A Survey on Emotion Detection
A lexicon based backtracking approach for detecting emotion from Bengali text

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Abstract—Emotion recognition ability has been introduced as a core component of emotional competence. Every emotion has different ways to be expressed such as text, speech, lyrics etc. This paper reflects the current experimental study and their outcomes on emotion detection from different textual data. In case of lexicon-based analysis, the position of emotional lexicons really varies the state of an emotion. In this empirical study, our focus was to find how people use the emotional keywords to express their emotions. We have presented an emotion detection model to extract emotion from Bengali text at the sentence level. In order to detect emotion from Bengali text, we have considered two basic emotion 'happiness' and 'sadness'. Our proposed model detects emotion on the basis of the sentiment of each sentence associated with it. A lexicon based backtracking approach has been introduced for recognizing the sentiments of sentences to show how frequently people express their emotion in the last part of a sentence. Proposed method can produce a result with 77.16 accuracies.

Index Terms—Emotion detection, sentiment, lexicon, backtracking, bengali text.

I. INTRODUCTION

The way of expressing emotions can be classified into many categories e.g., joy, sadness, anger, surprise, fear, hate etc [21]. Emotion detection from text reveals intended feelings or emotion that we might understand through someone's speech. Facial expressions help people to convey different types of emotions [12]. Recent Technological advancement has enabled us to test the human mind and especially the emotional hardware that is included in perceiving emotion, which is referring a more altered perception of the capacity and structure of emotion detection in the brain.

Emotion detection is a core part of artificial intelligence and Natural Language Processing (NLP) which enable us human-computer interaction. This interaction can be done in many ways like, desktop applications, internet browsers etc. Computer kiosks use the prevalent graphical user interfaces (GUI) of today [14]. Current emotion detection systems are as for singular modalities for example; face, voice and content or text [8]. Emotion detection and analysis has been comprehensively inquired in neuroscience [20].

This sorts of research have been introduced on different platforms on emotion detection hitherto. Researchers have introduced various kinds of approaches to sort out emotions from these platforms. Currently, three methodologies lead the field of emotion detection; keyword based, learning based and hybrid based approach. In this paper, we have summarized the current works in the area of emotion detection.

Rest of the paper is divided as follows. The second section describes various literature reviews that have been done in emotion detection field. Data source of our research has been discussed in the section three. In the fourth section a brief discussion about different approaches to detect emotion has been generated. In section five, we have introduced our proposed method for detecting emotion from Bengali text. Finally, we express our conclusion regarding this survey and provide references which help us in completing this experimental study .

II. LITERATURE REVIEW

At the absolute starting point of emotion detection, a basic model was proposed by Ekman with six essential feeling: happiness, sadness, surprise, anger, disgust, and fear [11]. At that point, Izard incorporates a couple of more essential arrangement of feelings which includes: joy, surprise, sadness,

anger, fear, contempt, disgust, distress, guilt, interest, shyness and shame [16] [7] [6]. Another Mehrabians model was proposed with the representation of a three-dimensional PAD (Pleasure-Arousal-Dominance) representation [19].

Lot of Work has been done to order sentences past Ekmans model of six essential feelings. A sensitive unsupervised context-based approach has been introduced for detecting emotions from the text, which gives a higher accuracy than other existing unsupervised approaches [1]. A few researchers have utilized regulated machine learning with the SNoW learning architecture. They have worked on text to speech synthesis initial experiments on a preliminary data set of 22 fairy tales [3].

SNoW (Sparse Network of Winnows) is considered as a general purpose multi-class classifier and has been utilized effectively in a variety of expansive scale learning tasks in domains such as natural languages, bioinformatics and visual processing. It is a sparse network of linear functions over a predefined or incrementally learned feature space that is particularly custom-made for learning within the sight of a verity extensive number of features [22].

A computational approach to detect emotion by using emotion model has been proposed by a supervised machine emotion detection architecture which is used to classify emotion by using a hybrid based technique with 93.43 percent accuracy [5].

