A Novel Approach for Detecting Emotion in Text

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Abstract

Objectives: In this paper, we present an experiment, which concerned with detection of emotion class at sentence level. **Methods:** Approach is based upon combination of both machine leaning and key word based approach. There is a large annotated data set which manually classified a sentence beyond six basic emotions: love, joy, anger, sadness, fear, surprise. **Findings**: Using annotated data set define an emotion vector of key word in input sentence. **Novelty:** Using an algorithm calculate the emotion vector of sentence by emotion vector of word. Then on the basis of emotion vector categorized the sentence into appropriate emotion class. Results are shown and found good in comparison to individual approach.

Keywords: Emotion Detection, Emotion Vecotor, Machine Learning, Natural Language Processing, Sentence Level

1. Introduction

Emotions play an important role in behavior science, and it is a component of human nature. Emotions are defining a state of mind with different thought, feeling, experience, behavior, cognitions and conceptualization[1,2]. It can be detected from different physiological characteristics such as facial expression, body language, voice, heartbeat and textual information. There is multiple ways to interact with computer. Using text people may easily communicate on web.

Now a day most of information is available on web in the form of text. So it is beneficial to extract the emotion from text for different purpose. In marketing emotional aspect is more important than price. To know that costumer is happy or not after buy a product at higher price. The aim of emotional marketing is to stimulate emotions in customer for increasing product sells and service. Emotions play an important role in decision making. Reason and emotion are only two main aspects for decision making. So here we focus on emotion detection from text.

The emotion detection from text divided in two categories, first the emotion of person who is reading the text and other is author/writer. It is difficult to classify the human emotion because human mind is very complex. There are many model to define the class of emotion. Basically emotion divided into two classes one is positive emotion and other is negative emotion. A person is happy it shows the positive emotion. While the use of word such as angry, sad or frustrated show negative emotion. For example: "we are happy to win the match." Show the positive emotion.

Some other model such as Ekman's emotion model and OCC(ortony/clore/collins) model also classify the emotion class. According to Canadian psychologist Paul Ekman emotion model happiness, anger, sadness, surprise, disgust, fear is 6 emotion classes. The OCC model includes 22 emotion categories[3]. It provided the specification of different kind of emotion. The six emotion class of ekman is also appearing in OCC model. The OCC emotion classes are: Relief, Fear, Fears-Confirmed, Gloating, Hope, Resentment, Happy-For, Sorry-For, Appreciation, Self-Reproach, Pride,Disappointment, Reproach, Anger, gratitude, Liking, Remorse, Gratification, Disliking, Shame, Admiration, pity.

There is lots of work done in the field of emotion detection from audio gesture and eye gazes over last ten year[4-8]. Automatic extraction and interpretation method

of facial expression using extraction of feature points is also discussed in various papers[9,10]. But the field emotion detection from text needs much improvement. There are many models to detect the emotion from text. Basically they categorize into three categorize keyword based, learning based, and hybrid based. Each method keyword based and learning based has some limitation. In this paper we propose a framework which uses the hybrid approach to detect the emotion.

2. Emotion

Identification of emotion is important for social behavior and making decision. Here we describe some basic knowledge of emotion from speech, face and text.

2.1 Emotion from facial expression

To recognize the emotion from face, we capture the feature of face. There are two type feature transient and in transient. Fined the position of lip, nose, eye, and some other feature on face and define a geometry using this feature. Capture the image of movement of feature and define geometry of each image then compare these geometry to geometry of neutral face and show that face is happy, sad, fear. Each emotion has different facial expression. So after comparing we can define the emotion from face.

2.2 Emotion from vocal expression

In case of emotion detection from voice analysis the speed, regularity and volume. Voice expression also depends on age, mood of speaker and context. On basis of voice expression we detect the emotion of speaker.

2.3 Emotion from Text

Nowadays internet is more popular way to communicate with other. Most of information on internet is in the form text. It can collected many source blocks, costumer review, news headlines, twits , books, e-mail and many other way. And for an effective communication emotion play an important role. So in humane-machine interface the emotion of writer can be detected by text. To detect the emotion from text analyze content, emotion key word and semantic information of text.

