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Applications, Challenges and Tools of Sentiment Analysis

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Abstract- The incredible effect of internet based life has prompted the disclosure of sentiments investigation. Sentiment investigation or analysis mainly designates to understand the public reviews and it distributes them into distinct classes like negative, positive and neutral. In recent area of the research, maximum work of the sentiment classification has been done over reviewing or rating sites. Large opinion of the people are found over social media in form of ratings, comments, reviews that are honest, informative, and casual as compared to the formal type of data survey analysis using magazines or reports. Different scopes and threats appear with the developing opportunity and acceptance of opinion-based assets such as social networking sites, wikis and blogs. This paper provides a review about the concepts of sentiment analysis and also covers applications, challenges and tools associated with sentiment analysis. Analysis of reviews can be useful in many areas but it also has to go through with some problems in case of false reviews.
Keywords: Sentiment Analysis, Reviews, Applications, Challenges, Tools.

I. INTRODUCTION

The process of sentimental analysis refers to emotions, attitude or opinion [4]. Sentimental analysis is the field of analyzing customer's reviews, feelings and comments regarding specific entities or events for knowledge discovery [20, 21, 22]. The concept of sentiment analysis has developed an interesting area of research, since the texts of subjective nature are beneficial for real world applications. It is considered as the fastest growing area of research in the field of computer science making it more valuable and challenging for tracking all the area-based activities of the system. Analysis of sentiment is the most common process of text classification that analyzes an incoming message and tells whether the sentiment is positive, negative or neutral [1, 11]. Positive words will include words like 'awesome', 'wonderful', 'joy', 'happy', 'good', 'satisfied', 'perfect', etc [15]. Negative words will include words like 'scam', 'sad', 'unprofessional', 'rude', 'refund', 'bad', etc [20]. Users can also use thumbs up and thumbs down to show whether they like or dislike the product. The expression "Feeling Analysis" itself portrays that it is examination of the different points or topics communicated by people over the web, or the conclusions of input given by clients to different business associations. Classification of sentiments utilizes machine learning techniques to track the feelings of the user about a particular entity. It gives the summated opinion of user. People's reviews and understanding are beneficial for other users. But to take profits from these reviews and understanding, gathered data should be mined and evaluated accurately [5]. The web-based life gives opportunity to users for sharing own feelings on famous networking sites like Facebook and Twitter. These sites enable an individual or a group to build connections and share information with others in a very simple manner Information through these sites is easily accessible anytime, anywhere via desktop, laptop or mobile.

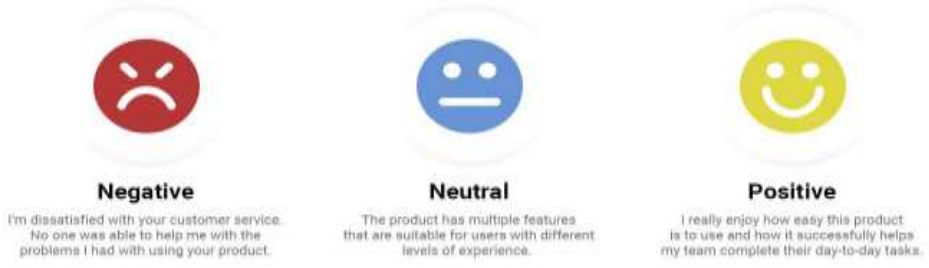

Fig. 1 Reviews of Product

Fig. 1 shows the reviews of product with negative, neutral and positive sentiments. In the given figure words such as dissatisfied and problems shows negative impact regarding any product while enjoy, easy and successfully expresses positive impact. Sentiment analysis follows to detect personal opinion or thought from written text, video, or audio data. Organizations have a large number of text data from their clients arising from emails, surveys, social media posts, etc. There are several words in the English language having positive or negative vibes while some are neutral [22]. There are number of tools that can help to measure text sentiment. This helps the company to take better and informed decisions to

improve customer experience and satisfaction. Sentiment analysis can be used in number of fields like Airlines, Healthcare, Banking, Finance, Travel, Restaurant, Journalism, Retail and many more [20, 21].

