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Comparative Analysis of Artificial Intelligence based Techniques for Emotion Detection in Text

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***Abstract*: Emotion detection as well as analysis has been extensively investigated in neuroscience, psychology and behavior science, as they are an important element of human nature. Recognizing user's emotions is a major challenge for both humans and machines. Traditional researchers tried to find emotions using emotional words. To solve this problem, I came with hybridization method in which knowledge base is being integrated with keyword based method, Support Vector Machine along with Neural Network in which accuracy of the system can be evaluated as well as enhanced.**

***Keywords*: Emotion recognition, Text Processing, Keyword based method, Neural Network, Support Vector Machine.**

1. Introduction

Emotion recognition in text is just one the several dimensions of the task of making the computers make sense of and respond to emotions [1]. The term "affect" is frequently utilized interchangeably with word "emotion" in the literature [2]. Human emotion can be sensed from such cues as facial expression, gestures, speech and writings. Detecting emotional state of a person by analyzing any particular text document which is written by him/her appears to be quite challenging but also essential numerous times because of the fact that most of the times textual expressions [3] are not only direct using emotion words but also result from the interpretation of the meaning of concepts as well as interaction of concepts that are explained in the text document [4]. Recognizing the emotion of the text plays a significant part in the human-computer interaction [5], [6].

Emotions may be expressed by a person's speech, facial expression and written text acknowledged as speech, facial and text based emotion respectively [7]. Sufficient amount of work has been done concerning to speech as well as facial emotion recognition but text based emotion recognition system still needs attraction of researchers [8]. In computational linguistics, the detection of human emotions in text is becoming increasingly important from an applicative point of view [9, 10].

Emotion is expressed as joy, sadness, anger, surprise, hate, fear and so on [11]. Since there is not any standard emotion word hierarchy, focus is on the related research about emotion in cognitive psychology domain. The main challenge in automatic emotion recognition [12] is in its highly subjective nature which does not allow to achieve perfect result quality without deep contextual knowledge [13]. Despite this fact the system should be able to give a reasonable output. However, for one or another reason currently suggested approaches do not achieve sufficient recall level with acceptable fail rate indicating the value of the new approach [14]. Computational approaches to emotion analysis have focused on various emotion modalities, resulting in a large number of multi-modal emotion-annotated data [15]. However, only limited work has been done in the direction of automatic recognition of emotion in text [16].

This paper focuses on textual emotion recognition. Nowadays in the web there is a large amount of textual information [17]. It is interesting to extract emotions for different goals like those of business [18]. I have used algorithms Support Vector Machine and Neural network for training and testing purpose and in the end results will be compared to show which works better.

2. Neural network in proposed work

Machine learning algorithms facilitate a lot in decision making and neural network has performed well in categorization purpose in almost every field [8]. Neural networks are those networks that are the collection of simple elements which function parallel. Neural networks process data in a similar way as the brain of a human being works [11]. The network is made of a huge number of highly interrelated processing components (neurons) working in corresponding to resolve a definite issue.

A formal neuron, which is obtained by re-formulating a simplified function of biological neuron into a mathematical formalism, will be the basis of the mathematical model of neural network. Its schematic structure is shown below:

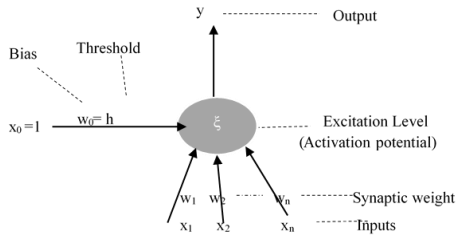

Fig. 1. Structure of a formal neuron

The formal neuron has n, generally real, inputs x1, x2… xn that model the signals coming from dendrites. The inputs are labeled with the corresponding, generally real, synaptic weights w1, w2… wn that measure their permeability's. According to the neurophys-iological motivation, some of these synaptic weights may be negative to express their inhibitory character. Then, the weighted sum of input values represents the excitation level of the neuron:

$$\xi = \sum_{i=1}^{n} w_i x_i$$

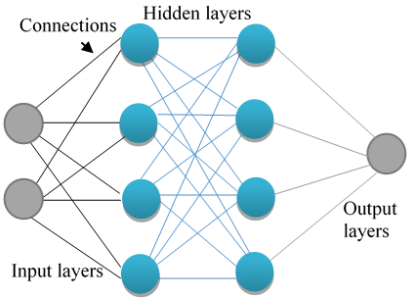

Fig. 2. Layers of neural network

Neural networks are typically organized in layers. There are mainly three types of layers in the neural architecture: Input layer, hidden layer and output layer. A neural network could possibly train to accomplish a particular fitness function by regulating values of the weights amongst various elements. Network fitness function is determined by the connections between elements. There are several activation functions that are used to produce relevant output.

Testing the NN is similar to the training procedure. Afterwards training of system is accomplished, the Neural Network is prepared for testing purpose using a test dataset. This specific dataset is minor than training data-set to confirm which network might detect interruptions it was trained to perceive. Similarly, test data-set is completed once to determine performance rate.