Emotion analysis of data such as blog and tweets could detect the human nature and behavior. As discuses above emotion can be detected using 3 methods. First is supervised learning method, in that a large annotated data set is required for training purpose. It is difficult to find such a large annotated data set but the result achieved from this method is good. Another method is unsupervised keyword based in which we do not need an annotated data set. These methods are based on emotion key words in which create a dictionary of emotion key word. And assign these key words into different emotion class, if the word in the sentence does not present in the dictionary. The sentence is considered as an emotionless. For example the sentence "he won the match". Convey the feeling of joy but it does not content the emotion word. So the result from this method is not as accurate as by supervised learning. We have provided a brief description on these approach and focus pros and cons of each.

3. Keyword based Approach

The keyword based method is very simple and stateforword to detect the emotion from text. the accuracy of this approch is depend on sentence parsingto find the emotion keyword and dictionary of emotion word. The dictionary contain the keyword which tage to different emotion classes and it also contaion the relation amonge the keyword. But this approach have fowlling limitation as discribed below.

3.1 Word Ambiguity

A keyword have different meaning different context. So these word does not belong to a pericular emotion class. It is difficult to asign to asign in a emotion class.

3.2 Incapability to Recognize Emotion in Absence of Emotion Keyword

If keyword present in the sentencedoes not in dictionary the sentence is consider as emotionless. For example "He won the match" imply the feeling of joy, but this method can not detect it.

4. Lack of Linguistic Information

The emotions are also depends on semantic and syntax structure of sentence. For example "He beats me" and "I beat him" express the different emotion in author's prospective. So we can't ignore linguistic information.

In summary, the accuracy of this method is depends on presence of keyword in dictionary and linguistic information.

4.1 Learning based Approach

The earliest supervised learning approach was employed by Alm[11]. In machine learning we need large annotated data to train the machine. The input text categorize into appropriate emotion class using previously trained classifier. Using various learning based theory such as support vector machine[12] and conditional random field[13]. The accuracy depends on the training data set. The result from this method is better than keyword based approach. Machine learning techniques also have some limitation.

4.1.1 Determining Emotion Indicator

The learning based method is based on feature extraction. This feature is similar emotion keyword in keyword based method. This feature may be emotion. Which may be in annotated data set? So the problem remains same as in keyword based method.

5. Emotion Categories

Most of these method categorize the sentence into two categorize positive and negative. But human mind is so complex so emotion categorize in many category. That is depend on method we are using.

5.1 Hybrid Approach

Both learnig based and keyword based approach have some limitation and could not give satisfactory result. So to improve the accuracy hybrid approch is better. One of hybrid sysytem[14] of which use both learning based approach to extract semantic and chines lexicone ontology to extract attribute.

6. Proposed Architecture

As we know there is some problem in both learning based and hand written rule so our approach use the combination of both to improve the accuracy. And consider that there are six emotion classes' disgust, joy, sadness, fear, surprise, anger. Before the preprocessing to input text, create the dictionary of emotion word. Here we manually labeled few emotion words between value 0 and 1 for each emotion class (disgust, joy, sadness, fear, surprise, anger). The value zero means that the word does not belong to that emotion class while one mean highly belong to that particular emotion class. The value is varies from 0 to 1. It is depend on word. For example we take word "cry".

The emotion vector of word cry is (0.1, 0, 0.8, 0.4, 0.1, 0.4) form the values of emotion vector it can be consider the words contribution for sadness is more as compare to fear and anger. While it does not contain emotion like joy and love.

Data on web is written in natural language, deal with data, we need some preprocessing techniques. In text preprocessing

1. Split text into sentence.
2. Remove stop word and tokenize the sentence.
3. The tokens are pos-tag using NLTK tagger
4. Extract noun, verb, adjective and adverb from tagged data

After preprocessing the text we get effective text for further processing. If in input sentence there is negative word such as no, not, nothing and many other. These words change the emotion of sentence. For example "Harshit is not sad." In this sentence sad word represent that this sentence belong to sadness emotion class. But due to negative word it does not belong to sadness emotion class. But we can't say that "not sad" mean happy so we can't put this sentence into joy emotion class. Negative sentence assign into neutral emotion class.

