Probability Based Emotion Recognition Using Machine Learning Approach

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Abstract: The emotions can be represented from multiple points of view that can be seen. It can be recognized through facial expression, speech or textual contents. This paper presents a probability based emotion recognition for textual contents by using machine learning approach. Recognition of emotions deals with a categorizing of the textual contents, based on the emotions such as sadness, fear, Happy, anger, surprise, etc. In the proposed method we used the prediction of five different classifiers to produce the final class of emotion by using the concept of probability. The accuracy of the proposed method is more than 92%


1 INTRODUCTION

Detection of emotions is one of the most emerging issues in computer human interaction. To make a comfortable communication between machines and humans, identification of the emotions plays an significant role which can be implemented in variant parts of media like signal, speech, facial expression, photos, textual data and so on. Textual data has always been the most effective way for us to circulate the ideas, emotions and opinions. In document of English sentences, there are some emotions. Each sentence expresses one of the five emotions such as Sad, Happy, Anger, Fear and Neutral. The emotion of a sentence depends on the words of the sentence. The connection between computers and humans has increased in recent times. To make this interaction effective computers are supposed to analyze the text and try to decode what feeling through the text the sender wants to invoke in the reader. In order to make a list of emotions and words that define the emotion can be useful to decode this writer’s message. For example, frighten or afraid are for scared emotions, weep and mourn are for sorrow, laugh or smile are for happiness. Recognition might be complicated for machines sometimes as it gets complicated even for us humans. So machines require some effective and advanced algorithms to fulfill it. Two methods are very useful i.e. hard sensing and soft sensing. Hard deals with a sensor detecting emotions through heart rate, brain signals, eye gaze, etc. while soft sensing deals with emotion fetching from software like emails, text messages etc. It can be seen through surveys that people use 65% of the all interaction through text messages. To identify the emotions of texts, some advanced algorithms are needed. In this report we are going to use text recognition through sentence level.

2 RELATED WORK

In this section we will explain related schemes of emotion recognition proposed by various researchers. A hierarchical classification was done by Ghazi for detection and classification of emotions. It first detects whether the sentence has an emotion or not, then whether is it positive or negative and at last level it categorize the emotion to make it more specific called at a fine-grained level. They made it better in prediction by a +7% compared to flat classification.[1] For the classification of an emotion to be positive or negative Content analysis Linguistic Inquiry and Word Count (LIWC) was used by hancock. They discovered that exclamatory marks are a representation of the positive attitude sentences, but some sort of weighted words are used for the negatives. [2] Hidden Markov Model (HMM) was used to make their model in which events that cause a transition to another state are taken as sub ideas and these ideas make the sentence, then tracing these events or sub-ideas machine determines most suitable emotion for the input text. This model didn't achieve a high accuracy and that is just because of semantic analysis.[3] This model had a limitation where there was found a lack of linguistic information which might lead to ignore person’s perspective and predict undesired results. For example ‘i was laughing at her’ and ‘she was laughing at me’. It results a emotion as happy, but there might be a different perspective in both sentences.[4] This uses unigram model. Unigram Model uses hashtags as labels and creates their features. Moreover, eliminating those words of tweets which are not a part of the emotion lexicon. Emotion lexicon consists of 28 basic words representing emotions. Further by using classifiers SVM, KNN, Naive Bayes and Decision Tree an accuracy near 90% is achieved. There was another model
created by Hasan et al. (2018) and it was an automatic emotion detection system to recognize the emotions from a stream of tweets. Where in first step an offline model of emotions was trained and then in second phase to detect tweets containing emotions, a two step classification was applied. At last some soft classification methods were used to categories these tweets in term of emotions.[5] A SVM classifier gave 82% of accuracy for the classification of happy emotion on twitter data and 67% in classification for the whole dataset used for this. Hashtags for test set and emojis for the training set, were used as labels.Final results gave a variation in accuracy from 13% to 76%, while they were tested to different emotions. [6] Here, classification was done on the basis of sentence level rather than being a document level classification. Problems that arise with sentence level classification is short sentence length causing less content and more than one label for a single sentence. The observations of Context dependence and label dependencies are used to form a Dependence Factor Graph (DFG). This graph gives an increase in accuracy and it goes up to 63.4%. [7] Here social media comments classification is done as per a specific event. A survey was conducted with 1192 participants and a news headline was given to them. These participants were instructed to comment on that news headline with the same pattern they follow to comment on social media. Then this data worked as training set for the model an accuracy near to 90% was achieved through this.[8]

3 PROPOSED WORK

Machine Learning is an application of artificial intelligence that gave the ability to learn for the machines and to improve themselves from their experience without being programmed again and again. We can take a better decision for the algorithms after observing the dataset.

