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Sentiment Analysis over Online Product Reviews: A Survey

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Abstract- Prior to the invention of the internet, while purchasing any product people used to ask the opinions to his family, friends for particular product. But now a days as the swift increase of usage of the internet, more users are motivated to write their feelings about particulars in the form of comments on different sites like Facebook, twitter, online shopping sites, blogs, etc. this comments are nothing but the sentiments of the users this may be positive, negative or neutral. There are various techniques used for summarizing the customer comments like Data mining, Text clssification, Retrieval of informtaion, and summarizing the text. People tend to write their reviews over a product over different sites. Most of the reviews are critical to conclude so it generates difficulty for usefulness of information. If anyone want to know the impact of the particular post/product then it becomes difficult to read all the comments and to classify it. Sentiment analysis is the ongoing research field in the data mining, Sentiment analysis is also referred as opinion mining. This field mainly deals with classifying the sentiments among different types of comments that are written by various users. This paper is about to discuss different techniques, challenges and applications related to sentiment analysis.

Keyword- *Sentiment Analysis, Product Aspect, Text summarizing, Text Classification, Data mining, Opinion mining*

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1. Introduction

Now a days the internet has changed in the way that users express their sentiments [1]. Now this online electronic text used for the business intelligence by major leading organizations. Millions of products from number of retailers are available for online shopping. Like Amazon .com contains more that 36 million products. Shopper.com has the records more than five million products from over 3,000 retailers [2].

Major of the merchant sites motivate to their users to write comment to express their sentiment on various features of the product. Consider a example of opinion *"The Design of the*

Figure 1: Various aspects of a typical smart phone

Samsung duos are awesome" this comment expresses the positive influence of the user on the feature *"Design"* of product Samsung duos. Along with the merchant sites, different forum websites also give opportunity to users to express their sentiments on various products.cnet.com have more than seven million product comments, pricegrabber.com contain millions of the comments on 32 million products in 20 unique categories over 11,000 retailers. This number of customers review contain important and worthy for the customer as well as the retailer. Retailer uses the reviews to improve their customer relationship quality of product etc.The users uses this information before purchasing any product. know their feedback about the product. for example a typical Smartphone have number of features as shown in figure 1. It has different features like *"Camera", "Bluetooth", "Battery",* etc. we debate some of the features are more important than others, this will have a major impact on the general users decision making also to firm to improve the development plans..for example some features of smartphone example *"Battery", "Speed"* are more focused by majority of uses and this features are more important than the other such as *"button", "mp3"* if we consider a camera product then the features such as "*lenses".*

For the sake of convenience the remainder of this paper is structured as follows: Section 2 contains the source of the data which is used in sentiment analysis. Section 3 explains about the sentiment analysis. Section 4 introduces the NLP, Natural Language processing techniques. Section 5 represents different techniques used in sentiment analysis. Section 6 is about the challenges for the sentiment analysis. Seventh contains the different applications of the sentiment analysis. Last section concludes our study and discusses the directions of the future research.

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2. Sources of Data

Now a day there are number of data sources are available for sentiment analysis. Customer's opinion is a major criterion for increasing the growth of the company and to improve the quality of the service. The different data sources are social media, news articles, review sites, blogs, datasets, etc [5].

2.1 Social Media

Social media become a huge platform to express the sentiments of the people. It is a large network where at a time millions of people can write share their views about the particular like there is different type of social media sites are available like www.facebook.com, www.tweeter.com, www.hi5.com, www.linkdin.com etc. which contains millions of the people sentiments

