Textual Lyrics Based Emotion Analysis of Bengali Songs

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***Abstract*—The type of song or music a person is listening to, usually represents his state of mind. We find many online music libraries/ repositories and music streaming and media services providers play or store songs or music based on the human emotions. This makes the emotion or mood detection of songs a very interesting study which has got the above mentioned areas of application along with many others. In this paper, we have proposed methods to identify the connotation of any song based on the textual lyrics only. The methods used are the very basic language independent features which show competent performance with F1-score of more than 81%.**

***Index Terms*—Bengali, low-resourced language, emotion analysis, mood analysis, sentiment sentiment, tf, tf-idf, CNN**

I. Introduction

Sentiment is an idea, view or thought based on a feeling about a situation or a way of thinking about something. Sentiment analysis is the field of study concerned on analyzing sentiments (opinions) expressed by humans which is making progress since early 90's. That is the process of systematic extraction of sentiments, from a source material which is written using a natural language [1]. Also new communication platforms and practices such as online forum discussions, social media (Facebook, Twitter, etc.) and blogs has been emerged and the Internet has now become an enormous source of opinions. Social networks and the Internet have increased our communication capabilities to the point that everyone with a connected device can be read or heard worldwide.

Bengali is a language which can boast of its literary and cultural richness. Songs, dance, music, poetry, literature is a part of Bengali lifestyle. The amount of work in this language is huge, and so the amount of work to be digitized has still a long way to go. The span of Bengali language is over two countries – India and Bangladesh. With the rapid growth of Bengali song industry, enormous number of lyrics has been written by lyricists to produce song. Availability of song production tools and song sharing social networks such as YouTube, Vimeo, Amazon Prime Videos etc., are the main reason of great number of Bengali song production. Many people from different stages of society are involved in this industry. Lyricists, producers, singers and artists are involved with this entertainment industry. Apart from rhythm, tune, fusion, singer or genre; lyrics is the most vital element of songs, as it has direct impact on the listeners' choice and emotion. Hence, in this paper we have tried to analyze whether the songs can be classified as a positive emotion or a negative emotion song, that too using some simple and basic features.

Songs and music have got the capability of inducing strong emotions among the listeners. When a person listens to a song, usually it is something which reflects his own state of mind. Not only that people usually the psychologists are researching and also using techniques using sound waves, music, songs to heal minds. They do affect human actions and feelings [2]. Hence the need for detecting the emotion and automatically classifying songs by their emotions arises.

The sentiment or emotion of any song can be of several types - positive, negative, happy, sad, ironic, sarcastic, patriotic, angry, and so many others. Polarity of words or phrases are concerned for deciding the sentiment of a piece of text. Polarity of a word is usually represented as a qualitative factor (positive or negative). Further that can be represented as quantitative by using a score. A list of words with assigned polarities is called a sentiment lexicon. Sentiment lexicon which is also known as subjective lexicon, is the primary resource that is needed for performing a lexicon-based sentiment classification [3]. . This paper presents a sentiment analysis framework implemented for Bengali songs, analysis is done at document level, meaning that a sentiment is generated per song. For classification of song various machine learning algorithms are being used. These include supervised learning approaches like Naive Bayes, K Nearest Neighbour, Support Vector Machine (SVM), Decision Tree, Random Forest, Lo-

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gistic Regression and Convolutional Neural Network with the default parameters as provided by Scikit-learn.

For the purpose of supervised classification, a new annotated corpus of 1500 Bengali songs was created. The dataset which was proposed by Hossain et al. [5] is publicly available. And from this we have generated sentiment annotated corpus for this language. Each song is given label of *positive* and *negative*, thus allowing document level sentiment classification. Approx. 2.2M tokens were used to develop the word embedding models. This experiment is designed to extract sentiment based on emotions that exist in Bengali songs. It detects the sentiments that refers to the specific emotion using Natural Language Processing techniques. Sentiment lexicon is a primary resource required to perform a lexicon-based sentiment analysis in any language. So, we have constructed a sentiment lexicon for Bengali Language. To classify sentiment, our experiment consists of three main steps, which are subjectively classification, semantic association and polarity classification.

