

A Novel Method to Evaluate Students Sentiments from Twitter Messages



Archana Sharma, Vibhakar Mansotra

Abstract: Classroom education is a dynamic environment, which brings students from different backgrounds with diverse abilities. By introducing machine-learning algorithms to learn the sentiments of the students in a classroom-based environment, can provide us a better research tool to understand the student psychology behind their attentiveness as well as the impact the instructor has on them while delivering lectures. Emotions can be analyzed mainly through many ways like facial features, audio signals and text messages. In this study, we have proposed a student emotion classifying mechanism that works after the lecture by analyzing the tweets posted by the students in the social media platform, Twitter to study their sentiments, or thoughts as expressed in the department twitter handle as a feedback to the classroom lecture. Students can post a tweet to their respective department's twitter handle about their opinions, emotions, suggestion. Our application has been designed to monitor the department's handle, a unique user-id via twitter API handler and when any posts appear, collects it and predicts the emotion. A hybrid-based approach which contains lexical and learning based approaches will be used to handle the twitter-based data and to predict the emotions of a student. A lexicon dictionary will be used in lexical based approach and for learning based approach, a manually customized dataset was used, and a support vector machine was designed to train the datasets and classify the emotions. The use-case of this application can be ideal for colleges, companies and wherever anyone wants to ease up the process of analyzing the feedback, suggestions or complaints from the students or employees, thereby saving considerable manpower and time. Our proposal is expected to garner good results and improved prediction time and accuracy.

Keywords: classification, convolutional neural network, deep learning, emotion recognition, twitter, tweets

I. INTRODUCTION

Micro-blogging [1] is the one of the popular platforms for expressing social views and discussion among the younger generation that are digital savvy. Social media has become a perennial source of emotions-rich data in the form of status updates, product reviews, comments on new articles, blog posts, tweets etc. Among them, Twitter plays an important

role, where the users can openly express their feelings, thoughts, and opinions. Twitter framework provides the social users to convey their thoughts more precisely with their limitations in the number of characters per tweet. This auger well with our requirement to analyze emotions from the twitter messages, namely, tweets as every tweet is restricted to a definite number of characters that is like the number of characters allowed in the Short Messaging Service (SMS) [2]. To offer some perspective, both the Tweets [3] and texts are short: combination of some words or some sentences that is kept minimum to a few lines of text. The way of expression in the tweets is very informal with short notations for lengthy words, devoid of punctuations or primarily expressed through punctuations, wrongly spelled words, but understandable enough to the users, short URLs and abbreviations for common terminologies like RT for "re-tweet", when a tweet is shared again to a person or a group of people in the friends or followers list and # for "hashtags", those words that are used as "tags" for the tweets and other social users who look for tweets on a specific topic can identify the tweet with the topic of interest mentioned in the hashtags.

Under this scenario, looking for the sentiments in the tweets can be of primal importance to learn more about the twitter user's behavior and sentiments. With the amount of content that is being generated in the social networks, it has become highly improbable to analyze the data manually to find a pattern in the expressions to make any valid argument. Now with improved technology and the ease of access to big data and the mercurial developments in the fields of data science and data analytics, emotion analysis has become much more feasible to a researcher with substantial knowledge in deep learning algorithms [4] and access to high computing power at their disposal.

The motivation behind our work arises from the recent research works turning their focus on text messages-based emotion identification techniques to tap the power of the social media content available for free. The computational techniques for successful retrieval and analysis of texts have also gained some ground among the research communities. The retrieval of information from the text messages or tweets follow those techniques that focus on searching, analyzing and processing the information gathered. Though facts are objective in most of the cases, we can also find certain subjective characteristics like sentiments, attitudes, opinions etc., in a text message which forms the core of this paper. The raw tweets contain some special characters and symbols that the model will not be able to process, hence the data needs to be cleaned before it can be passed to our deep learning model.