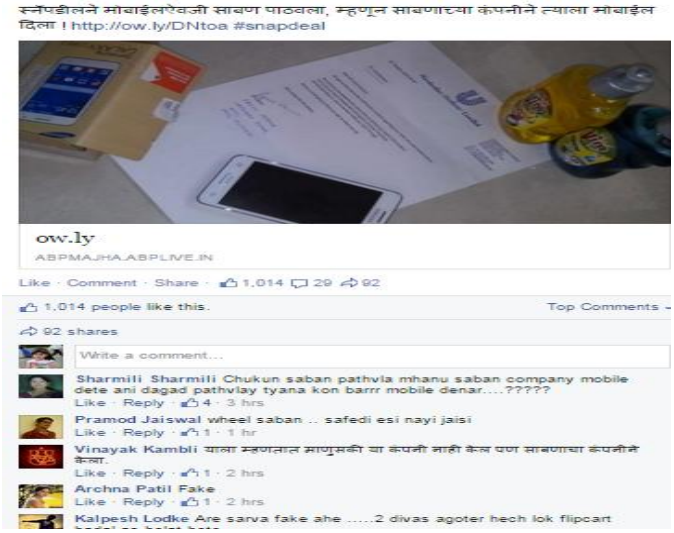

Figure2: Facebook status comments by users

2.2 News Articles

The websites like www.abpmajha.com, www.aajtak.com and www.lokmat.com, www.bhaskar.com has news articles that allow users or readers to comment. This helps in recording the opinions of the people in issues that are of current relevance and importance, like politics, corruption etc.

2.3 Review Sites

Before purchasing any product it is very important to know the opinion of the product There are various ecommerce sites like www.flipkart.com, www.cnet.com, www.snapdeal.com ,www.gsmcamera.com request customers to write their opinion about the product they have purchased[6]. So this sites contains the million and trillions of the customer reviews about the product. Other sites like www.rediff.com/movies/reviews,www.indiaglitz.com and www.rottentomatoes.com has reviews for movies and www.yelp.com,www.burrp.com has restaurant reviews [7]

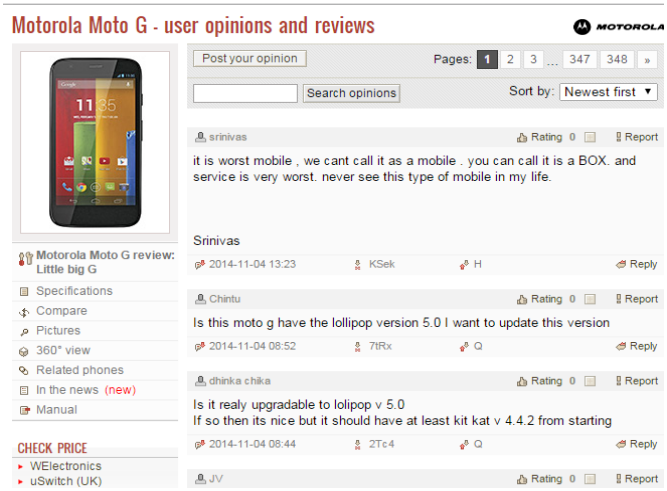

Figure3: Example of the customers review about particular product

2.4 Blogs

A web log is called as blog it is a personal webpage on which particulars can write their likes, dislikes, opinions, hyperlinks to various sites etc. daily. Tweeter is one of the popular micro blogging service in which user creates status messages in a limited word count which called as tweets. The tweeter will get flooded while the elections were going on. Tweets can also use as data source for sentiment classification. Many of the blogs contain the issues; product information's recopies etc. so blogs used for the data source of the sentiment analysis [8]

2.5 Datasets

Most of the work in the field of sentiment analysis uses movie reviews data for classification. Movie review data sets are available at (http:// www.cs.cornell.edu/People/pabo/movie-review-data). Other datasets which are available online is multi-domain sentiment (MDS) dataset. (http:// www.cs.jhu.edu/mdredze/datasets/sentiment). The MDS dataset contains four different types of product reviews extracted from Amazon.com including Books, DVDs, Electronics and Kitchen appliances, with 1000 positive and 1000 negative reviews for each domain.

3. Sentiment Analysis

Sentiment Analysis is an extension of data mining which involves processing natural language and extraction of information for the purpose of obtaining writer's emotions expressed in positive or negative reviews, by analyzing enormous amount of data [9]. If we deal with general terms for emotion detection, considering the pitch of the voice, tone of voice, attitude of the speaker this are the features which are involved in it.

