

A Hybrid Approach for Sentiment Analysis of Twitter Data

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ABSTRACT

Sentiment can be described in the form of any type of approach, thought or verdict which results because of the occurrence of certain emotions. This approach is also known as opinion extraction. In this approach, emotions of different peoples with respect to meticulous rudiments are investigated. For the attainment of opinion related data, social media platforms are the best origins. Twitter may be recognized as a social media platform which is socially accessible to numerous followers. When these followers post some message on twitter, then this is recognized as tweet. Because of some exclusive properties of tweets, many novel confrontations have lifted. Superior investigation is required for the opinion mining in comparison with certain other approaches. The presented investigative study is relied on the opinion mining of entity appraisal of Amazon figures. For the implementation of opinion mining, characteristic withdrawal and categorization techniques are utilized. Opinion mining in the earlier study was implemented with the help of WDE-LSTM method which is a substitute of KNN-LSTM practice.

1. Introduction

1.1 Sentiment Analysis

A kind of normal communication dispensation for knowing the opinion of customers for a meticulous object is known as sentiment or emotion analysis. The other name of emotion analysis is opinion or belief mending. This analysis develops a scheme for collection and examining views about a certain object appeared in social media posts, evaluation, tweets or remarks. The technique of emotion investigation can be beneficial in various ways. This analysis shows its presence from computer discipline to administration discipline and public science because of its worthiness in public and industries.

In recent years, manufacturing actions adjoining emotion study are also flourished. Various novel industries have been developed. A lot of huge businesses encompass self relies domestic ability. Emotion scrutiny schemes have established their claims in approximately each industry and public region [1].

Opinion study may be depicted as a procedure which includes computerized extraction of sentiments, estimation, vision and feeling from Natural Language Processing in the form of content, language, chirp, record and so on. During Opinion investigation, the tweets are mainly categorized in three categories. These categories are "optimistic", "pessimistic" and "unbiased". This analysis can also be understood in the form of prejudice investigation, belief extraction and assessment mining.

In sentiment analysis, some areas are considered very important and they are:

- **Opinion Cataloging:** In this approach, whole reports are categorized in accordance with the estimation about some product.
- **Attribute relied Opinion Categorization:** This categorization takes into consideration, certain beliefs about some product.

- **Sentiment Characterization:** The work of sentiment characterization is distinct from the conventional content characterization. In this task only the product characteristics are extracted on the basis of which the customer has articulated his views.

1.1.1 Challenges in sentiment analysis

Opinion study is an extremely difficult job. Difficulties faced during the task of sentiment analysis are given below:

- I. RECOGNIZING SLANTED FRACTION OF CONTENT:** Prejudiced sections symbolize emotion-carrying text. The similar statement may be utilized in the form of slanted in single case, or purposeful in another case. Identification of the slanted parts of content can be more challenging because of this.
- II. REGION RELIANCE:** Identical idiom or axiom may have dissimilar sense in dissimilar areas.
- III. MOCKERY RECOGNITION:** Mocking phrases articulate pessimistic estimation concerning an objective by means of optimistic expressions in different method.
- IV. DISSATISFIED TERMINOLOGY:** In several phrases merely some section of a sentence concludes the entire divergence of the report.
- V. UNAMBIGUOUS CONTRADICTION OF OPINION:** Emotions may be annulled through various means like for opposing something, use normal words like no, not, never and so on. Identification of such kind of contradictions is complicated. .
- VI. SORT RELIANCE:** Conversation arrangement scrutiny is necessary for opinion extraction.
- VII. OBJECT ACKNOWLEDGMENT:** Separation of content from a certain object is essential because it investigates the emotion about object.
- VIII. DEVELOPMENT OF A CLASSIFIER FOR SLANTED VS. INTENTIONAL TWEETS:** Existing study effort concentrates mainly on classification of optimistic vs.

pessimistic properly. The tweets must also be classified on the basis of emotions vs. no emotions directly [2].

- IX. **MANAGEMENT OF ASSESSMENT:** Container of vocabulary representation cannot manage all evaluation in a satisfactory approach.
- X. **UTILIZATION OF OPINION STUDY ON FACEBOOK COMMUNICATION:** Only some small researches are carried out in facebook for the investigation of emotions because of certain limitations.
- XI. **INTERNATIONALIZATION:** Existing study effort concentrates chiefly on English text but on the same time it is also true that twitter has many followers all across the world.

