A Survey on Various Sentiment Analysis Approaches and Its Challenges

Pratibha Mohbey
PG Scholar, CSE, VITS, Bhopal, India

Prof. Sumit Sharma,
HOD CSE, VITS, Bhopal, India

Abstract
Sentiment analysis is a broad research area in academic as well as business field. The term sentiment refers to the feelings or opinion of the person towards some particular domain. Hence it is also known as opinion mining. It leads to the subjective impressions towards the domain, not facts. It can be expressed in terms of polarity, reviews or previously by thumbs up and down to denote positive and negative sentiments respectively. Sentiments can be analyzed using NLP, statistics or machine learning techniques. Sentiment analysis may ask questions regarding "customer satisfaction and dissatisfaction, "public opinion towards new iPhone series launched" etc. In real world, public or consumer opinions about some product or brand are very important for its sell. Hence sentiment analysis is a very important research area for real life applications i.e. decision making.
However various methods were introduced for performing sentiment analysis, still that are not efficient in extracting the sentiment features from the given content of text. Naïve Bayes, Support Vector Machine, Maximum Entropy are the machine learning algorithms used for sentiment analysis which has only a limited sentiment classification category ranging between positive and negative. Especially supervised and unsupervised algorithms have only limited accuracy in handling polarity shift and binary classification problem. Even though the advancement in sentiment Analysis technique there are various issues still to be noticed and make the analysis not accurately and efficiently. So this paper presents the survey on various sentiment Analysis methodologies and approaches in detailed. This will be helpful to earn clear knowledge about sentiment analysis methodologies. This Paper describes different applications of sentiment analysis, techniques and challenges of sentiment analysis.
Keywords: Sentiment Analysis, Decision Making, Opinion Mining, Machine Learning, NLP

1. INTRODUCTION

DATA Analytics is an art of processing raw data to extract some reasonable information. Data Analytics is widely used in many industries and organization to make a better Business decision. By applying analytics to the structured and unstructured data the enterprises brings a great change in their way of planning and decision making. Data analysis is the process of verifying, cleaning, and transforming in order to retrieve useful information from the data. This information will be more helpful in suggesting business conclusions and decisions making [1].

Data Analysis has a variety of angles and methods that combines many techniques in order to provide better accuracy. One of the most popular methods of data analysis technique is data mining that mainly concentrates on modeling and discovery of knowledge for prediction process rather than descriptive purposes. Predictive analytics is mainly used for predicting forecasting/classification where as text analytics make use of statistical, linguistic and structural techniques in order to retrieve information from text sources. This text sources are mostly in the form of unstructured data.

Sentiment analysis (or) opinion mining plays a significant role in our daily decision making process. These decisions may range from purchasing a product such as mobile phone to reviewing the movie to making investments---all the decisions will have a great impact on the daily life. In ancient days before buying a product / service people will seek opinion from their friends, neighbors, etc. But in internet era it is easy to seek opinion from different people around the world. Nowadays people before buying any product/service will make a glance on review sites (e.g. CNET) e-Commerce sites (e.g. Amazon, eBay) and social media (e.g. twitter) to get a feedback about the specific product (or) service in market.

Sentiment Analysis makes use of 3 terms in order to fetch the sentiment .That is object and feature, opinion holder, opinion and orientation. Sentiment Analysis deals with several technical challenges such as object identification, opinion orientation classification, and feature extraction. Usually sentiment analysis can be performed using supervised and unsupervised learning such as naïve Bayes, Neural Networks, and Support Vector Machine. Among these three techniques SVM is considered to be more suitable for sentiment Analysis. Sentiment classification can be performed in 3 states such as