As the rapid growth of the internet, text based analysis of sentiments is need of today's world. so sentiment analysis tags the words into categories of positive, negative and neutral[10]. Opinion Analysis aims to solve the problems related to products, services, political posts, news groups, review sites etc. [11]. There are various techniques for summarizing of customer reviews like Data Mining, Text Classification, Information Retrieval, Text summarization [12]. In earlier days while purchasing any product user ask the reviews to his family and friends to take right decision. In the same way retailers needed to take decision about their product to improve quality of services, they conduct surveys to the focused groups [13].

General structure for sentiment analysis is shown in figure which contains collecting user's reviews, preprocessing, sentiment analysis, feature selection, sentiment classification. Sentiment mining can be done at different level they are: document level, sentence level, aspect level, Phrase Level.

Depending upon which type of data is to be processed type of sentiment analysis level will be selected

1. **Document level sentiment analysis** used to predict whether the document express positive or negative effect [14]. It decide the polarity of the document, but if positive phrase is there it does not mean that customer like everything and likely if negative phrase is there it does not mean user dislike everything for example if user comments he like mobile but he dislike the reviews for a single topic is considered so it cannot be used with the blogs, news forums. so it is the best suited for the product feature ranking of particular domain[15].

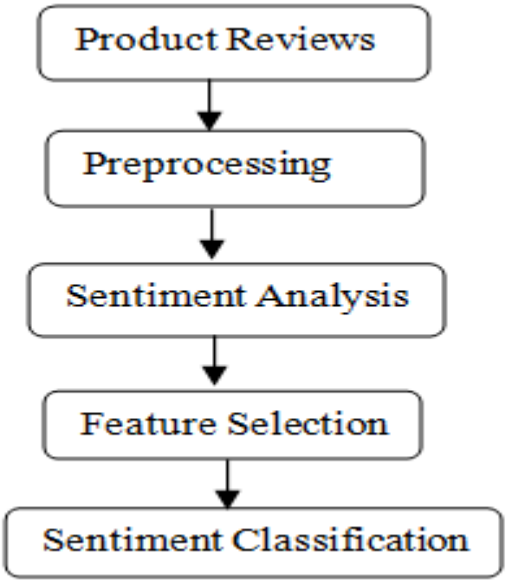

Figure4: Basic Structure of Product review Sentiment Analysis

It can be used with supervised, unsupervised learning algorithm. Subjectivity and objectivity is essential in this type of classification.

2. Sentence Level: Sentence level classification is deals with the considering polarity of each sentence. Document level classification can also be applied to sentence level classification to classify the sentences in polarity. Here also we have to consider the subjectivity and objectivity of the sentence. Subjective sentences contain words related to particular domain. Single sentence contains single opinion about single domain. Complex sentence are also commented in reviews. In such case sentence level classification cannot be useful. Sentence level classification is deals with the positivie, negative and neutral sentiments. Sentence level classification is deal with the subjectivity classification. For Example, *"I brought Canon Camera last week. At initial stage everything was good. The pictures were high quality and clearer, although it was bit bulky. Then it stops working today"*. The first sentence contain no opinion as it simply stats a fact. All other sentences express implicit and explicit opinions. The last sentence "*Then it stops working today"* is objective sentence but currently used methodologies cannot express opinion for the above sentences even it carry negative sentiment or undesirable sentiment.

3. Aspect Level: Document level and sentence level sentiment analyses do not fine what exactly people likes and dislikes. Aspect level earlier called feature based sentiment analysis. Instead on studying language constructs like sentence, word, and phrase), aspect level directly look for the features included in the opinion itself. It based on the idea those sentiments of an opinion (positive or negative) and a target (sentiment).A sentiment without a target domain being identified is of limited use. Most of applications, opinion sentiment targets are described by products/services and their different features [16]. For example *"Samsung net speed is best but its battery life is short"* it consist two aspects, net speed and battery life of the product Samsung. The opinion on the Samsung net speed is positive, but on its battery life is negative. So the net speed and battery life are the targets. Based on this analysis, a structured summary of sentiments about products and their features can be produced.