1.2 Implementation of sentiment analysis architecture

Following are the implementation techniques of sentiment analysis architecture:

- A) **PRE-PROCESSING OF THE DATASETS:** Some tweet involves a lot of sentiments about the information articulated in dissimilar traditions by dissimilar clients. Twitter data sample utilized in this study is tagged into two sections viz. pessimistic and affirmative division and thus the emotion scrutiny of the information becomes simple to scrutinize the consequence of different characteristics. The unprocessed information having division is extremely vulnerable to discrepancy and superfluous [4].
- B) **FEATURE EXTRACTION:** The preprocessed data sample includes numerous characteristic belongings. In the characteristic withdrawal technique, we mine the features from the developed data sample. Later these are utilized for the computation of optimistic and pessimistic polarity in a phrase helpful for formatting the estimation of the persons using replicas such as unigram, bigram etc. Machine learning methods need representation of the key features of content or papers for dispensation. These input characteristics are measured as characteristic vectors which are utilized for the categorization job.
- C) **TRAINING:** Managed learning is a significant system for resolving categorization issues. The training of classifier formulates it easier for prospect forecasting for unidentified information.
- D) **CLASSIFIERS:** Following are the classifiers used for the implementation of sentiment analysis.
 - **NAIVE BAYES:** Naïve Bayes is a probabilistic classifier relied on Bayes' Theorem. By investigative a set of papers, it can learn the prototype. An evaluation is made between the topic stuff of the paper and a specified deposit of language, for the attainment of an accurate group of categorization. NLTK comes with all wherewithals for opinion study such as characteristic withdrawal.
 - **MAXIMUM ENTROPY [ME]:** This form is considered as exponential. In this Classifier, development of any assumptions related to provisional sovereignty among characteristics is not mending. This Classifier desires additional time for training in comparison with Naive Bayes because of development issues. This scheme can manage overlapping characteristic also and then decides the replica with utmost entropy [5].

- **SUPPORT VECTOR MACHINE:** This classifier is typically utilized for prototype acknowledgment and information investigation. This was made-up by Vladimir Vapnik. In this classifier, categorization is implemented by the erection of an N-Dimensional hyper plane, which is capable of separating information into detached groups. Mainly two vectors of a meticulous dimension are applied in the form of inputs and after this categorization is implemented.
- Form of inputs and after this categorization is implemented.

1.3 Sentiment Analysis Techniques

Sentiment Analysis can be performed with the help of three methods.

- Sentiment analysis with the help of machine learning.
- Sentiment analysis with the help of lexicon based approaches.
- Sentiment analysis with the help of above two approaches united jointly

1.3.1 Machine Learning Approaches:

Machine learning technique engages both supervised and unsupervised learning and their brief explanation is given below:

- **UNSUPERVISED LEARNING:** This approach is relied on merely key, devoid of any target mentioning. This technique mainly relies on clustering. It does not contain any category. Also the accurate objectives are not assessable to this techniques therefore they just depend on clustering.
- **SUPERVISED LEARNING:** This approach describes earlier précised objectives and the attainment of these objectives is necessary in association with inputs. Information samples are trained for the attainment of important harvest while stumble upon in the period of execution.

The assortment and withdrawal of the precise set of characteristics implemented for the detection of opinions is the base of the succession of above mentioned approaches.

The machine learning approach is appropriate for opinion scrutiny, largely depends upon supervised categorization. In this approach, mainly two sets of data are needed:

- i. Training Sample
- ii. Test Sample.

Various machine learning approaches have been developed for the classification of tweets into classes. In sentiment analysis, various machine learning approaches have attained a huge success. Machine learning approach initiates with the collection of training data sample. In the next step, a classifier on the training information is trained. After the selection of a supervised classification method, a significant conclusion is made for feature selection. They may inform about the representation of a report [6].

1.3.2 LEXICON-BASED APPROACHES: this technique allocates optimistic or pessimistic division relied on the opinion of every remark and on the basis of this, a vocabulary is shaped. With the help of a unite function like sum or average, the universal outlook of a paper can be find out. This methodology utilizes emotion vocabulary in association with

estimation terms and matches them with information for the determination of division. They give opinion grades to the estimation texts for the description of optimistic, pessimistic and unbiased texts. Lexicon relied advances mostly depends upon a emotion lexicon i.e., compilation of recognized and earlier accumulated emotion stipulations, sentences and even idioms, structured for conventional varieties of interaction in the form of estimation locating lexicon.