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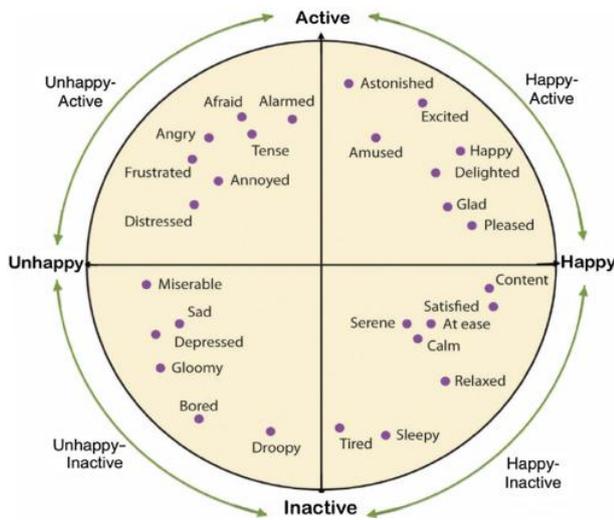


Fig. 1. Circumplex dimension model [2]

The most elementary way we can explore the emotions expressed in a tweet is by comparing the words in the posted tweets with the words in the manually labelled list, that contains the most frequently used words in expressing the emotions.

The current methods in analyzing the text messages are directed towards the polarity of the emotions, where it can be either positive or negative. The machine learning model requires building a model by training the classifier algorithm, in our case, the Support Vector Machines (SVM) [5] with labeled examples. This also implies that we must gather a dataset with positive, negative and neutral classes, retrieve those subjective words from the dataset and finally, train the model based on those examples. In this paper, we follow a hybrid-approach that uses the best of both worlds; detection of the polarity from the sentences using the lexicon-based approach and then apply it to the SVM based learning algorithm. This way of implementation can capture even finer elements of emotions like happiness, anger, sadness, surprise etc.

II. RELATED WORKS

The recognition of emotions from the data collected from social media networks has been of much interest over the past few years. Here, we have considered the most popular micro-blogging social network, Twitter and use the tweets to predict the sentiments hidden in it. There are a lot of research works presented recently on twitter-based opinion making systems or sentiment analysis. In this section, we consider some of those previous published literature on text-based emotion recognition for our discussion that can shed some light on the selection of our methodology for this proposed work.

Maryam Hasan.et.al [6], proposed an emotion recognition framework based on text data. The had designed an emotion classification system from a stream of text messages. For this approach, an offline training mechanism and an online classification mechanism was deployed. The first mechanism gathered huge streams of text data from twitter and created a

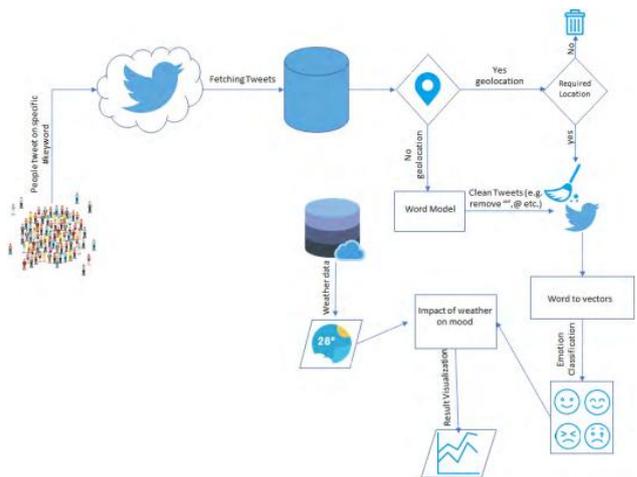


Fig. 2. Framework used by Rashid Kamal et.al [4]

model to train from the information or keywords in the text message. The second mechanism was used to get live streams of tweets and predict emotions from that data. A binary classifier was used to train the offline text data and classify the emotions. Once the emotions were identified, a dimensional model was used to analyze those emotions. This model illustrates emotions by defining their positions along two or three dimensions. Most widely used dimension model, a circumplex dimension model [7] was used in this study as shown in Fig 1.

