SENTIMENT ANALYSIS FOR SARCASTIC MESSAGES IN SOCIAL MEDIA USING DEEP LEARNING TECHNIQUES - AN EMPIRICAL STUDY

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Abstract

Sentiments is the term of opinion or views about any topic expressed by the people through a source of communication. Nowadays social media is an effective platform for people to communicate and it generates huge amount of unstructured details every day. It is essential for any business organization in the current era to process and analyse the sentiments by using machine learning and Natural Language Processing (NLP) strategies. Even though in recent times the deep learning strategies are becoming more familiar due to higher capabilities of performance. This paper represents an empirical study of an application of deep learning techniques in Sentiment Analysis (SA) for sarcastic messages and their increasing scope in real time. Taxonomy of the sentiment analysis in recent times and their key terms are also been highlighted in the manuscript. The survey concludes the recent datasets considered, their key contributions and the performance of deep learning model applied with its primary purpose like sarcasm detection in order to describe the efficiency of deep learning frameworks in the domain of sentimental analysis.

Keywords:- Datasets, Deep Learning, Machine Learning, Natural Language Processing, Opinion, Sentiment Analysis

Introduction

In present years, the websites of online media are utilized to impart the opinions of individuals such as advertising the business review about the products, movies, etc. [1]. The twitter includes an alternate space since it is not difficult to accumulate the details and also easy to maintain the relations among the people [2]. Further, the twitter post includes only 140 characters which implies it includes a data about the items, motion pictures, social action ,and so on [3]. It creates the method of automatic opinion or opinion classifications by using the information of twitter. Many company and institutes uses data of twitter to determine the mentality or feeling of client about items that assist to upgrade the business [4]. The way of examining the extremity of twitter data is called as opinion or sentimental analysis. But, it is difficult to know the user opinions in larger data [5]. The sentimental analysis of twitter is acuired attentions among the analysts since it gives required data about the products review, movie review, social activity review, etc.

Twitter is an major platform used for sharing and communication of information among the friends [6]. Twitter makes the users to express their opinions with 140 characters only that makes simple to convey and pursue the details in one post of tweet . Twitter gives a various measures of data that is used as writing for a blog for many applications like marketing, reviews, elections and SA [7]. People post tweets regarding various topics like reviews on products, movies, politics, brands, etc, to impart their opinion [6]. Before analyzing the polarities of sentences, it is necessary to identify whether the sentences are subjective or objective. If the sentences are subjective, then the researcher can only determine positive, negative and neutral form or else the sentences are discarded. In SA of twitter, the recent techniques concentrated only on positive and negative value for the extraction of data from online blogs . However, the existing methodologies faced the issues that neutral tweets were not considered for classification of the tweets, because neutral tweets are very small and includes less cues for sentimental analysis[8].

The issues looked by the researchers in implementing the applications are; (i) the field specific words and lesser lexicon of emoticons that resulted in helpless classifications of sentiments, (ii) sporadic, lacking words, slang, and shortenings were also leaded to poor

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classifications[9]. Hence, it is important to establish an automatic approach for analyzing and detecting the user sentiments from the data of twitter . Many approaches were developed for the automatic classification of sentiments like Naive Bayes, Support Vector Machine (SVM), maximum entropy, decision tree, etc [10]. The serious issue in the current procedures is the quantifications of relationship among the words in a tweets.

Taxonomy of Sentiment Analysis

In this section, the methods used in existing sentimental analysis about the popular sentiment analysis approach is presented. The taxonomy of the sentimental analysis technique is shown in figure 1.

