279

Cell Phone	MI	562
Cell Phone	Micromax	280
Cell Phone	Moto	362
Cell Phone	Samsung	983
<b>TOTAL</b>		<b>5695</b>

2) *Data Collected through Integration with Facebook:* This application is integrated with Facebook to extract comments given for each product. Every product added to the ecommerce application will be added to Facebook page as Post. User can give his/her comment in ecommerce application product details page or in Facebook. To calculate user sentiment both comments given in e-commerce and comments given in Facebook are considered.

### B. Methodologies

Many researchers have proposed various methods for the sentiment analysis. Among many approaches, this paper uses method proposed by Hu and Liu, bag-of-word model and based on sentiment score. Based on the result of the survey that has been done on online review comments, Hu and Liu categorized list of positive words and negative words. They listed 2,006 positive words and 4,783 negative words. This project uses above list for breaking review sentence into positive or negative words. Once sentence is broken into list of positive or negative words, polarity of the sentiment will be identified using two approaches, first approach is bag-of-word model and second approach is based on sentiment score calculated for each word.

Bag-of-word model counts the appearance of positive or negative token from the given sentence. If total number of positive tokens are more than the negative tokens, then sentence will be tagged as positive. If total number of negative tokens are more than the positive tokens, then sentence will be tagged as negative. If positive and negative tokens are equal, then sentence will be tagged as neutral.

Second approach is based on the sentiment score calculate for each token. For each positive and negative word, sentiment score will be calculated based on the rating and the

number of occurrence of each word in all the rating. Total sentiment score obtained for the list of positive words and negative words, decides the polarity. If total sentiment score of positive words is greater than the total sentiment score of negative words, then polarity will be positive and vice versa. If total sentiment score of positive and negative words are equal, then polarity of the sentiment is neutral.

Figure 1 shows the phase diagram, how sentiment is calculated for the comment. User comment is considered as input for this. Sentiment sentence will be extracted from user comments. Sentiment sentence will be converted to lower case and remove all non-alpha character. This will help to match positive and negative words list as all positive and negative words taken from the library are in lower case. Sentiment sentence will be mapped to list of words by using white space as delimiter. Then each word will be mapped with parts of speech. This application uses Stanford POS tagger to identify POS for each word. Nouns and Pronouns will not describe any sentiment, so it should be removed from the list of words which are extracted from sentiment sentence. Get the sentiment score for each word and calculate the final sentiment for the product and represent the result in bar chart product name v/s sentiment score.

### C. Sentiment Score Calculation

1) *Bang of word model:* There are many ways to calculate sentiment score. Bang of word model is commonly used model for this. It will find the positive word count and negative word count in the sentiment sentence. If total count of positive words is more than negative words, then user sentiment will be positive and if total count of negative words is more than positive words in the user comments then user sentiment is negative for that product. If positive word count and negative word count is same, then user sentiment is neutral.

$$\text{Sentiment Score} = P - N \quad (2)$$

Where P is the count of positive words in the sentiment sentence

N is the count of Negative words in the sentiment sentence.