Section II discusses previous works related sentiment analysis in general, sentiment analysis in songs and Bengali language processing, Section III introduces the methodology used, Section IV gives the details of the dataset used, preprocessing and data annotation. Section V presents the feature identification, selection and extraction methods and Section VI presents the results and discussions of the experiments conducted. Finally, we conclude the paper with a look into the future in Section VII.

II. Related Works

A lot of work has already been done in the field of Sentiment analysis by using machine learning methods. In general, Sentiment analysis refers to the problem of categorization of sentiment polarity [6]. Given a piece of written text, the problem is to categorize the text into one specific sentiment polarity, positive or negative (or neutral). Based on the scope of the text, there are three levels of sentiment polarity categorization, namely the document level, the sentence level, and the entity and aspect level [7]. Cambria [31] studied in his paper how besides being important for the advancement of AI, emotion processing is also important for the closely related task of polarity detection, which has led to the emerging fields of affective computing and sentiment analysis, which leverage human-computer interaction, information retrieval, and multimodal signal processing for distilling people's sentiments from the ever-growing amount of online social data. Cambria et. al. [32] explored the potential of a novel semi-supervised learning model based on the combined use of random projection scaling as part of a vector space model, and support vector machines to perform reasoning on a knowledge base, which they propose will help in the development of future semi-supervised learning approaches to big social data analytics.

The main problems that exist in the current techniques are: inability to perform well in different domains [9], inadequate accuracy and performance in sentiment analysis based on insufficient labeled data, incapability to deal with complex sentences that require more than sentiment words and simple analyzing.

As mentioned above, emotion classification problem belongs to sentiment analysis. This problem has been addressed using a high variety of techniques. Survey works like [10] and [11] categorize those techniques as machine learning, lexicon-based or hybrid. They exercised Naive Bayes, Maximum Entropy and Support Vector Machine algorithms on movie reviews they had collected and prepared. Since that time, researchers have extensively explored all kinds of supervised learning algorithms like Bayesian networks or k-nearest neighbors, linear classifiers like logistic regression, decision trees, random forests, rule-based classifiers or even the most recent deep neural networks. . For example, authors of [12] implemented a hybrid approach by first dividing each document into sentences which are classified as positive or negative using keyword lists of each category. Labeled sentences are then used as data for training traditional supervised algorithms and making the overall prediction.

The higher weight indicates that the feature is a strong indicator for the specified class. The Importance of the feature in classification is decided through weight vectors. Feature is strong pointer if the weight is higher.

Jeonghee Yi et al., [14] proposed a Sentiment Analyser to extract opinions about a subject from online data documents which utilized the sentiment lexicon and sentiment pattern database for extraction and association purposes. Ahmed Abbasi et al., [15] in their work proposed a novel sentiment analysis methods to classify web forum opinions in multiple languages. The proposed sentiment analysis method utilized the function of stylistic and syntactic features to evaluate the sentiment in English and Arabic content using the Entropy weighted Genetic Algorithm.Several such experiments were done using machine learning algorithms in the works of [16] and in [17] where tfidf was used as a feature to cluster and to build the model.

Emotion or sentiment analysis of songs is a topic which is not that explored for low resource languages as such. Though a not so new field of research, most of the works have been done for the highly resourced languages only. Chen and Tang [24] proposed a method based on computational analysis of the lingual part of song lyrics. They constructed a composite emotion point matrix for each song which can then be used to further classify songs based on its inherent emotion and make recommendation accordingly through extracting and combining the term frequency and inverse document frequency (tf-idf) from song lyrics.