4. Phrase Level: The phrase level sentiment analysis is deal with the phrases of the sentence within a particular document. The words which appear much near to each other that is the neighbor words are called as phrases. The phrase level sentiment analysis is focused in opinion mining [17]. The phrases which contain sentiment words are found out and a phrase level classification is done. Depending upon the situation it will be advantageous or disadvantageous. In some problems, the exact sentiments about a product can be correctly classified. But in some other problems where

contextual polarity matters then the results will not be accurate. Negative words occur locally. In such examples, these levels of sentiment analysis are adequate [18]. If sentences with negative words which are very far from the sentiment words, phrase level analysis is not efficient. Long range dependencies cannot be considered here [19].

5. Natural Language Processing: Natural Language Processing uses the grammatical structure of the sentence and according to the grammar it finds nouns, adjectives, verbs, etc. so for identifying features of particular product it will be best suited. For example, *"The mobile has excellent Camera"*. Here as we are human so we can identify Camera is the feature of the product mobile. But machine cannot understand that camera is the feature. If we observe that the camera is the noun term here. So if we broke the sentence in to English grammar structure then it will be easy to train to machine that the noun term is the feature of the product. The only drawback of using NLP is if runs badly if the users review are used grammatically incorrect words and as we see today's large part of electronic text contains bad English sentences. So before using it on a large scale there are methods to detect and correct bad English[20]

4. Techniques Used for Sentiment Classification

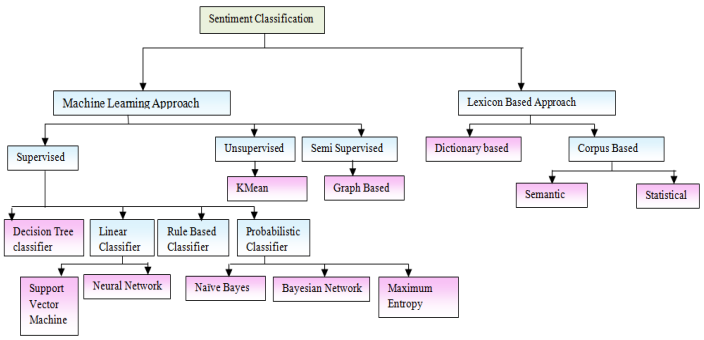

Figure5: Different Techniques used in sentiment classification

Different approaches are considered for the Sentiment Analysis and Classifications. Mainly it is divided into two pinpoints they are Machine Learning Approach, Lexicon Based Approach. It again divided into subcategories they are listed below.

1) Machine Learning: Machine Learning Approach is mainly divided in to three categories supervised, unsupervised and semisupervised .each category again sub divided in to different algorithms

a) Supervised Learning: Supervised Classification is used for prediction of the result from the given set of values on the basis of defined set of attributes and given predictive attributes. It contains training data and testing data. Training data is created model on test corpus contain in the same attributes without having prediction attributes [21]. Accuracy is check by how accurate the machine is predicting the values. Supervised learning again categorized in to different categories like Support Vector Machine, Naive Bayes, Maximum Entropy, Decision Tree etc. [22]

The Following table consists of list of models which used supervised learning

Table1: Models which used Supervised Learning approaches

Name of model	Used Learning algorithms
Experiments with SVM to classify opinions in different domains	Support Vector Machines
Feature Based Opinion Mining of Online Free Format Customer Reviews Using Frequency Distribution and Bayesian Statistics	Naïve Bayes
Sentiment Identification Using Maximum Entropy Analysis of Movie Review	Maximum Entropy method
Document-level sentiment classification: An empirical comparison between SVM and ANN	SVM classifier ANN classifier
Which Side are You on? Identifying Perspectives at the Document and Sentence Levels	SVM Naïve Bayes
Automatic Sentiment Analysis of Twitter Messages	Naïve Bayes

b) Unsupervised Learning: Training data set is not required for unsupervised machine learning classification. It uses different clustering algorithms like K-Mean clustering, Hierarchical Clustering to classify data into classes. Neural Network can be used for defining threshold values of the words and then classify them according to the defined values. Semantic Orientation and Point wise mutual information is also used for the unsupervised classification in sentiment analysis [23].