In another related work, Rashid Kamal et.al [8], designed a system for emotional classification of twitter data by using the lexicon-based approach. Twitter API [9] was used to access the tweets in real time. This application considered different functionalities while accessing the tweets and it allows parameters such as how many tweets are required, time interval for the tweets being posted and geolocation of tweets. A Lexicon-based approach [10] was used to classify the emotions. This framework as shown in Fig 2 has been tested different scenarios such as “Viewers response to the Hollywood movie ‘A Beautiful Mind’ through analysis of their tweets”, “Tweets about Mr. Sen. Sherrod Brown, a democrat senator of Ohio” and tweets about keyword or hashtags on “Bad weather” and “Good weather”.

Neha Singh et.al [11], proposed an emergency response services by analyzing the sentiment of twitter users. Twitter API [9] was used to collect the data from twitter about the event happened in Las Vegas by using specific keywords such as #Lasvegas, #lasvegasshoot and applying the Naïve Bayes classifier to predict and classify eight different emotions. Public can tweet about their feelings via twitter in five different topics such as ‘shooting’, ‘gun’, ‘victims’, ‘killed’, ‘prayers’. The emergency responders monitor this application in order to rescue or provide help to the public.

In a prior work, Yang Yu et.al [12], proposed a sentimental analysis of sports fans’ tweets in World Cup 2014. The real-time tweets from soccer fans during FIFA world cup 2014 with the help of Twitter Search API [9] and filter those tweets with a list of predefined hashtags such as #FIFA, #Football, #Worldcup, # Soccer.

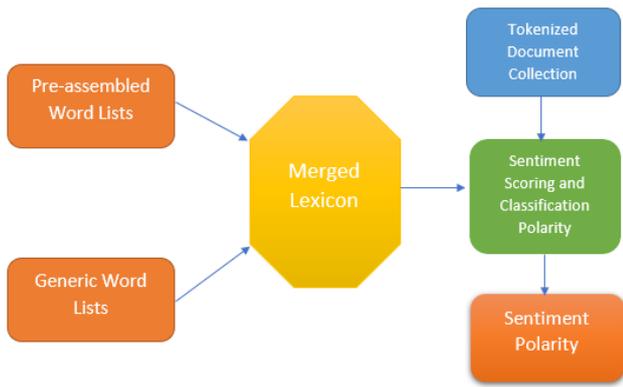


Fig. 3. Lexicon based Approach

A Lexicon-based approach [10] was used to classify the emotions with the help of predefined hashtags and big data approach [13] was used to examine the vast number of tweets.

In the research work by Nurulhuda Zainuddin [14], an emotion cataloging system from twitter data was put forth with the hybrid approach i.e. by combining the lexicon and learning approaches in their study.

Hate Crime Twitter Sentiment (HCTS) [15] dataset was used and applied a support vector machine to train and predict the emotions. Before training the model, a single and multi-word extraction was done by association rule mining [16]. These association rules were created by analyzing the data for frequent ‘if/then’ patterns. Then, the supporting criteria and confidence were used to identify the relationships of data.

III. EXISTING SYSTEM APPROACHES

In this paper, we have intended to implement a sentimental analysis of students from twitter data (tweets) in a classroom environment. Before proposing this technique, we have reviewed some previous implementations on emotion recognition from twitter data. There are four types of approaches that deal with emotion recognition from text data.

A. Lexicon Based Approach

Lexicon based approach [10] in Fig. 3 is a basic way of classifying emotions with the help of keywords, hashtags (twitter)... etc. This method uses some sentiment dictionary with opinion words such as feeling bored, sad, exciting, beautiful and #lol and match them with the data (in our case tweets) to determine the polarity. This method is mainly relying on the sentimental statements or words. There are two types of lexicon-based approach [10].

In this approach, the usage of terms or words that represents emotions are collected and annotated manually. An example for this dictionary-based approach is WordNet [17], which is used to develop the thesaurus called SentiWordNet.

The main drawback of this method is, it cannot deal with context-specific orientations. For example, “I met my old friend by accident”. In this context, the statement is negative with the word “accident”, but the real context is positive. So, this would be the problem in some scenarios.