1.3.3 HYBRID METHOD: This methodology merges both machine learning and lexicon relied techniques for the attainment of improved categorization outcomes. The prevailing characteristics of these approaches may be implemented for the attainment of balanced outcomes.

2. Literature Review

Jianqiang, et.al (2018) suggested the use of deep convolution neural system for the categorization of twitter data sentiments [7]. In this technique, sentiments characteristics vector of t tweeter data utilized emotion lexicon and n-gram characteristics. In the presented approach, already trained statement enclosed characteristics were developed with the help of Glove statement attitude divisional characteristics. The characteristics of twitter sentiments were given as input to deep intricacy neural system. The conceptual data was confined with the help of persistent arrangement. With the help of a complicated neural system, the demonstration of content was constructed. Almost five data samples were used for the validation of investigational outcomes. The tested results depicted that the presented approach performed well in comparison with several other approaches. Thus it was concluded that the depth complicated neural system exploiting previously trained statement trajectories showed superior performance.

Ankit, et.al (2018) projected a novel approach for the classification of twitter data sentiments and this approach was named as ensemble classification approach [8]. A number of conventionally utilized twitter emotion investigating approaches were considered for calculating the valuation of proposed approach but the proposed ensemble classification approach was declared best. A number of base learners were utilized for the representation of the proposed approach. The proposed approach of ensemble classification showed better results in comparison with stand alone approaches. For the observation of clients' beliefs about their goods, the presented system was quite appropriate for the corporations. The presented system was applicable for the clients also because with the help of public beliefs they could choose the better goods. In future, major area of consideration will be the learning of unbiased tweets because of their neutral nature.

Das, et.al (2018) stated that stream-based setting by using the incremental active learning approach, gave capability to algorithm for choosing new training data from a data stream for hand-labeling [9]. Stream based active learning in financial domain could be helpful to both sentiment analysis and the active learning research area. With the use of RNNs Long Short –Term Memory, this experiment also proved helpful for feasibility study through batch processing. To analyze the sentiments and the current stock trends, a hybrid model could also be developed. This model would improve the reliability of prediction. In future for analyzing the stock data, addition of

machine learning algorithms can be done. Some other methods of data ingestion like data ingestion through Apache Flume or NodeJS can also be used in future.

Alzahrani, et.al (2018) proposed a novel approach of hybrid internet of things system utilizing calculative syntax realm. For the generation of genuine tweets, API of twitter was utilized [10]. For the investigation of twitter sentiments and beliefs creation, an internet of things system utilizing Raspberry Pi set up was implemented. For conducting the experiments, Arabic tweets information samples and Naïve Bayes approaches were used. This classifier showed considerable precision on the used data sample for the classification of twitter data into optimistic or pessimistic. The classifier was trained with the help of gold standard data sample and thereby a precision rate of 0.992 was achieved. The tested results displayed the efficiency and viability of the proposed approach. In future, some other classifiers will also train with the help of different data samples. Improvement in the proposed approach will also be performed in near future for showcasing the prevailing tweeter emotions.

Symeonidis, et.al (2018) proposed that various pre-processing techniques evaluated on their resulting classification accuracy and the number of features they developed [11]. The obtained results indicated that some techniques like lemmatization, removing numbers and replacing contractions improved precision while other techniques like removing punctuations did not. To investigate the interactions between the techniques when they were employed in a pipeline manner, an ablation and combination study was done. The outcomes of these techniques clearly indicated the importance of techniques like replacing numbers and replacing repetitions of punctuations.

Tasoulis, et.al (2018) proposed a practical mechanism relied on open source technique for the recognition of genuine sentimental changes [12]. The proposed approach was mega proficient in terms of memory utilization as well as in the case of calculation rate. For the accomplishment of this work, tweets were gathered reiteratively in actual time and also discarded instantly after their utilization. For the classification of sentiments, Lexicon technique was utilized. Also suitably controlled graphical representation was utilized for the attainment of alter recognition. It was also believed that for the determination of fraudulent reports, the projected approach prompted an impending huge scale threads' scrutinizing. The tested results depicted that with the help of proposed methodology significant attitude alterations athwart hash tag life span could be detected. In future, the researchers will analyze the methodologies which are used for improving the sturdiness of alter recognition approaches.