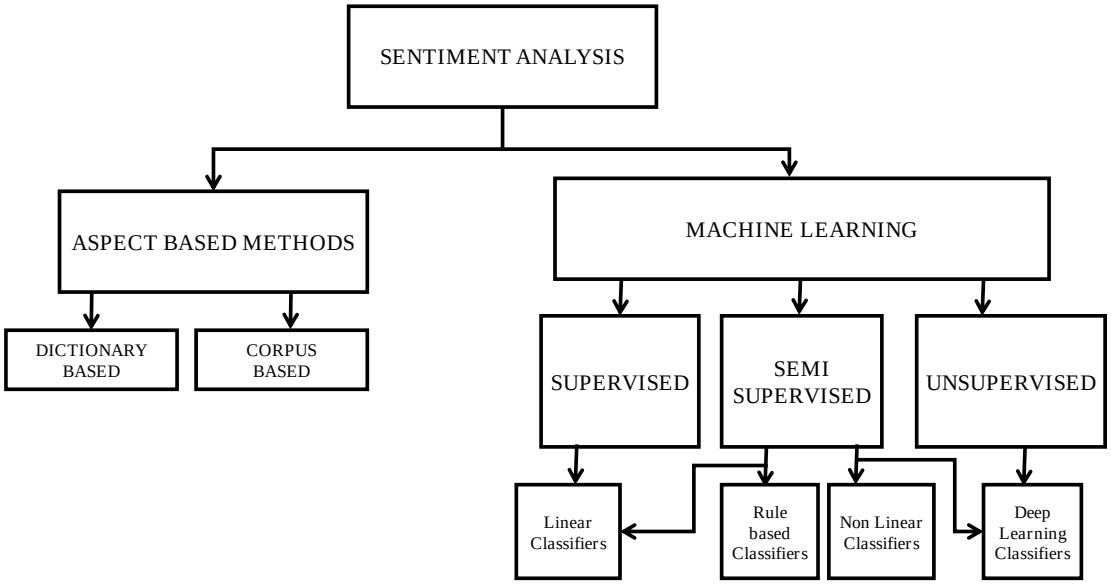

Figure 1. The taxonomy of sentimental analysis.

The Sentimental analysis is an process of retrieving the informations about the entities and to automatically determine the subject of particular entities. The aim is to identify whether the texts generated by the users gives positive, neutral or negative feedback. The classification of sentiments is carried out by the three levels of extraction such as aspects or features level, sentence level, and document level.

The sentimental analysis can be performed by using either deep learning or machine learning that requires the textual training data that is corrected before using it to induce the model of classification. The tweets includes punctuation marks, white spaces, Retweet (RT), Non-Characters, stop words, and "@ links",. The characters area removed by using the libraries called Beautiful Soup which do not contains any useful details for sentimental analysis. After removing, the tweets are splitted into single words that are converted into form of base form by using lemmatization and converted into vectors of numerical by word embedding or Term Frequency-Inverse Document Frequency (TF-IDF).

Word embedding is a method for modelling the languages and features learning, where the every words are mapped to an vectors of real value in a way that same meanings of words includes same representation. The value learning are carried out by using the neural network. The commonly used words in embedding system are Word2vec such as GloVe, or Gensim that contains techniques like skip-gram and Continuous Bag-Of-Words (CBOW). The both techniques are on the basis of probability of words that occurred in the proximity with each other. The skip-gram provides the possibility to start with an words and identifies the words which will surround it. The CBOW stores by identify the words which will occur based on the particular context of words. The TF-IDF is an statistical evaluation for knowing how important the words in documents for the corpus. This measure consider the frequency of words in targeted documents and the frequency in the data of corpus. The greater the value of frequency of words in target documents, the lower is its frequency in the other document .

The class vectorizer in scikit-learn libraries are used to evaluate the TF-IDF. The

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word embeddings and TF-IDF were utilized as an input features in deep learning algorithm for NLP. The sentimental analysis process converts the collections of raw data into an vector in the form of continuous real number. There are various types of process such as feature or aspect based sentiment analysis, subjective or objective classification and polarity based sentiment detection. In aspect based sentimental analysis the sentiments are expressed as an certain aspects of entity like room, location, value, cleanliness and service. In objectivity classification the words and sentences are dependent on contexts and objective documents that contains the objective of sentences. The polarity and intensity are the components utilized to score the sentimental analysis. The polarity gives whether the sentiments are positive, negative or neutral. The intensity gives the relative strengths for the sentimental analysis. Presently, there are 3 techniques to overcome the problem of sentimental analysis such as

Lexicon technique, Machine Learning technique and Hybrid technique.