Let w_i are words extracted from the input sentence. If w_i presents in the dictionary then find the emotion vector that word. If the extracted word does not present in the dictionary, it does not contribute in emotion recognition. While it may be contribute to find output emotion level. So after getting emotion level we add it to dictionary. Let $w = \{w_1, w_2, w_3, \ldots\ldots, w_n\}$ is set of all emotion word extracted from sentence. $E = (e_1, e_2, e_3, \ldots e_n)$ be the set of n emotion classes that a sentence can be classified. Here we using Ekman's model of 6 emotion then $E = ($ disgust, joy, sadness, fear, surprise, anger $)$. The emotion vector (σ_{wi}) of word w_i is drive from dictionary. Emotion vector of w_i is represented like that,

$$\sigma_{wi} = \langle \rho(w_i, e_1), \rho(w_i, e_2), \rho(w_i, e_3), \rho(wi, e_4), \rho(w_i, e_5), \rho(w_i, e_6) \rangle$$

where $\rho(w_{i,} e_1)$ is probabilty of word belong to e_1 emotion class. Emotion vector of sentence can be calculated by aggrigating the emotion vector of all word and avaraging it.

$$\sigma_s = \frac{\sum_{i=1}^{6} w_i}{n}$$

where σ_s is emotion vector of sentence. Here emotion vector of sentence is $\sigma_s = \langle s_1, s_2, s_3, s_4, s_5, s_6 \rangle$. Now get highest

value from emotion vector, if it is greater than a certain threshold, sentence is labeled to that emotion class.

7. Experiment and Result

There are 404 sentences, with more than 2000 words. All the sentences are read and manually classified. Table 1 show the tagged detail.

After applying the proposed framework, the obtained results are shown in Table 2. In which we represent true value in row and predicted value in column.

To check that results are acceptable. For that we calculate precision and recall. The precision is calculated as

$$P = \left(\frac{S_P}{S_P + S_P} \right) * 100\%$$

Where P stands for precision, S_{FP} stands for number of false positive, S_{TP} is stands for number of true positive.

Here the recall values show that how much sentence are relevant to prediction. It is calculated as

$$R = \left(\frac{S_P}{S_P + S_N} \right) * 100\%$$

Where R stands for recall, S_{FN} represents the number of false negative and other symbols have same meaning.

For the obtained result the value of precision is 80.6% and recall is 83.5%. The results are good as compare to use any single approach either key word base or learning base.

Table 1. Tagged details

Emotion	Disgust	Joy	Sadness	Fear	Surprise	Anger
Number	45	133	39	49	15	103

Table 2. Obtained results

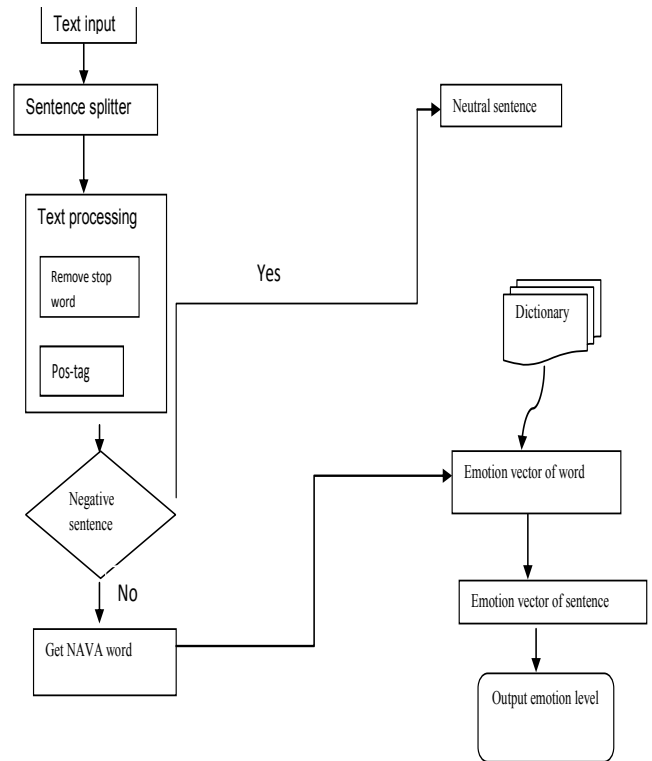|	Disgust	Joy	Sadness	Fear	Surprise	Anger
Disgust	39	0	3	0	2	1
Joy	0	114	3	4	2	10
Sadness	0	2	32	2	0	3
Fear	3	3	0	40	2	1
Surprise	1	0	1	1	12	0
Anger	1	6	1	4	1	90

Figure 1. Proposed framework for emotion detection.

8. Conclusion

In this paper a hybrid approach of emotion detection has been proposed. Because results from using any one approach either key word base or learning based are not according to prediction. And the results from this method improve the accuracy. In this article we apply the approach at sentence level. In future we applied at block or at other cuprous. And improve the dictionary so prediction should be more accurate.

9. References

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