Patil, et.al (2017) analyzed that the Micro blogging became a very important part of everyone's life in present scenario [13]. A number of internet users shared their feelings on different blogging sites like face book, twitter. Various tools were used for sentiment analysis of data by using some of the tweeted data as input and got respective scores as output. The earlier developed unigram model utilized as the gauge model and gave 4% of general report. This method used two classification methods, one is two way classification methods and the other is three way classification methods. The two ways classification defined positive versus negative classification of tweeted data and the three ways classification defined the positive versus

negative versus neutral classification of given tweeted data. Some uneven tweeted data identified after testing of both these classification methods. This data was considered as neutral tweet. The kernel tree was developed and prepared to prove the superiority of unigram model. Parts of speech of the particular words were mostly considered. The wealthier etymological examination will be explored for instance, parsing and semantic examination

Bilgin, et.al (2017) proposed that sentiment investigation helped various companies to improve their products and services after getting their feedback from the twitter users [14]. A sentiment analysis was done on Turkish and English Twitter messages by using Doc2Vec. This algorithm was developed to work on positive, negative and neutral tagged data using the semi-supervised learning method and the obtained results were recorded. Two newly developed versions of Doc2Vec, DM and DBOW were used on this model. On the basis of modeling, the success rate of these methods was calculated in test phase. This was one of the earlier studies which used Doc2Vec for sentiment analysis in Turkish. The experimental results indicated that the DBOW method was more accurate than DM. Because of the small data set, tested and training results obtained were lower for Turkish language in comparison with English language. The Program codes for the supervised learning will be improved in future and the system success will also be investigated. In future, the use of DBOW and DM as hybrid approach in sentiment analysis will also be investigated in order to get better results.

Bouazizi, et.al (2017) projected a novel access for investigating the twitter data sentiments [15]. In this approach, a pattern of tweet was categorized in seven distinct modules. The tested result showed that precision rate of around 60% was achieved for various module emotion investigations with the help of proposed approach. It was also believed that for the attainment of more precise results, an advanced training sample was needed. Demonstration of accuracy level of various-class attitude study was a difficult job. One more challenging job was the quantification of tweet's emotions. For the classification of tweets into "optimistic", "pessimistic" and "unbiased", the outcomes gathered through trilateral categorization will be used in future. On the basis of resultant emotion sub branches, grades will be allotted to the categorized emotional tweets.

Pandey, et.al (2017) proposed a method named novel met heuristic method (CSK). This method was based on K-means and cuckoo search [16]. In order to obtain the optimum cluster-heads from the sentimental contents of twitter data, this method was used. The effectiveness of the given method was tested on a number of twitter data sets and then compared with a number of other approaches. Various experimental outcomes and statistical predictions indicated that this method was more efficient than the pre-existing methods. This method had several theoretical implications in analyzing the twitter data. This method also contained several practical implications in designing a system which could provide definite reviews on any social issue. In future, the more possibilities will be discovered which will improve the accuracy by using and applying some feature-selection method and different kinds of optimization methods. Also there is a scope of improvement while dealing with sarcasm and irony tweets. In future, word level and post

level contextual information along with domain specific ontology can also be used for tweet classification.

Ray, et.al (2017) proposed a structure that used R software. By using, R software sentiment of users on Twitter data could be analyzed [17]. A lexicon based approach was used to analyze the tweeter user's sentiment after collection and pre-processing of twitter data. A dictionary based approach was used to implement and develop an algorithm which utilized a significant amount of data to estimate the sentiment of public. Acronym word was replaced by creating acronym dictionary and also detected emotions expressed in tweet. For decision making, both document level and aspect level analysis was done. These methods were based on proposed methodology. In future, the more work will be on comparative opinion with the use of machine learning approaches. This will be helpful for developing a hybrid working model.