3. Support vector machine in proposed work

Support Vector Machines (SVM) have recently gained prominence in the field of machine learning and pattern classification [19]. Classification is achieved by realizing a linear or non-linear separation surface in the input space. Support Vector Machines (SVM's) are a relatively new learning method used for binary classification. The basic idea is to find a hyper plane which separates the d-dimensional data perfectly into its two classes. Support vector machines(SVMs) is a binary classification algorithm developed by Vapnik. The main features of SVM are shown below due to which its application is very important:

- Robust to large number of variables.
- Can be applied to & it can learn complex and simple learning models.
- It avoid overfitting.

In Support Vector classification, the separating function can be expressed as a linear combination of kernels associated with the Support Vectors as

$$f(z) = \sum_{z_j \in D} \alpha_j t_j K(z_j, z) + b$$

where zi denotes the training patterns, $t_i \in \{+1,-1\}$ denotes the corresponding class labels and D denotes the set of Support Vectors [19]. Support vector machines (SVMs) has the hyperplane that classifies the various variables as shown below:

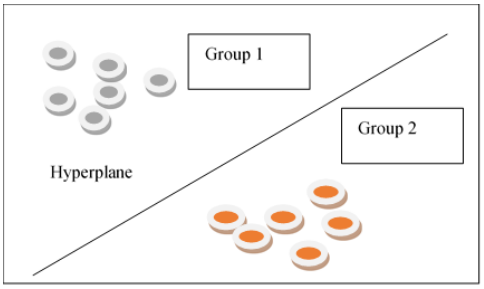

Fig. 3. Support vector machine

Equation of hyperplane can be written as below:

$$w \cdot x + b = 0$$

Here, w is the vector orthogonal to the hyperplane.

4. Proposed approach

The proposed work is divided in two sections: Training Section and Testing Section. Here training is done using keyword based technique and testing is done using Support Vector Machine algorithm along with Neural Network. These two algorithms are used because they provide good classification as well as accuracy results are also quite better than other algorithms.

The following given steps are being followed in the proposed system:

Training Section:

Step 1: Upload Text documents separately for Sad, Happy and Anger.

Step 2: Once, data is being uploaded then training is done using Keyword based emotion detection method.

In this technique it will find various occurrences of keywords from a given set as substrings in a given string. In the context of emotion detection this method is based on certain predefined keywords. These words are classified into categories such as sad, happy, angry, fearful, etc. The process of Keyword based detection method is shown in the figure below.

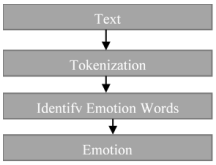

Fig. 4. Keyword based emotion detection technique

Keyword based detection technique for emotion recognition consists of four steps shown in above figure where a text document is taken as input and output is generated as an emotion class. At the very first step text data is converted into tokens, from these tokens emotion words are identified and detected. Initially this technique will take some text as input and in next step i perform tokenization to the input text. Words related to emotions will be identified in the next step. Finally, an emotion class will be found as the required output.

Testing Section:

Step 3: Upload test document of Sad, Happy, and Anger.

Step 4: Apply Support Vector Machine algorithm onto these documents for testing and classification. The foremost idea of Support Vector Machine classification is to transform the given original input fixed to a high dimensional feature space by using the kernel function.

Step 5: Apply Neural Network algorithm onto uploaded text documents for testing purpose. This algorithm is used for testing to classify that which of the group it belongs too. Network function is determined by the connections between elements which is further used for testing. Testing is done on the original sample and trained samples are compared with the tested samples and if they are matched then authentication is possible otherwise not possible. There are several activation functions that are used to produce relevant output.

Step 6: Evaluate Results using parameter such as FAR, FRR and Accuracy. The end result evaluation will be doe using following formulas:

False Acceptance Rate =(sum (sum (result)) - myerror*rand) /(numel (result) * numel (training_data)) *10000;

False Rejection Rate = (sum (myerror) - FAR*rand) / (numel (result) * numel (training_data));

Accuracy = (1- (FAR + FRR)) *100;

Proposed Algorithm:

1. *Training Case*
   Get file name
   Read uploaded data
   Get values of angry text
   Get values of happy text
   Get values of sad text
   load values of angry text
   load values of happy text
   load values of sad text
2. *Testing Case*
   Load test file data.
   Read text file.
   Proceed to classification
   load angry_values
   load happy_values
   load sad_values
   clear min_sad
   clear max_sad
   clear min_happy
   clear max_happy
   clear min_angry
   clear max_angry
   Test data using NN then SVM
   Compare values using 2 classifiers