B. Learning Based Approach

Learning based approach [18] is the most popular way of identifying emotions from a textual data. It is mainly based on dataset and thus the labels are provided to the model. These labelled datasets are trained to get emotional labels such as angry, happy, sad... etc. This method is mainly depending on selection and extraction of specific features used to detect the emotion.

For this kind of approach, two sets of data must be needed, train set and test set. Train set contains list of textual data and applying a machine learning method on that train set. Once the method is trained, a criterion will be calculated by applying trained model on test dataset and compare with the original dataset.

The most common features in sentimental classification are

- Term presence and their frequency.
- Parts of speech information
- Negations
- Opinion words and phrases

The supervised and unsupervised learning algorithms can be used in this kind of approach. Machine learning techniques such as Support Vector Machines (SVM) , Naïve Bayes and Deep learning methods such as Convolutional Neural networks (CNN), and Recurrent Neural Networks (RNN) are the most popular techniques used in the classification.

C. Hybrid Approach

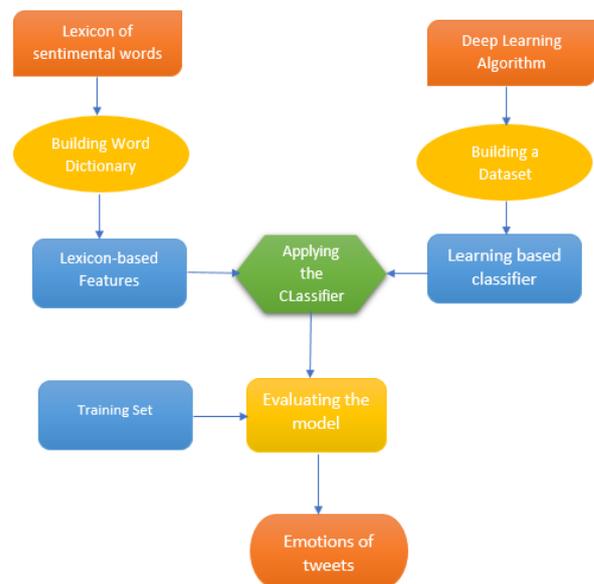


Fig. 5. Hybrid Approach

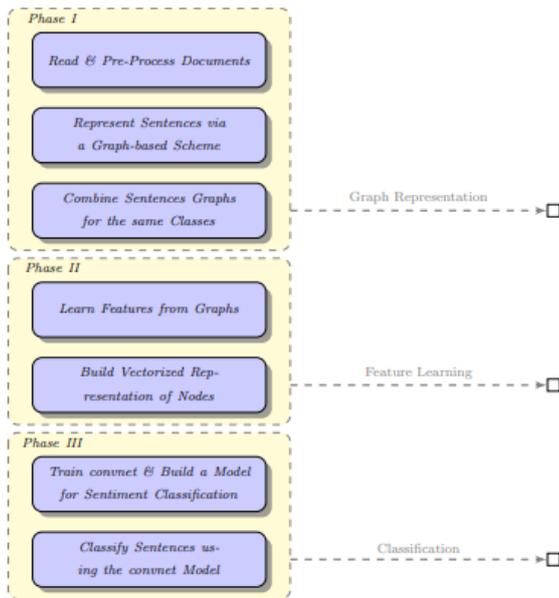


Fig. 6. Graph based Approach [21]

Hybrid approach [19] is basically a combination of lexicon-based and learning-based approaches. As we have discussed in the previous sections, lexicon-based approach first builds the list of sentimental and opinion driven words and creates a dictionary of it like WordNet, while the learning-based approach gathers a collection of tweets of data and creates a train and test set. Once all the data is collected, machine learning classifier will be applied and can be trained to classify the emotions from those data.

D. Graph Based Approach

Graph based approach [20] is the advanced technique on classifying the sentimental analysis from text-based data. Initially, the data from the text documents will be processed and transformed into graphs. A text document can be represented as a graph in many ways. In a graph, nodes denote features and edges outline the relationship among different nodes. A feature learning technique with an intrinsic feature of graphs are to be determined, and later, deep learning methods are used to classify the emotions. Graph-based text representation can be acknowledged as one of the genuine solutions for the deficiencies of other existing and proposed methods.