Dedhia, et.al (2017) suggested the use of an ensemble model which used SVM as base learner and Adaboost as the Ensemble boosting algorithm for classification [18]. The accuracy, recall and F1 score are identified by comparing it with the base line algorithm. The overall precision of the model is increased by the feature extraction module because it used only most useful features and eliminated the noisy features to make a strong vector of features. The obtained results clearly indicated that the ensemble method performed better in comparison with the traditional classification methods. SVM linear and RBF Kernel is a good identifier which worked on re-weighting the wrongly classified samples and assigned it higher weights. SVM with Adaboost gave better performance and did good with unbalanced datasets. In future, there is a lot of scope to work on this model because it uses aspect based classification and emotional retweet information which will make it a more generalized learning algorithm.

Ramadhani, et.al (2017) introduced that the twitter data research related to text mining proved very helpful and this could be subjected to sentiment analysis [19]. A new technique like machine learning was needed for handling a large amount of unstructured data. One of the methods of machine learning was deep learning which used the deep feed forward neural network with many hidden layers in the term of neural network with the outcome of the experiment about 75%. During Experiment, almost 1000 dataset of each positive and negative was used for training and testing among the total of all data which was 4000. The experiment was trained with 100 epochs and the used the 0.1 and 0.001 learning rate. Tensorflow Program was used for creating the network during experiment.

Liao, et.al (2016) proposed that deep learning techniques could be used to understand the real world situations with sentiment analysis of twitter data base [20]. Deep learning method was useful to solve problems occurring in computer vision. The convolution neural network also gave good performance in image analysis and image classification. CNN could extract a number of features from global information and was able to consider the relationship among these features. The above idea could give more accuracy in analysis and classification. CNN was one of the best known method to do image classification. CNN contained a convolution layer to extract information from a large of text. For this reason convolution neural network was used for sentiment analysis. When a simple convolution neural network model was tested

on standard, the tested results clearly indicated that it gave better accuracy performance in twitter sentiment classification in comparison with some conventional methods. In future more researches can be done like considering the word2vec tool, multilayer convolution neural network, larger training dataset and other situation or status analysis.

3. Research Methodology

The methodical system for projected method is elucidated in the figure 1 where both N-gram and KNN approaches are exploited.

A. Dataset

Mainly two categories of information samples are produced here manually. One data sample is utilized for training and other dataset is utilized for testing. Inside the training sample, X: Y association is presented. X is used for the representation of possible estimation remark grade and Y is utilized for the estimation of positive or negative grade. The testing set is produced after the attainment of remarks available on different social media sites. For the identification of optimistic or pessimistic test sample, a remark is tagged physically. After the completion of training, the appraisals will be alienated on the basis of optimistic and pessimistic opinions. With the help of appraisal from the test sample, gathered earlier with known polarity, the testing process of method is performed. The accurateness of the arrangement may be resolute on the base of outcomes produce by the scheme.

B. Data Preprocessing

Mainly three kind of pre processing methodologies named Stemming, fault alteration and discontinue statement elimination are implemented in this research work. The essential job of stemming process is the detection of a root of a statement. The main objective of this technique is the removal of suffixes and number of terminology concerned. With the help of this approach, time and memory consumption of the scheme can be reduced up to large extent. The development of fault alteration system is necessary because alike grammatical regulations, punctuation as well as spellings are not used by all the assessors. The situation may be unstated in dissimilar because of these errors and therefore some kind of rectification is needed. The discontinue vocabularies are eradicated for the minimization of text complication. The nucleus orientation of the declaration may get effect because of the removal of some terminology such as "it" which must be evaded.

C. Lexical Analysis of Sentences

The sentence which comprises either an optimistic or a pessimistic opinion is known as slanted sentence. Though, there are some questions or phrase written by the followers which may not embrace any emotions inside them are called as objective sentences. In order to minimize the absolute size of the review, these sentences can be detached for the minimization of absolute appraisal dimension. A query is mostly produce with the adaption of some words like "where" and "who", these words in the phrase do not give any opinion. Such kind of phrase should also be eliminated from the records. The usual terminology implicated inside python does not distinguish these queries.

D. Extraction of Features

During the extraction of characteristic from data sample, the main problem occurs inside the opinion study. For the representation of the characteristics of an entity, a noun is used always. The utilization of POS tagging is performed for the detection and extraction of all the nouns for the recognition of all characteristics. Extremely exceptional features are needed to be removed from here. After the elimination of rarely present features, a trail of frequently generated characteristics can be obtained. For characteristic extraction and for the post tagging of phrases, N-gram approach is utilized.