II. RELATED WORK

Owen Rambow, *et al.* [1] examined the twitter-based sentiment analysis. The framework included two types of working methodologies. In first methodology, the POS-unique prior polarity-based features were introduced. The practitioners also explored the tree-kernel in order to prevent the requirement for quality engineering of tedious form. New trademarks in association with recommended pervious trademarks, and the kernel tree approximately performs at equal stage. Both these methods exceed the baseline state-of-the-art. Medhat, *et al.* [4] conferred about applications of SA, recent modernized advancements in algorithm which were presented and investigated briefly in paper. Recently, the articles were reviewed gathering the reader's interest in technology offered by sentiment analyses (detection of emotions, resource building up, and transfer learning). Various surveys took place in context to several algorithms of SA providing a sophisticated distribution. The algorithm based on Emotion detection was used for analyzing and enhancing emotions, it could either be implicit or explicit. Several types of algorithm were used for presenting the emotions and sentiments. Some of them are Point-wise Mutual information, Latent Semantic Indexing, Chi-square. The opinion-based techniques of classification were disjointed into hybrid, lexicon-based, and machine learning. Vijaya Shete, *et al.* [6] discussed a paradigm for emotion from famous micro blogging service, where the users generally post their opinions. The research had discussed all the already existed analysis of twitter-based data. This approach was usually introduced to classify the sentiments of Tweets in an automatic form. These reviews were called off as positive, neutral or negative. This was really useful for firms want to get product feedback. The researchers have used the algorithms of machine learning classification of twitter sentiment analysis using a supervision of distant type. The trained set of data involves the messages along with acronyms, emoticons, which were used as noisy features. The research was totally based over; (1) Parts of Speech and (2) a tree kernel were examined in order to prevent the desire for feature engineering monotonously. Onam Bharti, *et al.* [7] proposed an approach using KNN, Naïve Bayes, and the modified version of k-means clustering, and it found that the modified version is more accurate than the KNN techniques and Naïve Bayes individually. The researchers obtained classification accuracy of 91% on overall basis over the 500 mobiles review of test-set. The algorithm running time is O (n + V log V) for the process of training where n represents the word number in a document and the V represents the vocabulary reduced size. It runs faster than the algorithms of machine learning similar as SVM and NB that takes more time in converging optimally in regard to set of weights. The level of accuracy was comparable to the existing algorithms used for the classification of sentiments based on reviewing mobile. Rongrong, *et al.* [8] surveyed the approaches based on visual SA. Such kind of survey was mainly presented defining the distinct used techniques for the analysis of visual sentiments. Here, images were used for prediction of person-based sentiments. It mainly focused on leading edge methods used in the process of image analysis. This kind of survey helps in describing a new platform for the experts as the research was mainly done using the concept of text but the ontology of visual sentiment presented newly built concept for performing some new method. For visual-based sentiment analysis to be of effective form, a deep learning approach must be adopted for research. Disha Kohli, *et al.* [9] focused to analyze the expressed sentiments on Twitter demonetization such that the opinions of public and certain views were extracted, and analysed. After analysing the sentiments of results, it was observed that many of the sentiments are of neutral type. The remaining tweets have shown that the positive type of sentiment remains over higher side i.e. about 50-55%. Jawed Ahmed, *et al.* [10] proposed a study using an algorithm of Machine Learning based on Naïve Bayes performing the analysis of Sentiment. It worked well for the comments of negative type. The problems generally arose when the tweets are sarcastic or of ironic behavior, has own difficult context or reference. So, enhance the results of evaluation, the researchers required references and context into consideration. They further tried to make a network i.e. LSTM network, and the results were benchmarked as compared to the NLTK machine learning implementation. Radhi Desai [13] performed sentiment classification that was based on the twitter. Twitter was considered to be an impressive point for the researchers in several areas such as democratic event prediction, movie box-office, popularity linked with celebrities. SA represents the opinion or feelings of one person to another domain type. The sentiment analysis or classification and opinions based on the mechanism of polarity perform a major challenging target. The other challenges perform overwhelming information amount and all of these are expressed in distinct ways. Lots of work on sentiment analysis has to be done for sentiment analysis. Kalyani Galande, *et al.* [14] aims to detect the project of sentiment that recognized tweet characteristics whether positive or negative. This helped the researchers to know people's review about any topic or subject. It also explained the disaster-prone areas. The use of such result helped the government and the social charities to take right decisions for the people. Another customer-based review helped the organizations in improving some of the specific areas and identified the customer-based appreciation for some idea or product. Rout, *et al.* [15] investigated the social-media based unstructured data such as tweeter for sentiment, emotion, and blogs analysis. Such type of work takes place over both the supervised as well as the unsupervised type of approach on distinct type of databases. The approach based on unsupervised form is mainly used for the process of automatically identifying the sentiments for several tweets. Distinct types of algorithms based on the mechanism of machine learning were used for