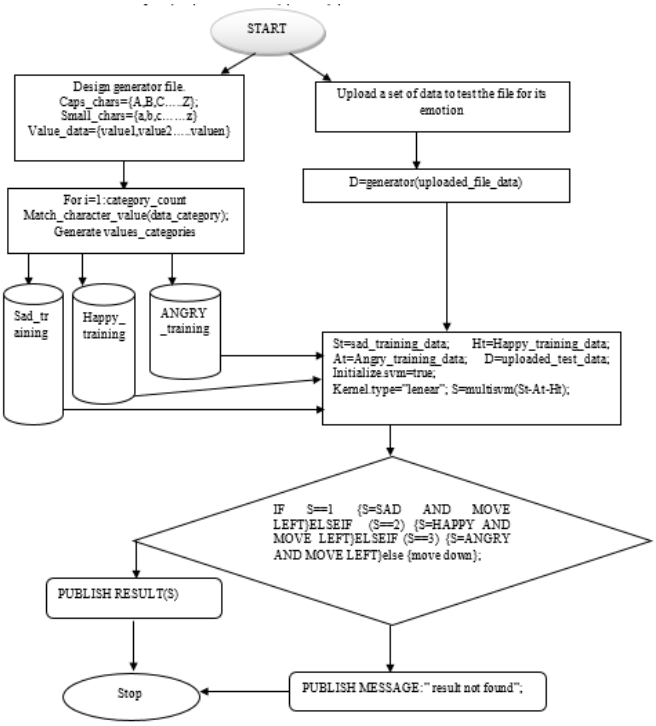

Fig. 5. Proposed work flowchart

Table 1
Comparison Table of results evaluated using Support Vector Machine and Neural Network for emotion detection in text documents

Emotions	Support Vector Machine			Neural Network		
	FAR	FRR	Accuracy	FAR	FRR	Accuracy
Sad	0.16667	0.15278	68.0556	0.055556	0.052469	89.1975
Happy	0.041667	0.079861	87.8472	0.018519	0.0360089	94.5473
Angry	0	0	100	0.018519	0.054527	92.6955

5. Experiments

In this section, i present the evaluation results of our keyword based emotion detection approach on a single Dataset. I focus specifically on the three emotion categories and check the output emotions to the three emotion categories in the following ways: (sadness, tears) →Sad, (joy, wonderful) →Happy, and (anger, fight) →Angry. I have developed two baseline algorithms which are Support Vector Machine algorithm and Neural Network algorithm. Then, I evaluate results using three parameters on the basis of which results are evaluated which are: False Acceptance Rate, False Rejection Rate, and Accuracy.

In table 1, we have shown the results evaluated for emotion detection from text documents by using Support Vector Machine algorithm and Neural Network algorithm on the basis of False Acceptance Rate, False Rejection Rate, and Accuracy parameter.

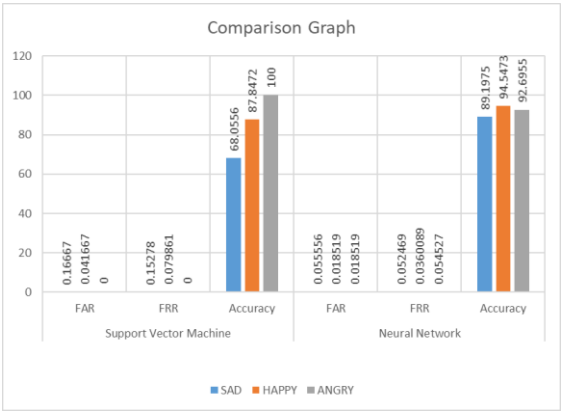

Fig. 6. Comparison graph

In above graph, this is shown that while testing is done using Support Vector Machine the results evaluated for SAD emotion on the basis of FAR, FRR and Accuracy are 0.16667, 0.15278, and 68.0556, for Happy emotion on the basis of FAR, FRR and Accuracy are 0.041667, 0.079861 and 87.8472, for Anger emotion on the basis of FAR, FRR and Accuracy are 0, 0, & 100. And when testing is done using Neural Network the results evaluated for SAD emotion on the basis of FAR, FRR and Accuracy are 0.055556, 0.052469, and 89.1975 for happy emotion on the basis of FAR, FRR and Accuracy are 0.018519, 0.0360089, and 94.5473, for Anger emotion on the basis of FAR, FRR and Accuracy are 0.018519, 0.054527, and 92.6955.

6. Conclusion and future scope

Emotion Detection can be seen as an important field of research in human-computer interaction. A sufficient amount of work has been done by researchers to detect emotion from facial and audio information whereas recognizing emotions from textual data is still a fresh and interesting research area, so we have proposed a keyword based emotion detection system for detecting emotions from text, which is proven to be effective.

In this paper, i proposed hybridization method of keyword based technique, Support Vector Machine algorithm and Neural Network Algorithm. Here, keyword based method is applied for training of the given data set, then further for training Support Vector Machine along with neural network. In the end, results which are obtained after testing by using both algorithms will be evaluated using three basic parameters such as False Acceptance Rate, False Rejection Rate, and Accuracy and compared with each other. The stimulation results shows that Neural Network performs much better in detecting emotion from text as compared to Support Vector Machine algorithm.

For future work, I will further enhance the detection of various emotions by using various other techniques of AI method in hybridization with machine learning algorithms.

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