E. Define Positive, Negative and Neutral Words

For the withdrawal of certain characteristics, the approach of Stanford parser can be implemented. The parser gathers the grammatical reliance's present amid the text used in phrases and applies it as output. The reliance will be considered in the next few stages, for the identification of sentimental text gathered from the last stage. The straight reliance is considered a straight recognition of estimation terminology for meticulous characteristics. The indulgence of transitive reliance is also needed in association with straight reliance's inside this stage.

F. SentiWordNet

The Sentiwordnet is produced particularly inside the estimation withdrawal applications. Mainly three pertinent divisions are present for every word inside the Sentiwordnet and they are recognized as positivity, negativity and subjectivity. For the word "high" within the SentiWordNet, 125 is the complete grade. Also the word high may not be used as positive word in some sentences like "cost is high". This sentence represents a negative approach in fact. Therefore these kinds of situations also measured carefully.

G. WDE-K-Nearest Neighbor Classifier

A classifier named WDE-KNN is chosen for this approach. Because, emotion study is a dual categorization and a large amount of data samples are present for execution, therefore WDE-KNN classifier is selected in this study. A manually generated training set is utilized for training the classification; a physically produce training sample is used here. An X: Y relation is provided inside the training sample where x represents the score of an estimation text and y is used for the representation of optimistic or pessimistic word and gives them score accordingly. The score of t estimation statement associated with characteristic inside the appraisal is applied as key to WDE-KNN approach.

H. Extraction of Feature Wise Opinion

For the extraction of opinion associated with a specific characteristic, entire remarks which involve characteristic must be utilized. For the attainment of a particular characteristic, the remarks containing optimistic opinions rationed with complete existing remarks are computed. For the evaluation of negative score of a specific characteristic, the ratio of whole number of appraisal inside a negative emotion connected to a characteristic is applied to the whole figure of appraisal present is considered.

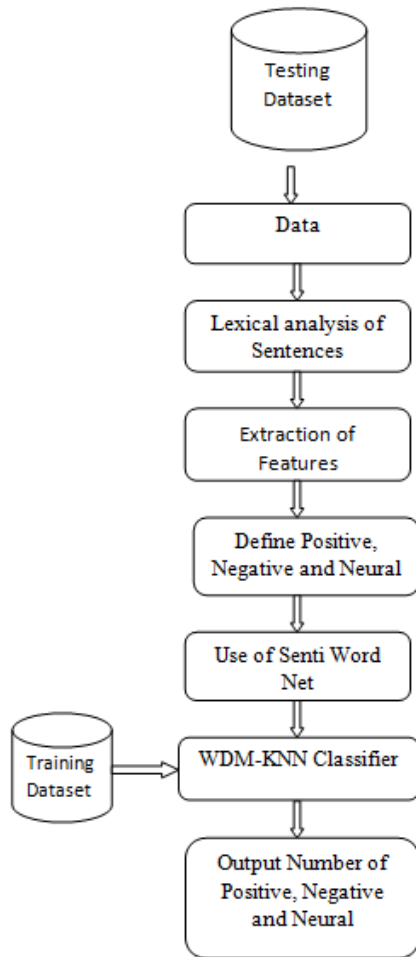


FIG.3.1. Proposed System Architecture

4. Conclusion

In this research work, the performance of consumer is investigated on the basis of emotion scrutiny of twitter information. For sentiment analysis, N-gram approach is utilized here. With the help of this approach, characteristics of key information can be investigated. For the activities scrutiny of consumer, categorization approach is used. With the help of N-gram classifier, the whole key data sample will be alienated into numerous sections. Every section is independently examined, for performing the opinion investigation task. Logistic regression classifier is utilized for this study. Numerous classes were developed during the information categorization. In this study, a comparison between WDE-LSTM and WDE-KNN classification methodology is implemented. The comparative results indicated that with the implementation of WDE-LSTM approach a precision rate of 83% is achieved while with the use of WDE-KNN approach precision rate is 89%. By means of accurateness and implementation time, the performance of both the techniques is also evaluated. The tested results indicated that the projected approach performed superior in all the constraints.

References

[1] Kiruthika M, Sanjana Woonna, "Sentiment analysis of twitter data", 2016, International journal of innovations in engineering and technology.