identifying the sentiments. The POS, unigram, and bigram features are effectively in formation of tweets. Mumtaz, *et al.* [16] viewed and expected a methodology presenting a combined form of lexical-based and machine learning. The hybrid approach i.e. proposed provides high amount of accuracy than the classical-type of lexical method and it helps in providing the enhanced form of redundancy than the approach of machine learning. The approach i.e. proposed is mainly used for opinion/sentiment mining through NLP which helps in extracting the opinions from text associated with an entity. Shidaganti, *et al.* [17] investigated over a method that presented a combined process of machine learning and data mining. The work proposed was done over tweeter data for the purpose of analyzing the tweet to collect the opinions of the user in regard to a specific type of topic or issue. The platform of tweeter is mainly used by individuals for expressing their sentiments (views) in a short type of message in response to several types of products, brands, celebrities, along with political criticisms. In this type of work, clustering and TF-IDF algorithm is mainly presented with their effective result. Fouad, *et al.* [18] scheduled a miniature for analysis of tweeter-based sentiments describing weather the is or negative or positive form through the machine learning concept. The model proposed uses distinct type of methods for labeling the training phase input by using distinct forms of datasets. The method of classification was performed in order to correlate and compare certain performances. The methodology of information gain and feature-based selection is mainly used in such type of work. Archana Purwar, *et al.* [19] proposed a study on Twitter data that mostly used social media platform for distinct type of analysis. Tweet-Rush helped to analyze the data of twitter and it further provides results making it useful for advertisers and marketer. Username vs. Influential and Line graphs User Tweet Flow were used to provide recommendations, hence minimum and maximum tweet out-reach was calculated. It was also analyzed that how beneficial a user would be in tweet spread? And very genuine results were obtained.

III. APPLICATIONS OF SENTIMENT ANALYSIS

Sentiment classification is essential for several industries or business. It is beneficial for users who need to find the sentiments of products before any investment and also for the organizations who want to know the opinions of public about any brand. While the areas of sentiment analysis application are interrelated, they are all about boosting the performance via analysis of shifts in public opinion. Following is a brief discussion on the possible usage of analysis study:

a) Drive choices: Sentiment investigation gives discernment on any adjustment in public-related opinions identified with ones image that will either bolster or nullify business. High or low estimation scores help everyone to recognize the approaches to remake the organization or grow new innovative methodologies.

b) Highlight Competitive Advantage: There are vital advantages in knowing purchaser sentiments identified with rivals. Sentiment analysis or classification can help to foresee client patterns, so keeping a pulse on general opinions of the public of different organizations and gives a control gathering to analyze against scores.

c) Social Media Monitoring: Social media observing is otherwise called measurement and listening of social media. It is utilized to gather and mine information, particularly by associations looking for client insight to decide current industry patterns. The procedure has turned out to be simpler - yet increasingly boring because of free and promptly accessible outlets, similar to online journals, wikis, news destinations, person to person communication locales, discussions, video/photograph sharing destinations and message sheets.

d) Employees Assessment: Sentimental investigation can likewise be utilized to acknowledge assessment from the representatives of the organization and examine feelings, frame of mind towards their activity. It is additionally used to decide whether users are happy with their activity or not.

e) Providing Better Services: Text mining can give a channel about which administration of the organization is getting increasingly negative criticism. This will assist the organization with knowing, what the issues are emerging with that specific administration. Also, in light of this data the organization can redress these issues. So, analysis can be used to find out faults in products based on actual users' involvement. Customers' reviews can assist to increase the profits and reduce difficulties [5].

f) Monitoring Market Research: It won't just assistance the organization to remain refreshed and associate more with the group of spectators, yet it will likewise encourage the ascent of new thoughts, for growing new items. This will permit the organization figure out what most of the group of spectators' requests and build up an item as indicated by these requests [5].

g) Acquiring any Product: While obtaining a product online and offline, catching correct selection is a challenging job. Analysis of emotions provides evaluated opinion that can be efficiently used for choice making. With the help of this approach, people can figure out other user's judgment about product and also they can compare the competing brands [5].

h) Policy Making: With the help of opinion mining, policy inventor can take people's perspective towards some scheme and they can use this data in creating new scheme. By analyzing reviews into good and bad, scheme say which policy should get confirmed and which should not get confirmed [5].