Table 2: Models which used Unsupervised Learning approaches

Name of model	Used Learning algorithms
A Novel Product Features Categorize Method Based On Twice-Clustering	K-Means COP K-Means
A Framework To Answer Questions Of Opinion Type	Bayes classifier k-means clustering
An Unsupervised Method For Joint Information Extraction And Feature Mining Across	undirected graphical model

Different Web Sites	
Enriching Senticnet Polarity Scores Through Semi-Supervised Fuzzy Clustering	Fuzzy-C clustering

c) Semi Supervised Learning: In semi supervised approach supervised and lexicon based approach are combined. By using this combination the system performance get improved for classification, because it will give the word stability and readability from a lexicon based approach and high accuracy from the supervised approach [24].

2) Lexicon Based Approach:

Sentiment words are classified in positive and negative states. There are also opinion phrases and idioms are present which together called opinion lexicon [24]. There are three approaches first is manual which is time consuming other two are automated they are dictionary based, corpus based. In dictionary based approaches a small set of sentiment words are collected manually then this will grow by searching their thesaurus for their synonyms and antonyms [25]. The newly found words will added to the list and again the iteration starts it will stop when no new word will be found. Here the drawback is that inability to find sentiment words with domain and context specific. Corpus based approach finds the sentiment words with context specific manner. It uses two sub categories they are

1. Statistical approach: It finds co-occurrence pattern or seed sentiment words.
2. Semantic approach: It gives opinion values directly relies on different principles for computing the similarity between the words

5. Challenges for the Sentiment Analysis

Sentiment mining is ongoing research field it deals with the electronic text. While dealing with this text many pitfalls come in to the picture. These Different pitfalls are listed as follows

1. Natural language processing will having problems if the language contain grammatical errors, ambiguity, co-references so it will give influence on sentiment analysis [26].
2. The internet contains the authenticated and spam electronic text so for efficient sentiment classification the spam text should be removed before processing of the data. This is called detection of the fake and spam comments. This can be done by detecting duplicates, by identifying outliers [27].
3. In some cases noun words can be also considered as the aspect words but verbs and adjectives can also used as the aspect word which are complicated for identify[28].
4. Consider one customer comment, "earphones are worst" and second customer comments, "Headphones are worst". Even if both users comment for the same aspect with different synonym words so this is also the challenging task [29].
5. Now a day's English shortcuts are come in picture so many of the users comment in the free text style format, he can use the shortcuts, numerical words, abbreviation. For example *"gud"* for *"good"*, *"b4"* for *"before"*, "5in" for *"fine"* etc. so to work with this words lot of work should be needed [30].
6. Product comments, opinions, reviews, opinion and feedback may be available in various languages like Arabic, English, German, French, Marathi etc. so to identify each language is a challenging task.
7. Identifying the polarity of the sentence is a challenging task in sentiment analysis because the words may be act different in different situation like, "*The ram is size is less"* here the less adjective is used for negative sense but if in parallel said that *"The weight of mobile is less"*. here less adjective is used as positive impact.[31]
8. The Major challenge in the sentiment analysis and opinion mining is the domain dependent behavior of the user's sentiments. One aspect set may be give good output in one domain as compared to another domain.
9. Lack of availability of sentiment mining software. The sentiment analysis software is highly expensive and affordable for only large scale organizations and government body.
10. Now a day's style of comment changes to smileys, images and videos so this will be challenging task to decode it and analyses the opinions of the users.
11. Handling the negative sentence is challenging task in opinion mining. Negation expressed in various ways even without the use of without negative word. A method often followed in handling negation explicitly in the sentence like, *"I do not like cinema"*, in reverse polarity of all words appearing after negative word (like not).But this does not work for, *"I do not like the singing but I like dancing"*. So the thing that should be done is to change polarity of all words appearing after negative word till another negative word. But still there can be problem: example, *"Not only did I like singing but also the dancing"*, the polarity is not reversed after "not "due to the appearance of *"only"*. So this type of sequences of *"not"* with other words like *"only"* has to be considered while dealing with the algorithm.
12. The short comes in classification filtering while dealing with the most popular concept or product. For efficient

opinion classification result of this drawback should be removed. The risk of filter bubble give irrelevant sentiment sets and it result to the false summary of opinions.