[2] Varsha Sahayak, Vijaya Shete, Apashabi Pathan, "Sentiment Analysis on Twitter Data", 2015, International Journal of Innovative Research in Advanced Engineering (IJIRAE)

[3] Apoorv Agarwal Boyi Xie Iliia Vovsha Owen Rambow Rebecca Passonneau, "Sentiment Analysis of Twitter Data", 2011, Conference of the European Chapter of the ACL

[4] Chandan Arora, Dr. Rachna, "SENTIMENT ANALYSIS ON TWITTER DATA", 2017, International Research Journal of Engineering and Technology (IRJET)

[5] Vishal A. Kharde, S.S. Sonawane, "Sentiment Analysis of Twitter Data: A Survey of Techniques", 2016, International Journal of Computer Applications (0975 – 8887)

[6] Onam Bharti, Mrs. Monika Malhotra, "SENTIMENT ANALYSIS ON TWITTER DATA", 2016, International Journal of Computer Science and Mobile Computing, Vol.5 Issue.6,

[7] Zhao Jianqiang, GUI Xiaolin, "Deep Convolution Neural Networks for Twitter Sentiment Analysis", 2018, IEEE

[8] Ankit, Nabizath Saleena, "An Ensemble Classification System for Twitter Sentiment Analysis", 2018, International Conference on Computational Intelligence and Data Science

[9] Sushree Das, Ranjan Kumar Behera, Mukesh Kumar, Santanu Kumar Rath, "Real Time Sentiment Analysis of Twitter Streaming Data For Stock Prediction", 2018, International Conference on Computational Intelligence and Data Science

[10] Salha M. Alzahrani, "Development of IoT Mining Machine for Twitter Sentiment Analysis", 2018, 15th Learning and Technology Conference (L&T)

[11] Symeon Symeonidis, Dimitrios Effrosynidis, Avi Arampatzis, "A comparative evaluation of pre-processing techniques and their interactions for twitter sentiment analysis", 2018, Expert Systems With Applications

[12] SOTIRIS K. TASOULIS, ARISTIDIS G. VRAHATIS, SPIROS V.GEORGAKOPOULOS, VASSILIS P. PLAGIANAKOS, "REAL TIME SENTIMENT CHANGE DETECTION OF TWITTER DATA STREAMS", 2018, INNOVATIONS IN INTELLIGENT SYSTEMS AND APPLICATIONS (INISTA)

[13] Rashmi H Patil, Siddu P Algur, "Sentiment Analysis by Identifying the Speaker's Polarity in Twitter Data", 2017, International Conference on Electrical, Electronics, Communication, Computer and Optimization Techniques (ICEECCOT)

[14] Metin Bilgin, Izzet Fatih Senturk, "Sentiment analysis on twitter data with semi supervised DOC2 Vec", 2017, International Conference on Computer Science and Engineering (UBMK)

[15] Mondher Bouazizi and Tomoaki Ohtsuki, "A Pattern-Based Approach for Multi-Class Sentiment Analysis in Twitter", 2017, IEEE Access

[16] Avinash Chandra Pandey, Dharmveer Singh Rajpoot, Mukesh Saraswat, "Twitter sentiment analysis using hybrid cuckoo search method", 2017, Information Processing and Management

[17] Paramita Ray and Amlan Chakrabarti, "Twitter Sentiment Analysis for Product Review Using Lexicon Method", International Conference on Data Management, Analytics and Innovation (ICDMAI) Zeal Education Society, Pune, India, Feb 24-26, 2017

[18] Chintan Dedhia, Mrs Jyoti Ramteke, "Ensemble model for Twitter Sentiment Analysis", International Conference on Inventive Systems and Control (ICISC-2017)

[19] Adyan Marendra Ramadhani, Hong Soon Goo, "Twitter Sentiment Analysis using Deep Learning Methods", 2017, 7th International Annual Engineering Seminar (InAES), Yogyakarta, Indonesia

[20] Shiyang Liao, Junbo Wang, Ruiyun Yu, Koichi Sato, Zixue Cheng, "CNN for situations understanding based on sentiment analysis of twitter data", 8th International Conference on Advances in Information Technology, IAIT2016, 19-22 December 2016, Macau, China