IV. PROPOSED SYSTEM FRAMEWORK

The proposed framework is implemented in a classroom environment, where students can post their feeling or sentiments on their experience with the class lecture via

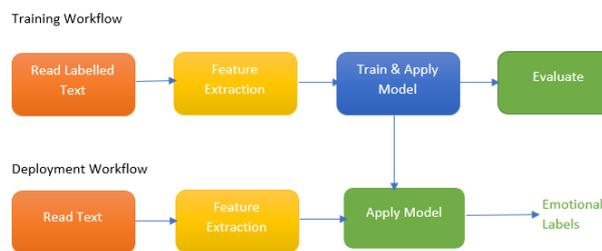


Fig. 3. Learning based Approach

twitter. This method gathers all the tweets at certain time intervals and apply the trained model to get the emotions. Once the emotions are gathered from all the tweets, the process of analyzing the tweets to get the lexicon words will begin and later these words can be used to train the machine learning model to detect the sentiments expressed by the tweets and the classified emotions can be used to improve the quality of the lectures, evaluate the instructor’s performance and design new approaches to keep the students interested during the lecture.

A. Dataset Preparation

To identify the student emotions in a classroom setting, there are not any publicly available datasets. For lexicon-based approach, we have manually collected the lexicon words that convey the sentiments, other idioms and have prepared a text document. For the learning-based approach, we have manually collected a huge number of tweets where students can share the opinions, feelings and interests on their department twitter account with a unique handler and categorized the different emotions by manual inspection of the tweets, which is then written to a text document with the labels representing the emotions. We have planned to get seven types of emotions from students such as Anger, Fear, Sad, Disgusted, Neutral, Happy and Joy. By considering all these emotions, we have prepared our own dataset that can be well-representative of the emotions experienced by the students in the classroom. These custom-prepared datasets prove that our proposed approach is domain-independent for detecting the explicit and implicit aspects in twitter sentiment analysis in order to attain highly effective results.

B. Pre-processing

In the case of text-based approaches, pre-processing is not as much as important as media-based approaches. But we have selected Twitter, as the platform for our approach where users can post their feelings, emotions, opinions and suggestions as a short message. So, there may be a few words in short forms, hashtags, handlers, weblinks and spelling mistakes need to pre-process and clean the data. Here, we have performed a few operations to clean and pre-process the unnecessary data as mentioned below.

- Remove duplicate tweets
- Remove retweets
- Remove URLs.
- Remove unnecessary space
- Finding hashtags
- Remove punctuation marks and numbers.
- Remove usernames which starts with @ symbol.

C. Lexicon-based Approach

In hybrid-based approach, lexicon-based approach is the foremost step. The steps followed in the lexicon-based method is discussed in detail below.

C.1. Feature Extraction

As tweeters post their feelings, there may be unnecessary data that are not related to our emotion analysis, but we need to focus only on those subjective words or lexicons that can convey a lot about the emotions. For that to happen, feature extraction scheme must be employed to the text and find out the tweets that contain the adjective, as they can tell us something about an opinion, a feeling or a thought process. The next thing is to find out the subjective tweets, that contains user emotions. Hence, it becomes important to find out both the subjective and objective tweets.

C.2. Sentence Type Detection

Sentence type detection is the trusted way to find out an emotion directly. There may be a few sentences in a real time data that may directly point out the class of emotion such as negative, positive, neutral, which in turn can be useful in finding out the exact emotion.

C.3. Polarity detection

In this technique, we must identify the occurrences of words which are presented in the dictionary we have used and replace the position of that words with the polarity value which shows by lexicon dictionary. The aggregation of polarity present in that tweet represent the whole tweet polarity. Word ontologies is the metaphysics which are used to estimate word polarities or scores. There are three ways to find out the aggregation of individual words.

- Sum of all the individual polarities (Valences).
- Take the maximum values among the words.
- Normalize (divide) by the number words or by the number of scored words which means getting a mean of all scores or divide the square root of that number.