- Document level
- Sentence level

• Feature level

In document and sentence level the sentiment analysis make use of only a single object and extracts only a single opinion from the single opinion holder. But these types of assumptions are not suitable for many situations. Extracting sentiment for entire document/blog will not be efficient as extracting sentiment by considering aspects of each subject in the particular sentence.
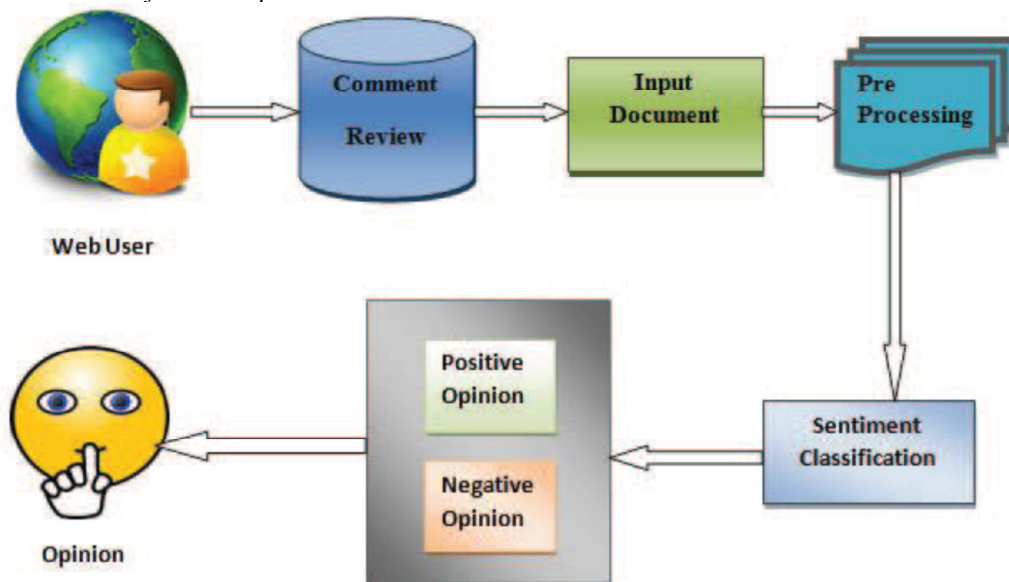

Fig 1: Sentiment Analysis concepts

The Fig 1.1 shows the overall process of sentiment analysis which starts from preprocessing of review dataset and continuous the sentiment classification or opinion mining through the various machine algorithms or some other dictionary based techniques.

1.1 LEVELS OF SENTIMENT ANALYSIS

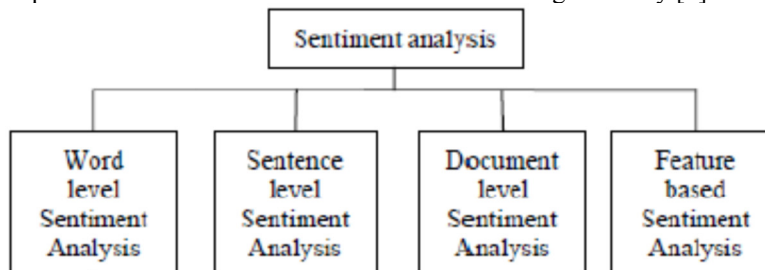Tasks described in the previous section can be done at several levels of granularity [2].

Fig.2 Levels of Sentiment Analysis

• **Document level**

In Document level analysis task is characterize whether an entire opinion of document level communicates a positive or negative supposition For instance, given thing audit, the framework figures out if the survey communicates a general positive or negative decision about anything. This undertaking is regularly known as document level sentiment classification [2]

• **Sentence level or phrase level**

In Sentence level the fundamental undertaking is goes to the Sentence and makes sense of if every sentence communicated a positive, negative, or neutral sentiment. Neutral means no opinion about any sentence. This level of investigation is immovably related to the subjectivity arrangement. Which is recognizes sentences (called target sentences) [3] that is express genuine information from the sentences (called subjective sentences) that express subjective perspectives and opinions. in any case, we ought to observe that subjectivity is not comparable to supposition the same number of target sentences can suggest feelings for e.g., "We purchased new car a month ago and the windshield wiper has tumbled off" [2].