The aspect based approaches were used first for the sentimental analysis. It is divided into two types such as dictionary and corpus based techniques. In general, the sentimental classifications are carried out by using an dictionary of words like used in WordNet and SentiWordNet. The corpus based sentimental analysis will not depend upon the pre-defined dictionary of words, but depends on statistical analysis of contents in collection of document by using K-Nearest Neighbors (k-NN), Conditional Random Field (CRF), and Hidden Markov Models (HMM), among others techniques.

The Machine learning based approach developed for an sentimental analysis issues that are divided into two types such as traditional approach and deep learning approach. The traditional approaches are the classical machine learning method like Naïve Bayes (NB) classifier, Maximum Entropy (ME) classifier and Support Vector Machines (SVM). The input of algorithms consists of parts of speech, lexical features, adjectives, sentimental lexicon based features and adverbs. The accuracy of the model depends upon the data that are selected. The deep learning methods provides effective outcome than the traditional approaches. The various types of deep learning methods are used for the sentimental analysis by including Convolutional Neural Networks (CNN), Deep Neural Networks (DNN), and Recurrent Neural Networks (RNN) . These methods resulted in classification problems during sentence level, document level and aspect level. The deep learning methods based on sentimental analysis are discussed in the below section.

Literature review

The recent deep learning approaches on the sentimental analysis are discussed in this section to identify the people's opinion about specific topic and also the advantages and disadvantages of existing methods are presented.

A.P. Rodrigues et.al. [4] developed an hybrid lexicon naive bayes classifier method for the opinions extraction. The hybrid method was carried out by using labeled dataset and filtered the unwanted tweets by using lexicon approach. The hybrid method worked well on larger scale of datasets. The sarcastic tweets of data leaded to misclassification and resulted in poor opinions mining. The hybrid method was not focused on filtering the sarcastic opinions that leaded to poor classification result. The hybrid method was conducted by using twitter dataset by using accuracy, f-measure, precision, recall and time parameters.

S.M. Nagarajan et.al.[5] developed an hybridization method based on particle swarm optimization and genetic algorithm for opinions classification. The hybrid technique with Decision Tree (DT) classifier attained an accuracy of 90% for classifying the twitter data into three categories such as positive, neutral and negative. By comparing the existing methods such DT, KNN, SVM, and hybrid SVM and KNN, the hybridization technique showed effective results interms of accuracy, f-measure, recall and precision. However, due to misspellings in the data, the hybridization approach resulted in misclassifications of twitter dataset.

L. Terán et.al. [6] presented an Dynamic Voting Advice Application (DVAA) in 2017 for national ecuadorian election. During implementation, the dictionary was generated in spanish language. In literature, the root mean square error was utilized as an performance metric to determine the effectiveness of DVAA. Manually reviewed the dictionary and was not able to recover every words combinations semantic. To give out an better recommendation system, the DVAA provided only lesser information due to only 118 users were interacted.

L. Wang, et al., [7] proposed an SentiDiff approach for analyzing the sentiments by using twitter data. The relationship among the sentiments diffusion pattern and textual details regarding tweets were analyzed. The experiment was carried out on twitter datasets

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and the parameters like area under curve and recall were used to determine the effectiveness of SentiDiff with TBM method and Deep-CNN. By combining the sentimental diffusion information with textual information, the performance of developed method was reduced because of the negative influences.

Z. Jianqiang et.al. [8] used Deep-CNN for sentimental classification by using twitter datasets. The developed deep-CNN approach was significantly extracted the contextual informations from the twitter data which helped in the reduction of sparseness problem.

M. Z. Asghar et.al. [9] established a system to classify the tweets by using hybrid methods such as SWN, emoticon, slang and field particular classifiers. The hybrid approach was also called as T-SAF which was used to solve the problem of irrelevant classifications of opinion. The T-SAF detected and classified the emoticons of twitter dataset. The hybrid method showed good performance compared to cuttent procedures such as SVM, RF and KNN by using metrics like accuracy, recall, precision, and fmeasure. However, the problem of the hybrid method was the lack of automatic scoring in the field of certain words.