Though in sentiment analysis there are indeed some work done in Bengali. However, to our knowledge, some works addressed automatic sentiment or emotion detection from Bengali text proposed the Tracking of emotions based on topic or event by employing sense based affect scoring techniques for Bengali [18]. The system identifies the emotions consisting of four inter-connected modules including word, phrase, sentence, and document and detect the opinion from Bengali

text based on news corpus using support vector machine. Also the work by Phani et. al., [23] who used simple and robust methodologies and implemented them over the SAIL data set and got a well performing model, still regarding song or music classification not much work has been done yet.

Regarding the emotion analysis of songs in low resourced Indic languages, many works have been done over mood analysis of Hindi songs. The number of studies increased after the advent of UTF-8 unicode encoding came to the rescue of handling these Indic language texts. Patra et. al. in their paper [25] analyzed the lyrics of Hindi-language based songs, in order to detect the mood of the listener. They used unigram and term-frequency as the main features and topic-modeling (Latent Dirichlet Allocation model)was used for mining the mood out of every song in the corpus. They observed good results when the model generated was tested against a pre-annotated data set.

Patra et. al. in their papers [23], [24] proposed methods which are needed to classify music by moods even from the uploaded music files in social networks, achieving a maximum F_measure of 68%. Their experiments showed that artist, sentiment words, putting more weight for words in chorus and title parts are effective for mood classification. Graph-based method promises a good improvement if we have rich relationship information among songs.integrate audio information with lyric for further improvement.

III. Sentiment Analysis of Bengali Songs

Retrieval and recommendations of song are based on title, genre, artist or other metadata, as well as on emotion, an important attribute of song. These advances promoted research in areas like Song Information Retrieval or Song Emotion Recognition.

Song sentiment classification has been investigated since 1990s in audio signal processing community and research works are mostly found relying on audio signal to make a decision using machine learning algorithms [13]. The sentiment analysis problem faces certain challenges for Bengali as the Bengali is a low-resourced language, though currently many works are being undergoing to digitize the resources which speak of the rich literature and culture of Bengal and Bengalies.

A. Bengali Text Processing

Bengali (or Bangla, as it is commonly called by the natives), one of the more important Indo-Iranian languages, is the sixth-most popular in the world and spoken by a population that now exceeds 250 million. It is the primary language in Bangladesh and second language in India [18]. Lots of research on sentiment analysis has been done on different languages such as English [19], Chinese [20], etc. But in contrary, sentiment analysis is still an unsolved research problem in Bengali and such kind of research work is very rare due to lack of resource and the complexity of Bengali language.

Natural language processing in Bengali faces certain challenges. The first one being the language being order–free language i.e., it has a very flexible structure for constructing a sentence. The second being the usage of compound characters and detection of them. Moreover, there is a lack of standard keyboard and the huge vocabulary and the inflections make the text processing based studies harder.

In this experiment, we present a scheme to determine the sentiment of Bengali song. The methodology is based on positive, Negative or Neutral sentiment of words of a Bengali sentence. We are interested in identifying positive or Negative e.g. Happy or Sad respectively sentiment from a Bengali song.

TABLE I
Data set details

Author Name	No. of Songs	No. of Words
Rabindranath Tagore	856	52784
Kazi Nazrul Islam	620	43246
Gazi Mazharul Anwar	82	7282
Pulak Bandyopadhyay	66	5955
Gauri Prasanna Majumder	62	5080
Lalon Shah	38	3108
Latiful Islam Shibli	30	3052
Shibdas Bandyopadhyay	24	1773
Kabir Bakul	22	2483
Mohammad Rafiquzzaman	22	1559

IV. Dataset

Since in Bengali computing or Bengali language processing the key challenge is lack of a standard annotated dataset to train. For our experiment we took the help of the dataset "BanglaMusicStylo" [5]. This data set consisted of songs of various singers, belonging to various genres. The details of the dataset are given in Table I.