• **Aspect level or Feature level**

In Aspect Level both the document level and the sentence level analyses do not discover what exactly people liked and didn't like. Aspect level performs better-grained investigation. Aspect level is directly looks at the

opinion itself. In the Aspect level is depend on the possibility that an opinion consists of a sentiment positive, negative or neutral or an objective of sentiment.[2] For e.g. Sentence is "The Sony telephone's call quality is amazing, yet its battery life is short" assesses two focuses first is call quality second is battery life, of Sony (component). The conclusion on Sony's call quality is certain in sentence however the opinion on its battery life is negative. Sony telephone's call quality and battery life of Phone are the feeling targets. In this level of investigation, an organized of assessments about elements and their viewpoints can be created, which turns unstructured content to organized information and can be utilized for a wide range of quantitative and subjective examinations. Document and sentence levels orders are as of now very difficult.

1.2 Different Classes of Sentiment Analysis
Sentiments can be classified into three classes .i.e. positive, negative and neutral sentiments.
a. Positive Sentiments: These are the good words about the target in consideration. If the positive sentiments are increased, it is referred to be good. In case of product reviews, if the positive reviews about the product are more, it is bought by many customers.
b. Negative Sentiments: These are the bad words about the target in consideration. If the negative sentiments are increased, it is discarded from the preference list. In case of product reviews, if the negative reviews about the product are more, no one intend to buy it.
c. Neutral Sentiments: These are neither good nor bad words about the target. Hence it is neither preferred nor neglected.

2. SENTIMENT ANALYSIS APPROACHES
Sentiment Analysis systems are generally classified on the basis of following Techniques
A. Machine Learning
Machine learning algorithms can be addressed as a combination of methods to automatically detect the available pattern in the given set of data. It makes use of undiscovered patterns to forecast the future data (or) to implement the decision making under uncertainty. Machine learning can be performed in 2 ways such as supervised and unsupervised. Supervised learning is performed by considering the target value (i.e. label) and unsupervised learning is conducted by not considering the target value(i.e. label).There are various types of algorithms for supervised learning such as classification(Decision tree, Naive bayes etc) and unsupervised learning algorithm such as clustering (SOM, Neural network).
B. Dictionary Based
Dictionary oriented approach is considered as easiest way for performing sentiment analysis. Dictionaries such as wordNet, SentiwordNet are publically available to perform SA. Dictionary can be build by providing a set of sentiment words Iteration of Algorithm ends when there are no new words found to add in dictionary.
C. Ontology Based
Ontology is a word mostly used in philosophy and it is used in many different areas which means that "theory of Existence/ Nature of Being". Ontology is related to the conceptualization which captures a structure of specific domain. Ontology clarifies the concepts in the domain and also the relationship between those concepts. Different types of ontologies are available such as upper ontology, domain ontology and hybrid ontology. Among this domain ontology will be very suitable for sentiment analysis. Researchers mostly prefer ontology in feature extraction phase of sentiment analysis. One of the important thing to be addressed in ontology is taxonomy (i.e.) Ontology will be constructed in the hierarchical form. Ontology can be developed by using several ontology languages such as OWL and RDF. Most commonly ontology was developed by using the tool protégé. Ontology includes several components such as Individuals, classes and properties. The table.2.1 shows the pros and cons of various sentiment analysis techniques

3. SENTIMENT ANALYSIS CHALLENGES
Now-a-days Sentiment Analysis is dealing with various issues such as
- **Polarity Shift**

Polarity Shift is a most important issue to be addressed in Sentiment Analysis. Polarity Shift means that Polarity (Sentiment) of the sentence is calculated in different way from the polarity actually expressed in the Sentence. This problem is mainly arises due to polarity shifters such as negation (e.g."I don't like this car") and contrast (e.g. "good, but not in my own style").In the above mentioned example the sentence "I don't like this car" is very similar to "I like this car". Here the polarity shifter is "Don't".
- **Binary Classification**

Binary Classification is another important problem to be addressed in which the given review's Polarity is classified only by using "Positive", "Negative" by ignoring the "Neutral". This type of problem mainly arises when the sentiment classification is purely based on machine learning algorithms. Opinion mining that only considers positive and Negative will not have good accuracy. Now-a-days the classification is extended by

considering 5 possibilities such as "Positive", "Strong Positive"," Negative", Strong Negative" and "Neutral". By increasing the classification category it is possible to improve the accuracy of the opinion mining.