Work has been done on Linguistic Rules-based approaches. A system called Emotion Sensitive News Agent (ESNA) has been produced as a news aggregator to get news, and to classify the themes of the gathered news into eight emotional affinities by employing different RSS (Really Simple Syndication) news feeds selected by the users [2]. Among different approaches, Machine Learning is a better option than others where supervised learning approach provides good result than unsupervised [9].

Emotions from various Bengali Blog documents have also been identified with the help of two methods mainly rule based and supervised approaches. The rule based baseline system passed blog sentences through a Bengali shallow parser that gives distinctive morphological data and clues. They have developed a support vector machine (SVM) to extract the emotional expression holders and topics. From 2245 trained and 512 test sentences, three separate modules have been produced to distinguish three components [10]. A Sentiment Analyzer has been generated which recognizes Bengali sentiment opinion from a given Bengali test by applying machine learning methodology. They have constructed a phrase pattern. Then extracted bengali phrase pattern matches with their predefined phrase pattern and calculate the sentiment orientation of each sentence [13].

Table I is given below that shows some research work using different approaches.

III. DATA SOURCE

In emotion detection, its a challenge to enable active innovation from a labeled emotion database. ISEAR and SemEval 2007 are two most commonly used databases [17]. Emotionally rich contents can be found from product reviews, social networking sites, blogs/journals etc. In our empirical study, for detecting emotion from Bengali, we will classify the emotional affinity of sentences in the domain from Facebook status, news lines, from text book and direct speech. As we know sharing and discussing emotions freely in any place could be counted as a source of data.

IV. APPROACHES

Emotion detection methods can be divided into three main parts; lexicon based methodologies, machine learning methods and Hybrid based approach.

A. Lexicon based approach

Lexicon based methodologies utilize a few lexical resources to recognize emotion. Lexicon is a sort of keyword based approach which is basically based on some foreordaining set of words to order the text into different emotion types. It may use a segmentation tool where texts are segmented into words. Emotional words are collected from the segmented words. Depending on the emotion label, each emotion type is determined.

B. Machine learning based approach

Though lexicon based approach gives efficient outcome, it has some limitations. This is because lexicon works by keywords and for that, a reliable database is needed. To overcome these limitations, machine learning based approach is introduced. Machine learning based approach is highly demanded empirical researchers, and mainly it deals with the study of algorithms. This method is additionally classified into two sections; supervised learning and unsupervised learning. Supervised learning works with labeled training data. It analyses these training data and closes a capacity, which is utilized for mapping new examples. On the other hand, unsupervised learning uses algorithms to illuminate hidden structure in data which helps to build models for emotion classification.

C. Hybrid based approach

It is the combination of both keywords based and learning based approach. It has a higher possibility of giving accurate results and thus has the capability to minimize difficulties.

V. PROPOSED METHOD

After the survey on emotion detection field, we have intended to detect two primary emotions from Bengali text, basically happiness and sadness. In order to find emotion from Bengali sentences, at first the sentiment of each sentence will be identified using a backtracking technique. And then emotion will be detected on the basis of their sentiment associated with them.

TABLE I
EMOTION DETECTION STUDY

Author	Citation	Description	Detection approach	Granularity
Saima Aman et al.	[4]	Annotating sentence in a blog corpus with information about emotion category, intensity and emotion indicator	Knowledge based approach	sentence
Ameeta Agarwal et al.	[1]	Unsupervised approaches of detecting emotions from text using semantic and syntactic relations. Does not required an annotated data set or any detailed affect lexicon.	Unsupervised	Sentence
Yajie hu et al.	[15]	Implemented an emotion classification method based on lyrics with emotion lexicon. Lyricator uses ANEW to extend the emotion lexicon by natural language corpus with a co-occurrence method.	Fuzzy clustering method	Song lyrics
Richard sproat et al.	[3]	The text-based emotion prediction problem in the domain of children fairy tales with child directed expressive text to speech synthesis.	Supervised machine learning.	Text to speech
Haji Binali et al.	[5]	Proposed Hybrid based architecture for emotion classification.	Hybrid based architecture.	Text
H. Li et al.	[18]	Incorporating personality factor in chatting system to improve accuracy results.	Keyword based	Sentence