i) Politics: In Politics, opinion mining can be used to drive the reviews of the people regarding particular entity or situation, for what people are angry or happy for, etc [12, 21]. Assessment investigation can assist political association with understanding which issues are near the voter's heart. So, opinion gathering can produce relevant judgment and thus support politic parties to develop impressive plans.
j) Students Feedback: Universities and colleges can also use analysis to analyze the scholar's assessment or feedback about their teaching methods, practical labs, course and other facilities they are providing. Feedback can be collected either from surveys, or from online sources. Then institutes can use the results to find out the areas of student disapproval, as well as they can identify and build on those areas where scholars are showing positive feedback.
k) Government Intellect: By analyzing comments on social media sites, ministry division can check audience emotions towards their administration and the advantages they transfer. Government can use these reviews to solve social issues, enhance benefits such as parking, relaxation, policing, transport system and the condition of roads [21].
l) Customer Serviceability: Customer service agents mainly use sentiment classification to fundamentally description of user email into "urgent" or "not urgent". Then agent directs their time toward resolving the users with the most urgent needs first. Now customer service support becomes more and more programmed with the help of machine learning.

IV. CHALLENGES OF SENTIMENT ANALYSIS

Analysis of sentiment can be connected to numerous regions yet touching base at whether a statement is negative or positive can be troublesome. The order is for the most part into two kinds: opinions and facts. Facts are communicated about elements, while conclusions are about their properties. Moreover, opinions are totally emotional and portray individuals' slants, examinations or general inclination towards substances and their properties. The fundamental problems that are encountered by sentiment classification are given below:

a) Problem of Language: In SA and sentiment mining, English language is very much utilized due to its accessibility [4]. Reviews given by clients could be in language other than English (German, Italic, Arabic, Urdu and so on). Therefore, to handle each language according to its coordination is a crucial job.
b) Fake Opinion: It is related to unauthentic instruction. Some fake reviewer posts reviews which misguide the users by giving them false positive or negative sentiments identified with any article. How to check the accessibility and quality of the review being trustworthy is a major problem [5].
c) Temporal Relations: The season of audits might be significant for analysis of sentiments. The commentator may feel that Windows Vista is great in 2008, however now he may have negative supposition in 2009 in view of Windows 7. So, evaluating this sort of assessments that are shifted with interval may recover the exhibition of the analyzed framework. This causes to watch if a specific item gets enhanced with time, or individuals change their conclusion about an item.
d) Sarcastic Sentences: Content may have ironic and sarcastic words. For instance, "What an extraordinary vehicle, it quit working in the subsequent day." In such case, positive words can have negative feeling of importance. Ironic and sarcastic sentences can be difficult to distinguish which can prompt incorrect conclusion mining.
e) Grouping Synonyms: Many occasions content contains various words having same significance. So, such word ought to be distinguished and bunch together for classification based on accuracy. It is a troublesome undertaking to recognize these words, as individuals frequently utilize various words to portray a similar component. For instance, "voice" and "sound" both allude to a similar element in telephone survey.
f) Thwarted Expectations: Some content contains sentences beginning with various setting which has diverse significance toward the end. For instance, "The cast was bad, on-screen characters performed ineffectively, however I loved it." In above survey the last sentence makes the entire audit positive. In the event that term recurrence considered the above articulations would arrange as negative because of increasingly negative words in survey.
g) Domain Specific: The main problem experienced by information retrieval and emotion analysis is the domain dependent nature of words. One feature set may give excellent results in one domain, at the same time it perform low in another domain [5].
h) Asymmetry in Availability of Software: Software which are used to perform mining tasks are costly. Currently these are affordable only to large industries and ministry. It is away from the commoner's assumption [5].
i) Lack of Proper Data: The major challenge of the emotion detection is the fulfillment of proper data. Organizations need to maintain unlimited data sources to get prosecutable judgment. So, lack of proper data may lead to disorganized outcome.
j) Geographical Variations: Various countries and regions use particular assertion and slang, even within the similar language. Large numbers of services only fulfill in English, ignoring the other languages spoken in the world. While a few services consolidate dictionary slang, they cannot keep up with developments in street slang.
k) Co-referential Resolution: This kind of goals is the issue of recognizing what a noun or a pronoun phrase alludes to. For instance, "We viewed the film and went to eat dinner; it was terrible." What does "It" allude to? Co-referential goals might be valuable for the theme/perspective- based mining.