- **Data Sparsity problem**

Third issue to be addressed is Data Sparsity problem which is caused due to the imposed character limit in micro blog/social media websites. For instance the maximum character limit in twitter is 140.Due to this limitation people will not express their opinion in clear manner. All these three issues are closely related to the accuracy of the sentiment analysis.

- **Domain Dependency**

In this type of challenge words polarity changes from one domain to another domain in the domain dependency. For an example, two statements; "The story was unpredictable." and "The steering of car is unpredictable." In first statement, in Sentiment express that is positive whereas the second statement express sentiment is negative.

- **Language Problem**

In Opinion Mining English language is mostly used because of its resources availability means lexicons, dictionaries and corpora but User get attracted by using Opinion mining with language other than English like Hindi, French, Chinese, and German Arabic etc. i.e. lexicons dictionaries and corpora for these languages.

- **Fake Opinion**

Fake opinion is also called fake review and refers to bogus or fake reviews. The fake opinion is misguide the users or readers by providing them untruthful positive or negative opinion related with any object. This is social challenge which is faces by OP [14]

- **Negation**

In Sentiment Analysis Negation is Challenging task. Invalidation is communicated from multiple points of view without the reasonable seen utilization of any negative word in the sentence. The presence of a negation is usually change the opinion polarity. For example she is not happy.

4. Related Work

In recent years a lot of work has been done in the field of "Sentiment Analysis on Twitter" by number of researchers. In its early stage it was intended for binary classification which assigns opinions or reviews to bipolar classes such as positive or negative only.

Pak and Paroubek [4] proposed a model to classify the tweets as objective, positive and negative. They created a twitter corpus by collecting tweets using Twitter API and automatically annotating those tweets using emoticons. Using that corpus, they developed a sentiment classifier based on the multinomial Naive Bayes method that uses features like N-gram and POS-tags. The training set they used was less efficient since it contains only tweets having emoticons.

Parikh and Movassate [5] implemented two models, a Naive Bayes bigram model and a Maximum Entropy model to classify tweets. They found that the Naive Bayes classifiers worked much better than the Maximum Entropy model.

Go and L.Huang [6] proposed a solution for sentiment analysis for twitter data by using distant supervision, in which their training data consisted of tweets with emoticons which served as noisy labels. They build models using Naive Bayes, MaxEnt and Support Vector Machines (SVM). Their feature space consisted of unigrams, bigrams and POS. They concluded that SVM outperformed other models and that unigram were more effective as features.

Barbosa et al. [7] designed a two phase automatic sentiment analysis method for classifying tweets. They classified tweets as objective or subjective and then in second phase, the subjective tweets were classified as positive or negative. The feature space used included retweets, hashtags, link, punctuation and exclamation marks in conjunction with features like prior polarity of words and POS.

Bifet and Frank [8] used Twitter streaming data provided by Firehouse API , which gave all messages from user which are publicly available in real-time. They did experiment multinomial naive Bayes, stochastic gradient descent, and the Hoeffding tree. They arrived at a conclusion that SGD-based model, when used with an appropriate learning rate was the better than the rest used.

Agarwal et al. [9] developed a 3-way model for classifying sentiment into positive, negative and neutral classes. They experimented with models such as: unigram model, a feature based model and a tree kernel based model. For tree kernel based model they represented tweets as a tree. The feature based model uses 100 features and the unigram model uses over 10,000 features. They arrived on a conclusion that features which combine prior polarity of words with their parts-of-speech (pos) tags are most important and plays a major role in the classification task. The tree kernel based model outperformed the other two models.

Davidov et al., [10] proposed a approach to utilize Twitter user-defined hash tags in tweets as a classification of sentiment type using punctuation, single words, n-grams and patterns as different feature types, which are then combined into a single feature vector for sentiment classification. They made use of K-Nearest Neighbor strategy to assign sentiment labels by constructing a feature vector for each example in the training and

test set.