A. Methodology

Our research methodology is to find the sentiment of a sentence before going for any emotional state associated with it. To do so, after tokenization of a given input sentence, an expression will be generated for every input sentence. Then the sentiment of that expression will be calculated by analyzing the behavior of other expressions stored in the database. Finally emotion will be detected on the basis of the sentiment.
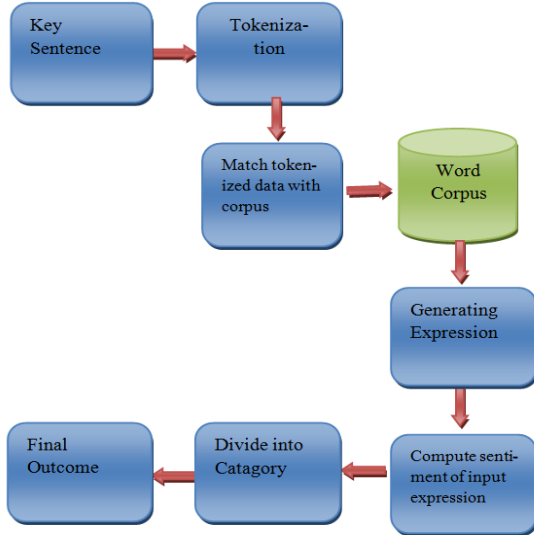

Fig. 1. Emotion detection methodology

Figure 1 shows the block diagram of our emotion detection methodology.

How emotions are divided according to the sentiment are shown in Table II.

TABLE II
EMOTION CATEGORY BASED ON SENTIMENT

হ্যাঁ-বোধক	না-বোধক	নিরপেক্ষ
সুখ	রাগ	
আনন্দ	দুঃখ	
অবাক	ভয়	
	বিরক্তি	
	অবাক	

B. Challenges

Some sentences like-

আজ মায়ের সাথে অনেক ভালো সময় কেটেছে।

Here the word "valo" indicate the positivity of that sentences. In other case, some sentences like

তার জাতীয় দলে জায়গা হয়েছে।

Here, the sentence has a positive meaning, though this sentence does not contain such kind of positive keyword.

As we are working with generated expressions from sentences, so it is possible to have a huge number of expressions. Same expression with different sentiment also be the general case.

C. Generating expressions

Lexicons have divided into four categories stored in word corpus; Positive, negative, negation and socially castoff. Table III shows the type of the lexicons.

In order to generating expression from every sentence we have denoted four kinds of words with individual symbol. Table IV shows the symbols for each category.

TABLE IV
TYPES OF LEXICONS

হ্যাঁ বোধক	P
না বোধক	N
না বাচক	B
সামাজিক ভাবে না	S

and if do then how frequently they do it. In this experimental study after generating an input expression we have taken the last three characters to see how they behave. Generated any expression will be within four character combinations P, N, B and S. Expressions generated from sentences are stored in the database to train our machine. We have selected each sentence and the expressions on the basis of two criteria.

Firstly: Sentence with positive and negative sentiment must have positive or negative emotional key words.
Secondly: Expression generated from every sentence must be unique.

After generating expressions from 301 sentences, we have selected the unique expressions. In case of two sentences having same expression, we have taken one. Consider the following pair of sentences having same expression showed in the Figure 2 below and Table V shows expressions with sentiment are stored in database.

Lexicons are stored in the database as unique hash values. Whenever an input sentence is introduces, firstly the program will generate hash value for each words of that sentence using hash algorithm.

```
long  hash_base = 31;

long hash = 0;

    for (int k = 0; k < str.Length; ++k)

{

hash = (hash * hash_base) + te[k];

    }
```

Then it will match the hash values of the sentence with the stored hash values in the database and will generate an expression. For example..

তোমার বিগড়ানো ছেলেটাকে ভালো করার সাধ্য আমার নাই।

N   P   P   B

Generated sentence will be .....

বিগড়ানো ভালো সাধ্য নাই = N P P B

Fig. 2. Same Expression pair

D. A Backtracking Approach For Sentiment Analysis

To find the sentiment we have checked a generated expression from the back. To see, do people generally express their emotion or sentiment in the last of the sentences or not

TABLE V
PREDEFINED PATTERN

NPPB	Negative
NNB	Negative
BN	Negative
PB	Positive
PNP	Positive
NP	Positive
.....	.....
.....	.....