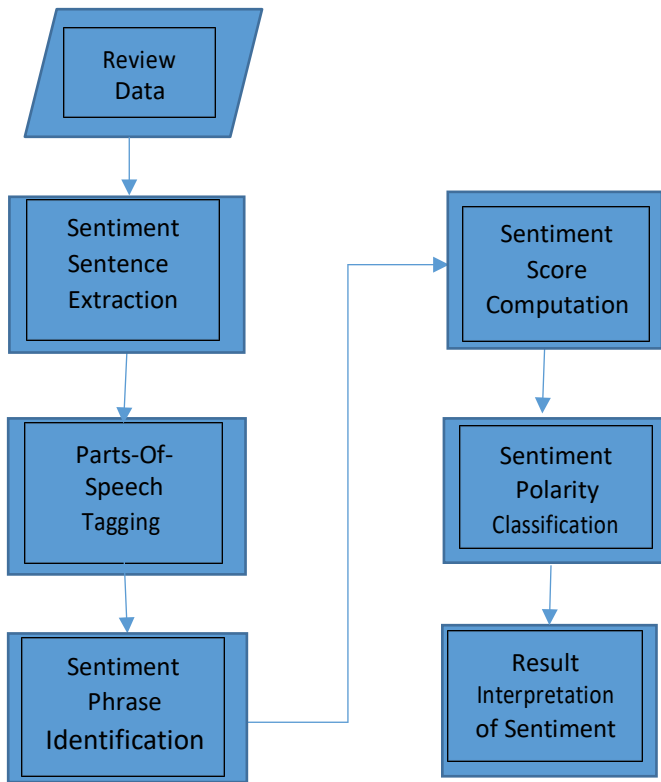


Figure 1. Phase diagram to find out sentiment polarity

2) Calculate Sentiment Score for token: Sentiment score is calculated for listed positive and negative words which is used for this application. There are 2006 positive words list and 4784 negative words list. Formula 3 is used to find sentiment score for all positive and negative words identified from 5532 comments provided by user for different category. 4784 negative words and 2006 positive words are used for finding user sentiment. Below formula is used to calculate the sentiment score for positive token and negative token

$$\text{Sentiment Score } (t) = \frac{\sum_{i=1}^5 i * y_{5,*} * \text{Occurrence}_i(t)}{\sum_{i=1}^5 i * y_{5,*} * \text{Occurrence}_i(t)} \quad (3)$$

$\text{Occurrences}_i(t)$  is the number of appearance of token  $t$  in  $i$ -star reviews where  $i = 1, \dots, 5$

$$y_{5,*} = \frac{|5 - \text{star}|}{|i - \text{star}|} \quad (4)$$

36, 25,806 reviews are collected from amazon website, each review has product ID, rating, review, title, helpfulness and review by. Using below algorithm sentiment score is calculated for each token and stored in the file system and will be used to calculate sentiment score for the product.

## V. RESULT

Different classification models are available for benchmarking performance of sentiment analysis and those will be calculated based on the F1 score. Formula for calculating F1 score is shown below.

$$\text{Precision} = \frac{TP}{TP + FP} \quad (5)$$

$$\text{Recall} = \text{Sensitivity} = \frac{TP}{TP + FN} \quad (6)$$

$$F1 = \frac{2 * \text{Precision} * \text{Recall}}{\text{Precision} + \text{Recall}} \quad (7)$$

Where TP is True Positive

FP is False Positive

FN is False Negative and

TN is True Negative

For performance analysis, 200 user comments are taken as input and F1 score is calculated for it. Calculated F1 score is compared against some standard studies/methods and result is represented in Figure 2.

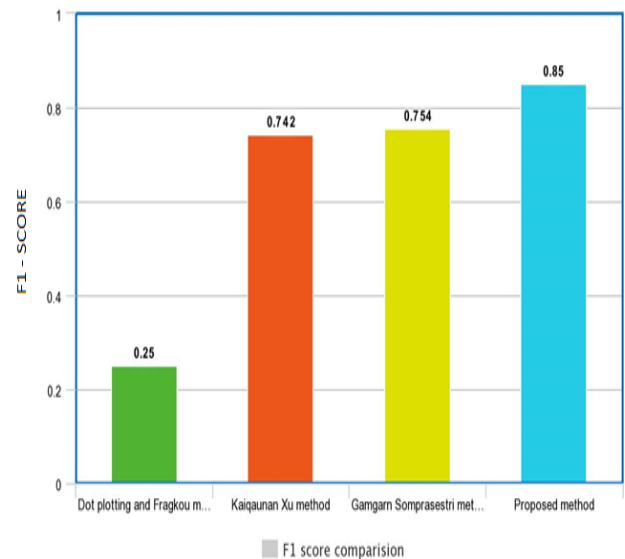


Figure 2. F1 score comparison

### A. Advantages over other methods

- ➔ Dot plotting and Fragkou method will work for only document level sentiment analysis, however this system works for both Sentence level and Document level and the F1 score is very less compared to purposed method