Po-Wei Liang et.al. [11] used Twitter API to collect twitter data. Their training data falls in three different categories (camera, movie, mobile). The data is labeled as positive, negative and non-opinions. Tweets containing opinions were filtered. Unigram Naive Bayes model was implemented and the Naive Bayes simplifying independence assumption was employed. They also eliminated useless features by using the Mutual Information and Chi square feature extraction method. Finally, the orientation of an tweet is predicted. i.e. positive or negative.

Pablo et. al. [12] presented variations of Naive Bayes classifiers for detecting polarity of English tweets. Two different variants of Naive Bayes classifiers were built namely Baseline (trained to classify tweets as positive, negative and neutral), and Binary (makes use of a polarity lexicon and classifies as positive and negative. Neutral tweets neglected). The features considered by classifiers were Lemmas (nouns, verbs, adjectives and adverbs), Polarity Lexicons, and Multiword from different sources and Valence Shifters.

Turney et al [13] used bag-of-words method for sentiment analysis in which the relationships between words was not at all considered and a document is represented as just a collection of words. To determine the sentiment for the whole document, sentiments of every word was determined and those values are united with some aggregation functions.

Kamps et al. [14] used the lexical database WordNet to determine the emotional content of a word along different dimensions. They developed a distance metric on WordNet and determined semantic polarity of adjectives.

Xia et al. [15] used an ensemble framework for Sentiment Classification which is obtained by combining various feature sets and classification techniques. In thier work, they used two types of feature sets (Part-of-speech information and Word-relations) and three base classifiers (Naive Bayes, Maximum Entropy and Support Vector Machines). They applied ensemble approaches like fixed combination, weighted combination and Meta-classifier combination for sentiment classification and obtained better accuracy.

Luoet. al. [16] highlighted the challenges and an efficient technique to mine opinions from Twitter tweets. Spam and wildly varying language makes opinion retrieval within Twitter challenging task.

5. APPLICATIONS OF SENTIMENT ANALYSIS
Sentiment Analysis has many applications in various Fields.
- ***Applications that use Reviews from Websites:***

Today Internet has a large collection of reviews and feedbacks on almost everything. This includes product reviews, feedbacks on political issues, comments about services, etc. Thus there is a need for a sentiment analysis system that can extract sentiments about a particular product or services. It will help us to automate in provision of feedback or rating for the given product, item, etc. This would serve the needs of both the users and the vendors.

- ***Applications as a Sub-component Technology***

A sentiment predictor system can be helpful in recommender systems as well. The recommender system will not recommend items that receive a lot of negative feedback or fewer ratings.

In online communication, we come across abusive language and other negative elements. These can be detected simply by identifying a highly negative sentiment and correspondingly taking action against it.

- ***Applications in Business Intelligence***

It has been observed that people nowadays tend to look upon reviews of products which are available online before they buy them. And for many businesses, the online opinion decides the success or failure of their product. Thus, Sentiment Analysis plays an important role in businesses. Businesses also wish to extract sentiment from the online reviews in order to improve their products and in turn their reputation and help in customer satisfaction.

- ***Applications across Domains:***

Recent researches in sociology and other fields like medical, sports have also been benefitted by Sentiment Analysis that show trends in human emotions especially on social media.

- ***Applications In Smart Homes***

Smart homes are supposed to be the technology of the future. In future entire homes would be networked and people would be able to control any part of the home using a tablet device. Recently there has been lot of research going on Internet of Things (IoT). Sentiment Analysis would also find its way in IoT. Like for example, based on the current sentiment or emotion of the user, the home could alter its ambiance to create a soothing and peaceful environment.

Sentiment Analysis can also be used in trend prediction. By tracking public views, important data regarding sales trends and customer satisfaction can be extracted.

6. CONCLUSION

Sentiment analysis is helps in identifying people"s emotional and attitudes states. People"s feeling that can be expressed in positive or negative ways. This paper talks about in subtle elements the different ways to deal with sentiment Analysis, mostly ML and Lexicon-based approaches. This survey paper is gives a point by point perspective of the distinctive applications and challenges of Sentiment Analysis. Sentiment analysis can be extremely compelling in foreseeing decision comes about, securities exchange or motion picture survey like Imdb audits of facebook and twitter can be likewise used to give helpful information which can be utilized to anticipate future.

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