3.1 Regression Method

An actual value function is used by the help of its values for various points. The regression techniques can be used for the categorization of the textual data. It predict the values between dependent and independent variable. Linear regression can be given as:

\[ Y = a + bX \]  

where X and Y are two points on regression line, a is the y-intercept and b is slope of the line and can be given as:

\[ a(\text{intercept}) = \frac{n \sum y - b(\sum x)}{n} \]  

\[ b(\text{slope}) = \frac{n \sum xy - (\sum x)(\sum y)}{n \sum x^2 - (\sum x)^2} \]  

3.2 Decision Tree Classifier

This classifier makes a tree where features denote nodes, edges excluding nodes denote feature weights and categories are depicted by leaves. It follows recursion. At every stage of recursion feature ‘F’ is chosen and the training collection is further separated into two groups, where one is with ‘F’ and other one is without ‘F’. This procedure runs till the one document of every category is left. A leaf is created at final and at each step selection of a feature is made by the use entropy.

3.3 Random Forest

This algorithm forms a forest consists of number of trees and with the increase in the number if trees forest becomes more robust and more accuracy results in the model.

3.4 K-Nearest Neighbors (KNN)

KNN is an easiest technique for classifying emotions and it is done by matching observations made to the similarly related classes. This technique uses a input constant x by user also an unlabelled vector to classify assignment of lable to the most frequent among the training example x provided by user. It uses the euclidean distance to figure out x neighboursclose to the unlabled data of the training space.

3.5 Support Vector Machine (SVM)

SVM is widely being used in pattern recognition community due to its generalised capabilities and ability to learn by examples for assignment of labels to objects. Two class problems can be efficiently solved by SVM but there are other methods in existence for the multi-class problem. With the help of iterative training algorithm the error chances are reduced by SVM. Performance of SVM is comparatively better than any other methods [9].

3.6 PROPOSED ALGORITHM

After checking the accuracy of the entire mentioned algorithm in our dataset. Our aim is to increase the accuracy of our proposed model so that we come up with a good solution. After the tokenization process of the textual data we can predict the result by all mentioned algorithm one by one and then analyse the result based on probability.

Proposed Training Algorithm:

Step1. Input a data file containing emotions.
Step2. Remove noise from input data to increase the accuracy of the proposed system.
Step3. Perform lowercase conversion.
Step4. Perform feature extraction by applying tokenization process on data received from step 3.

Step5. To train the system, perform the training through five different classifiers as: KNN, SVM, Regression, Decision tree and Random forest.

Proposed Testing Algorithm:
Step1. Input a file for testing purpose.
Step2. Remove noise to increase the accuracy of the proposed system.
Step3. Perform lowercase conversion.
Step4. Perform feature extraction by applying tokenization process to data received from step 3.
Step5. Received data is passed into various trained classifiers as: KNN, SVM, Regression, Decision tree and Random forest.
Step6. Let the predicted probability of each classifier is p1, p2, p3, p4, p5. Now, the final prediction is calculated as: \( P = \max (p1, p2, p3, p4, p5) \).
Step7. Display the result P as a final prediction of emotion.

4 RESULT AND ANALYSIS
To validate the approach we have taken total 2504 sentences for testing purpose. The result analysis of the proposed approach is represented through the figures. The figure 1 represents accuracy comparison of the proposed approach with single existing classifiers. As we can see in the figure 1 that the proposed approach has more degree of accuracy in compare to any existing classifiers. The figure 2 represents accuracy comparison of proposed approach with different method proposed by various researchers for emotion recognition. Figure 2 also reflects that our proposed approach has more accuracy than any of the existing approach. Figure 3 represents true and false prediction using confusion matrix.

**Fig. 1 Accuracy Comparison with different classifiers with proposed approach.**

**Fig. 2 Accuracy Comparison of proposed approach with existing approaches.**
Fig. 3 shows the correct and incorrect predictions of the proposed system. It shows that the proposed system acquire a high level of accuracy. In the proposed approach we have taken five different types of emotions as 0-sadness, 1-fear, 2-Happy, 3-anger, 4-surprise. Accuracy of the proposed approach can be calculated as:

\[
\text{Accuracy} = \frac{\sum \text{True Prediction} \times 100}{\text{Total Prediction}}
\]

By using equation (4), we get accuracy=(2320*100)/2504=92.65%.

5 CONCLUSION

The Proposed Probability Based Emotion Recognition using Machine Learning Approach works to recognize the emotions efficiently and effectively. The proposed system achieved a higher accuracy rather than any of the single classifier.

REFERENCES