- Noun product feature is directly modified into positive and negative opinion words in Lie Zhang method. Purposed system will do POS tagging for every word and objective words are extracted from subjective and use calculated sentiment for every token to find out sentiment.
- Xiowen ding method uses opinion words which are context dependent. Purposed system is using 4748 negative tokens and 2006 positive tokens.
- Gamgarn Somprasestri method and Kaiqunan Xu method's F1 score are comparatively lower than the purposed system. F1 score will represent the accuracy of method over studied test data. Table II describe different method's F1 score, advantages and disadvantages.

### B. Result represented in Graph

Sentiment score which is calculated for different brands can be pictorially represented using Bar Graph. Pictorial representation helps in taking clear decision based on the highest scored brand/product. Below figure shows the brand v/s sentiment score for the selected category. This paper selected various brands of Washing machine and sentiment score for each brand will be calculated based on user comments and result will be displayed in Figure 3.

## VI. CONCLUSION

Sentiment analysis or opinion mining is a field of study that analyzes people's sentiments, attitudes, or emotions towards certain entities. This paper tackles a fundamental problem of sentiment analysis i.e. sentiment polarity categorization. Online product reviews from Amazon.com are selected as data used for this study. Sentiment polarity categorization process has been proposed along with detailed descriptions of each step. Experiments for both sentence-level categorization and review-level categorization have been performed.

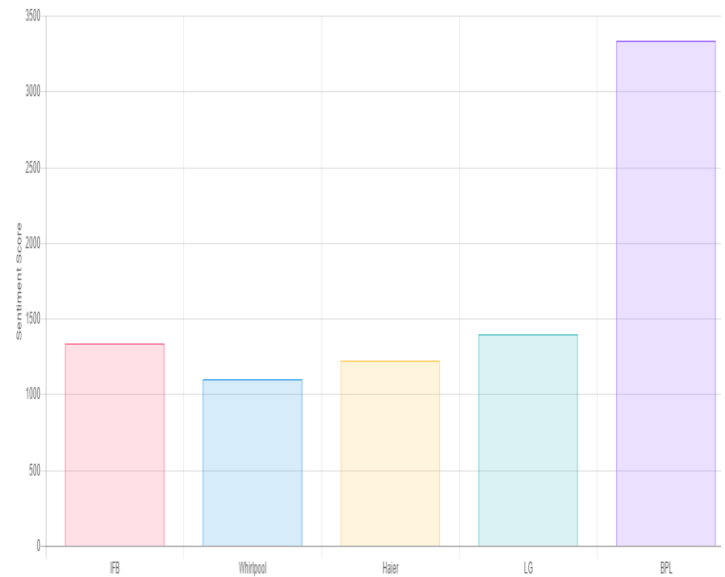


Figure 3. Sentiment Score v/s Brands

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TABLE II

F1 SCORE AND FEATURE COMPARISON

SL No	Studies / Method	Feature Selection	Data Source	F1 Score	Disadvantages/ Advantages
1	Dot plotting and Frangkou method	Linear text segmentation	Chinease restaurant review	0.25	Works at document level rather than sentence level.
2	Hu and Liu method	Feature generalization noun or noun phrases.	Amzaon.com and Cnet.com	-	Cannot effectively deal with the implicit feature expression problem.
3	Lie Zhang method	Noun product feature , Opinion lexicon	Product Review	-	Noun product feature is directly modified into positive and negative opinion words.
4	Xiowen ding method	Lexicon based approach	Product Review	-	Opinion words which are context dependent are easily used.
5	Gangarn Somprasestri method	Maximum entropy	Amazon Reviews	0.754	
6	Kaiqaunan Xu method	Multiclass SVM	Amazon Reviews	0.742	
7	Proposed method	Naive bayes, Support vector machine and Random forest	Amazon and Flipkart reviews	0.85	Works for sentence and document level both. Two type of features-POS based and Sentiment tokens.