In polarity detection, negation handling is the major issue which may intervene to produce incorrect prediction. Because, most of the sentences that contains negation word which shifts the polarity that leads to wrong prediction. So, we simply replace a negation term with ‘!’ symbol.

D. Learning-based approach

In our application, we have gathered a vast number of students posted tweets to train and applied a lexicon-based approach. Twitter API was used to access the tweets from a specific department or specific hashtags. We have built our support vector machine model to train and predict the seven different emotions such as angry, fear, sad, happy, neutral, surprise and disgust. The proposed framework is shown in Fig 7.

Algorithm: Support Vector Machine

```

Input:
    training dataset D and number of features for input k
    C for tune margins and errors
Output:
    number of features of output k
begin:
    /* performs clustering on dataset D and creating k
    clusters which are denoted by D1, D2, ..., Dk and
    their corresponding centers c1, c2, ..., ck */
    for i ← 1 to k do:
        /* learning SVM model from D */
end
    
```

TABLE 1
EMOTION CLASSIFICATION RESULTS WITH OUR PROPOSED HYBRID APPROACH

Tweet	Emotion
Great teacher! @victor. His new class participation method using twitter to input our answers is a good way to learn. #Department #Niceclass	Satisfied
Very knowledgeable about the subject. Interactive learning experience. #Helpful #Encouraging #Notboring	Happy
I am struggling with few concepts. I cannot complete understand today’s class. #disgust #Todaysclass	Sad

return svm model with *k* features

end

V. RESULTS AND DISCUSSION

We have reviewed some existing frameworks available for text-based emotion recognition. Out of that, hybrid-based approach achieved excellent results with 91% overall accuracy by using test dataset. This prompted us to use the same approach with our custom dataset to analyze the student emotions in a classroom setting. We strongly believe that we would be able to achieve better results than the other discussed methods.

VI. CONCLUSION

The primary objective of this research work was to explore the premise of using social network data from platforms such as Twitter to classify the emotions and apply the concept to the classroom student based environment where the students can express their feedback on the lecture or the instructor through tweets addressed to the department twitter account. With this proposal, we were presented with the tedious task of creating a large database collection of tweets with labels representing the emotions. The lexicon-based approach when used individually, can identify the sentiments expressed in the tweet but its limited to work on one specific context alone. This propelled us to use the hybrid approach that combined both the lexicon and learning based approaches. SVM was chosen as the learning algorithm as it outperformed the baseline set. This system was put in place in a classroom arrangement with access to internet services and wireless connectivity so that the students can post tweets on their experience with the just concluded class lecture. The department staff can be charged with the task of collecting the results generated by our proposed system and present the feedback consisting of the classified emotions to the department head and the corresponding instructor to help them to do a cross evaluation of their approach to teaching and devise methods that can benefits the students in making them more interested and productive in the future. The system that we have put in place here is an experimental one and is prone to misbehaviors and instabilities as it is still undergoing rigorous testing to analyze the deeper aspects of the student psychology during a lecture. This method can scale to higher levels in handling huge amounts of data generated from a large population of students, thereby making it an ideal way to classify emotions.



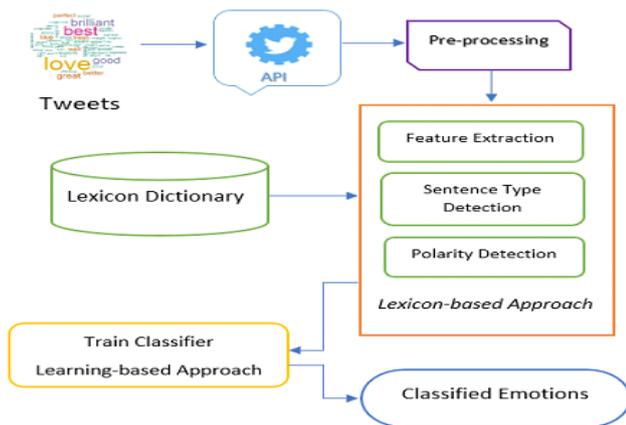


Fig. 7. Proposed System Framework that combines the lexicon approach with SVM based learning

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