V. TOOLS USED FOR SENTIMENT ANALYSIS

For analyzing the customer view point from written text and emoticons, a number of tools are available [21]. The tools used for the sentiment analysis are discussed in the section below:

a) NLTK: The mechanism of Natural Language Tool Kit provides processing tools for certain languages [15]. This kind of toolkit involves the processes like sentiment analysis, data mining, data scraping, machine learning, and many other tasks of language processing. It provides a platform for modelling of the Python programs in order to work with human-based data language which provides an easy interface corresponding as WordNet, in conjunction with libraries of text-processing for tokenization, stemming, parsing, tagging, and classification [3].

b) Tweet NLP: It represents the collection of certain tools for performing NLP tasks in connection to the Twitter's conversational language [18]. Tweet NLP includes hierarchical word clusters, a tokenizer, POS tagger, dependency parser. The POS tagger forms a significant tool for many applications of NLP for modelling feature vectors for a specified classifier. The Tweet NLP based tagger presented an accuracy level maintained above 93%.

c) Scikit-Learn: This basically represents a framework for Python programming language offering large machine learning models as well as the tools for data analysis and pre-processing. It provides state-of-art applications for large machine learning models with its aim to pay particular attention to consistent API, good type of documentation, and good performance. Such type of documentation provides a simplified structure for both the experienced and in-experienced type of readers to search the deep information and to take an over-view of the topic, respectively. Some major significant aspects are:

1) Transformer: One such object is the necessary condition for the performance of machine learning methods along with Scikit-learn. The other objects may include expand, clean, or feature generation representations.

2) Pipeline: The tool Scikit-learn helps in providing a framework for pipelining methods of machine learning tools which makes the process to chain the tasks easily like feature extraction and pre-processing along with algorithm based on machine learning in a very tidy way. The framework of pipeline performs grid-based search for all the estimators on the basis of parameter. This estimator is any kind of object that basically learns from the data such as classifier, or Transformer object extracting or filtering impressive features from unprocessed type of data in Pipeline methodology.

3) Grid search: It is very useful process for selection of vectorization of n-grams combinations working well for some of the parameters of the classifier.

d) Pandas: It represents an open source library which provides high-level of data performance of data structures, and it involves the analysis of data for Python programming language. It involves different tools for effective writing and reading of data between distinct textual file formats and in-memory structures of data like comma-separated value-based files.

e) CRF Suite: It is an implementation based on a classifier named Conditional Random Fields (CRF) sequence. Such a classifier is presented in C++ programming language. The parameter C1 and C2 forms the input parameters for each of the CRF classifier for the settlement of L1 and L2 normalization levels coefficients, respectively.

f) Mechanical Turk: The Amazon Mechanical Turk represents a marketplace which requires human intelligence methodology for their work [21]. It basically helps in performing large tasks based on human intelligence providing large workforce. It is a useful tool for annotating large tweet number manually that may be positive or negative one.

g) Google Alert: This is an easy and convenient approach to monitor search queries. By using this approach user will receive regular email updates on particular topic or entity. It is a powerful tool for finding latest trend.

h) Weka: Weka is a collection of machine learning algorithms for data mining tasks [6]. The algorithms can either be applied directly to dataset. It is an open source tool and mainly used for text classification in to different categories.

i) Rapid Miner: Rapid miner is an effective tool which allow user to perform data analysis task. In aspect-based analysis it can be used to find sentiments. Business can use it to increase customer satisfaction by focusing on enhancing certain aspects of their products and services. It is an open source tool and can analyze big data.

j) Facebook Insights: If a trade's Facebook page has more than 30 likes then it can take profit of Facebook Insights. With the help of Facebook Visions, brands are able to see their number of viewers, number of likes and dislikes. It also allows you to view daily active users and permit you to know your social media fans more appropriately.

k) Google Analytics: It permits occupation to find what about their brand is attracting users and how they can take advantage of it. Google Analytics allows to see the exact number of visitors that have found ones website and which exact terms they type in search engines. It will help organization to scale their rank high.

VI. CONCLUSION

Analysis of sentiment has broad scope of utilization but it is also facing number of problems in the domain of the research. Emotion detection has variation of applications in information systems, including classifying reviews, summarizing review and other real time applications. This paper covers applications, challenges and tools associated with sentiment analysis. Sentiment classification can be further applied for new operations. A more inventive and efficient approach needed to be simulated which should overthrown the present problems encountered by sentiment analysis.

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