13. It is important to detect the pragmatics of user sentiment which may be change the throughout opinion. Consider the following examples:
    "I just finished watching Barca DESTROY Ac Milan
    That final completely destroyed me."
    Capitalization can be used with subtlety to denote sentiment. The first example denotes a positive sentiment while the second example denotes a negative sentiment. There are many other ways of expressing pragmatism.
14. The ongoing research should be present to improve the user friendliness and efficiency in the field of sentiment mining.

6. Applications of Sentiment Analysis

Under the umbrella of Sentiment Mining there are certain areas which attract the researchers in today's world [32].The natural language processing communities are showing their interest in Sentiment mining and opinion mining. The enormous increment of web has changed people life style, they become so much possessive on their reviews and sentiments [33] and this tendency helps to researchers in getting users sentiments content easily [34]. The leading applications of the sentiment analysis are as listed below

1) **Intelligent product purchasing:** Whenever we want to purchase a product or want to deal with any service taking right decision is a lengthy procedure in earlier days but now it become easy. By using sentiment analysis people can easily analyze opinions without dealing with the third party consultant.
2) **Developing marketing strategies:** Sentiment analysis technique results can be used for developing marketing strategies [35]. By using sentiment mining methodologies, the recent trend of customers about service or product can be analyzed. By using opinion analysis anyone can decide attitude of public towards purchasing various products [36].
3) **Making Decisions:** People find very easy of decision making about particulars by using opinion mining. Opinion mining gives analyzed opinions of people so that it will become more efficient for them instead of studying all the unstructured data, analyzed results are more beneficial and time saving.
4) **Improvement in Quality of Service:** While dealing with sentiment mining the retailers or the merchant sites can collect the opinions of people about their product features[37] and then they can summarize which features should be improve to increase the quality of service. Different online product selling sites are there like Flipkart, Snapdeal, Amazon, Cnet etc.[38]
5) **Disaster Detection:** The Continuously Monitoring of newsgroups, forums, social networks, and blogs is easily possible using sentiment analysis. Opinion mining can easily detect arrogant words [40], shaking words or hatred language may use in tweets, social media, newsgroups on different internet sources.
6) **Recommendation System:** By classifying user's sentiments into positive and negative, the system can detect which product should get recommended and which should not get recommended [41].
7) **Policy Making:** By analyzing what are the pitfalls in current working policy using sentiment analysis one can build a new user friendly policy [42].
8) **Spam Detection**: Since few years web is become easily available to all, anyone can place anything on web, so this increases the spam content on internet. Sentiment mining and opinion analysis can classify the web contents into 'spam' content and normal contents [43].

7. Conclusion

In this paper we have studied the survey of sentiment analysis for dominating products which include different techniques used for Sentiment Analysis, Natural Language Processing, challenges of the Sentiment analysis and the applications of it. Sentiment analysis is a prominent field of the data mining used to extract the essential knowledge from a enormous amount of users comments, sentiments, reviews, feedback on any post/product or statement. Opinion mining is most helpful to recognize and predict the current and future trends, product survey, people sentiments for social issues, effect of particular event on people. Big organizations like SAP, TC, SAS uses the sentiment analysis for Business Intelligence applications. A lot of work is done in the field of opinion mining in the form of sentence level, document level sentiment analysis. Still lots of drawbacks and challenges are there like detecting the fake reviews, English shortcut usage so on. Now a days it is founded that the sentiment analysis trend is changing like people writing comments in the form of smiley's ,images or videos so it is always be a ongoing research field for future researchers.

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