In the case of analyzing how frequently people express their emotion in the last part of a sentence, only last three characters are considered. Suppose we have an expression PBNPN. For
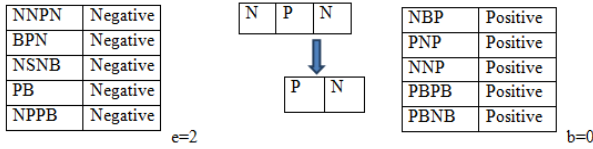
P B N P N ⟶ N P N

finding the sentiment of this expression we will check the last

three character of our test expression, position from (length -1) to (length-3). After taking the character of (length -1)th position into our consideration, we will check how frequently it has occurred in the same position of the stored expressions for being an expression positive and negative and will store the values into two variable c and f.

NNPN	Negative
BPN	Negative
NSNB	Negative
PB	Negative
NPPB	Negative

f=2

N	P	N

N

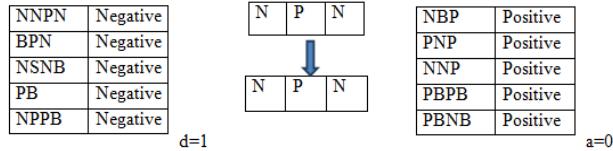| NBP	Positive
PNP	Positive
NNP	Positive
PBPB	Positive
PBNB	Positive

c=0
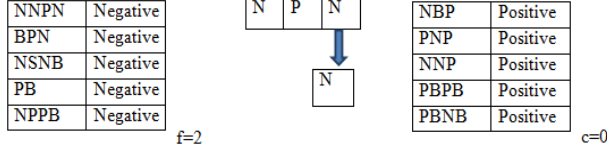
Having N twice in the last position, so f=2. And having no N in the last position, so c=0

Then we will go for the position (length -2) and (length -1). And again will check how frequently this pair of character occurred for the positivity and negativity of a sentence. Then store the record into another two variable b and e respectively.

NNPN	Negative
BPN	Negative
NSNB	Negative
PB	Negative
NPPB	Negative

e=2

N	P	N

P	N

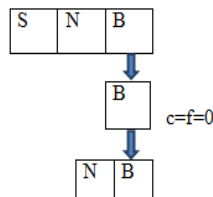| NBP	Positive
PNP	Positive
NNP	Positive
PBPB	Positive
PBNB	Positive

b=0

Having PN twice in the last part of the expressions, so e=2. And having no PN in the last part of the expressions, so b=0

Then finally will take last three characters as a string and will match with the unique expressions stored in the database. And keep the new values into a and d.

NNPN	Negative
BPN	Negative
NSNB	Negative
PB	Negative
NPPB	Negative

d=1

N	P	N

N	P	N

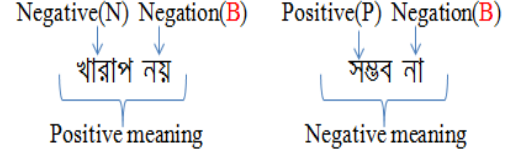| NBP	Positive
PNP	Positive
NNP	Positive
PBPB	Positive
PBNB	Positive

a=0

Having NPN once in the last position, so d=1. And having no NPN in the last position, so a=0.

In case of character B in the (length -1)th position, before calculating the value of c , it will check for the predecessor of it. If it find N or S or P as predecessor then program will direct go for the value of b and e, making c=f=0

S	N	B

B

c=f=0

N	B

Because if the last character is B then we need to check, what is the predecessor of B. Because negations denoted by B can change the mood of other words. See the following example. The expression NB holds a positive meaning where

Negative(N) Negation(B) Positive(P) Negation(B)
খারাপ নয় সম্ভব না
Positive meaning Negative meaning

the expression PB holds a negative meaning.

After calculating the value of all variable a, b, c, d, e, f and $total_P$ and $total_N$ the positivity and negativity will be calculated.