Comparative Analysis

Comparison analysis of existing sentimental analysis methods in terms of performance measures such as Mean Absolute Error (MAE), Precision, Accuracy, Recall and F1score is presented in table 1.

Table 1. Comparative Analysis of existing methods

Author with Year	**Methodology**	**Advantage**	**Limitation**	**Parameter Evaluation**
B. Bansal., et. Al[10]	Utilized an features of N-gram to determine the voting shares of uttar pradesh legislative elections on 2017.	The emoticons of opinions were identified and utilized to determine the voting shares. The developed method gathered 0.3 million tweets where geotagging was used on searching keywords.	The major problem is the reduction in data size after the geotagging. When users was not activated the geolocation in the devices this problem was occured. The number of tweets was reduced by using geolocation restrictions. The state and regional parties were not famous on Twitter so the voting shares were assumed as zero.	MAE was utilized to determine the efficiency of developed algorithm on four datasets.
A. S. M. Alharbi. Et al [11].	CNN was developed to determine the opinion of user	The developed method utilized behavioral information of user with the provided documents (tweet), where existing techniques focused only on textual content	The first dataset (SemEval-2016 1) consists of 3,694 tweets and the next one (SemEval-2016 2) includes 1,122 tweets, but these datasets were manually annotated. In addition, the developed method was affected by the issue of unbalanced dataset.	Accuracy, recall, precision, and fscore were used to test the performance of CNN.
M. Wang et. Al [12]	Developed an Attentional Graph	The AGN-TSA method combined the tweets	The method provides poor	Accuracy, recall,

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	Neural Network based on the Twitter Sentiment Analysis (AGN-TSA).	and textual informations. Then, the information of users connection by three layers neural architecture that included an embedding of words layer, user embedding layer and attention graph network layers.	performance, due to presence of imbalance data and irrelevant data in the tweets.	precision, and F1-score are used to test the performance of AGN-TSA
M. Arora., et. Al [13]	Established an textual normalization with the deep convolutional character embedding neural network model for sentimental analysis of unstructured datasets.	The developed method processed the raw sentences by using Twitter dataset founded the actual polarities of the messages. It tackled the issues such as processed the noised sentences for sentimental identification, handled smaller memory locations in the word level embedded learning and found the accuracy in sentimental analysis for the unstructured data.	The method didn't considered all the null hypothesis from the tweets for achieving better accuracy results.	Accuracy, recall, precision, and F1-score are used to test the performance of the developed method
Y. Wang. et al.[14]	Developed an feature weighting technique for the sentimental analysis of twitter data. It calculated the significance of every features according to intra category distribution.	The developed method called as category discriminative strength was introduced for characterization of discriminability features between various category and improved the Chi-square ($\chi 2$)-based measure was used to determine the intra category of features.	The developed method was performed in the environment of MATLAB manually by evaluating the labeled tweets.	The parameters such as accuracy, recall, precision, and F1-score are used in this study.
S. S. Shekhawat., et al. [15]	Developed an hybrid approach by using spider monkey optimization and k-means clustering to extract the opinions from the tweets.	The developed technique was superior than the conventional techniques because of the subjective behaviour of tweets.	The method will not works well for the sarcastic and paradox tweets.	Mean Accuracy and Mean computation time are used as parameters.

Conclusion

The research in sentimental analysis by using DNN procedures will make the researchers to go through the performance of model. In this survey, the performance evaluation of various DNN methods for sentimental classification is presented. The further study gives every deep learning practice with the methods to adapt the stable DNN method for sentimental classification of general messages and sentimental classification of sarcastic messages . Firstly, the tuning of hyper-parameters is task dependent, and it is used in hand, which is not addressed by the explicit formulations. It is necessary to write the algorithms to optimize the hyper-parameters on the basis of previous results by utilizing search technique. Further,

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the stability of DNN analysis is gained popularity in the community of deep learning research. At last, the applications of DNN is extended for other sentimental analysis approach like machine translation, topic identification, relation classification.

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