Formula for finding the positivity and negativity of a generated expression from a sentence is given below respectively.

$$P = \sum_{i=1}^{n} \frac{var}{Total_P} base^{\Sigma Position} \dots\dots\dots\dots (i)$$

$$N = \sum_{i=1}^{n} \frac{var}{Total_N} base^{\Sigma Position} \dots\dots\dots\dots (ii)$$

Here, var indicating the variables used to calculate the sentiment of each sentence. As we are dealing with last three character of a generated expression, we used three variables to store the records. Three variables for finding the positivity of an expression and three for negativity. Considering variable a,b,c for positive sentiment and d,e,f for negative sentiment.

$total_N$ and $total_P$ indicating number of negative and positive expression stored in our database.

n indicating number of the variable for finding positivity and negativity of a sentence. For both equation the value of n is 3.

base is 4, as we have categorized the words into four category. So generated any expression will be within 4 character.

Position means the positions of last three character from right to left. It generally counted as 0,1,2. But in case of getting smaller value we have considered 0,-1,-2.

E. Algorithm

1. Take last three character of the input expression
$test[string] \leftarrow last\ three\ char$
if $all\ char\ of\ test[string] = P$ **then**
    expression is positive
else if $all\ char\ of\ test[string] = N$ **then**
    expression is negative
else if $all\ char\ of\ test[string] = B$ **then**
    expression is negative
else if $all\ char\ of\ test[string] = S$ **then**
    expression is negative
end if
2. Take three variable a,b,c for calculating positivity
if $(length - 1)char = B$ **then**

if $(length - 2)char = N \text{ or } P \text{ or } S$ **then**
  $c \leftarrow 0$
  Check last two character and calculate b
  Check whole test string and calculate a
end if
if $(length - 1)char = N \text{ or } P$ **then**
  if $(length - 2)char = S$ **then**
    $c \leftarrow 0$
    Check last two character and calculate b
    Check whole test string and calculate a
  else
    Check last character and calculate c
    Check last two character and calculate b
    Check whole test string and calculate a
  end if
else
  Check last character and calculate c
  Check last two character and calculate b
  Check whole test string and calculate a
end if
3. Take three variable d,e,f for calculating negativity
4. Repeat 2 no instructions for finding the value of d,e,f
5. Calculate P and N

$$P = [(\frac{a}{total_P}4^{-3}) + (\frac{b}{total_P}4^{-1}) + (\frac{c}{total_P}4^0)]$$

$$N = [(\frac{d}{total_N}4^{-3}) + (\frac{e}{total_N}4^{-1}) + (\frac{f}{total_N}4^0)]$$

6. Compare P and N
7. Show Result.

After finding the sentiment of an input sentence then the emotional state of that sentence will be classified.

VI. RESULT

After this experimental study, by using a backtracking technique in a form of lexicon based approach on 301 collected sentences from different data sources, we have successfully come up with the conclusion of our hypothesis with 77.16 percent accuracy. A sentence may have a sentiment, or it may be neutral. If a sentence has sentiment then we can find the emotion (either happiness or sadness) associated with it. Therefore the entire accuracy refers that most of the time people used to express their emotion at the end of a sentence while speaking or in writing.

VII. CONCLUSION

Extensive works have already done to detect emotion from English text but detecting emotion from Bengali text still needs a lot of attention. Sentiment-based emotion detection is not that easy. While doing our survey we have seen that people disagree on identifying exact sentiment of the same sentence. We have faced some difficulties about the sentimental analysis of some sentences with controversial output. Then we did a survey which includes a questionnaire having ten complicated controversial Bengali sentences. Our main purpose was to know about the positivity or negativity

of those sentences from different people. Finally, with the hypothesis of expressing emotion in the last part of a sentence, we have introduced our backtracking approach and come up with a satisfactory result. As we have primarily worked on three hundred and one sentences, so our lexicon corpus only included three hundred and fifty one lexicons, that is not a big corpus to get a good result. In this study, we only focused on two types of emotions. To get the more accurate result of proposed hypothesis other emotions with strong lexicon corpus needed to be considered. A stemmer will make the tokenization more easy in sentence level can be added in a future study.

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