In this dataset [5] the authors have collected 211 lyricist's song. Among them more than 10 songs are collected of 38 lyricists. In which different authors song lyrics are kept in separate folders. Different songs of same author are kept in the same folder. Different song lyrics are stored in 'Siyam Rupali' Bengali font in text Microsoft .docx file format. Each file contains lyrics in text format, written in 'Siyam Rupali' Bengali font. In this dataset, the songs are present from different genres of Bangladeshi music like religious song, ethnic song and The said dataset is a repository of lyrics stored in Microsoft .docx format.

To study the emotion of any song, we needed the songs to be annotated as "positive" or "negative". There were several lyricists whose work could not be simply classified into just positive and negative emotion songs, like the *jeebanmukhi/jeevan mukhi gaan* (daily life oriented, contemporary, modern songs). The emotion these songs displayed were sometimes ironical or sarcastic sometimes. That's why instead of considering all the works of all the lyricist, we only considered Rabindranath Tagore songs only, whose contribution in the dataset was quite a big number in itself. An annotated dataset was created based on Rabindranath Tagore's songs, manually.

A. Data Annotation

The songs were classified as showing positive or negative emotions (data annotation), manually. The 684 songs of "Ra-

bindranath Tagore" were annotated using 2 labels *positive* and *negative* based on the following criteria[1]):

- **Positive:** If the song in it's entirety has happy or positive or excited or joyful feeling, or if something is mentioned with positive vibes. If more than one sentiment is depicted by a song then if the dominant connotation is positive then it is labeled as a positive song.
- **Negative:** If the song in it's entirety has sad or negative or displeased feeling, or if something is mentioned with negative vibes. If more than one sentiment is depicted by a song then if the dominant connotation is negative then it is labeled as a negative song.

The details of the created dataset[2] is given as in Table II.

TABLE II
DETAILS OF THE OUR DATASET.

parameters	Dataset		
	Positive	**Negative**	**Total**
# songs	343	341	684
# words	17617	18097	35714
# unique words	9753	9836	9854
# avg. words	51.361	53.07	52.213
# characters	114362	116298	230660
# avg. characters	333.566	341.049	337.222

V. FEATURE IDENTIFICATION, SELECTION, AND EXTRACTION

We extracted the song lyrics from the .docx format to the unicode text files. These unicode files were cleaned by removing the punctuation and special characters if any were there. This cleaned dataset was used to extract the features. Since language resources are not currently available for Bengali, we resorted to some of the commonly used language independent basic feature representations. These are including Bag-of-Words, tf-idf, tf and Word2Vec. These features were extracted for the feature categories unigrams (extracted from the dataset) and a list of stopwords.

- Bag of Words: The bag-of-words model is a simplifying representation used in natural language processing and information retrieval (IR). In this model, a text (such as a sentence or a document) is represented as the bag (multiset) of its words, disregarding grammar and even word order but keeping multiplicity.
- TF: Term frequency is the number of times a given term or query appears within a search index. Term frequency is a key component for determining the relevance of a given document for a particular query, and is an essential piece of the widely used TF-IDF relevancy algorithm.
- TF-IDF: Term frequency-inverse document frequency is a statistical measure that evaluates how relevant a word is to a document in a collection of documents. This is done by multiplying two metrics: how many times a word appears in a document, and the inverse document frequency of the word across a set of documents. It has many uses, most importantly in automated text analysis, and is very useful for scoring words in machine learning algorithms for Natural Language Processing (NLP).
- Word embeddings (Word2Vec): Word2vec is a group of related models that are used to produce word embeddings. These models are shallow, two-layer neural networks that are trained to reconstruct linguistic contexts of words. Word2vec takes as its input a large corpus of text and produces a vector space, typically of several hundred dimensions, with each unique word in the corpus being assigned a corresponding vector in the space.

We have extracted the features for 1000 most frequent unigrams (without stopwords) and also only for 398 stopwords[3]. These selected features from the feature extraction phase were fed to a supervised learning classifier. For Model building, we experimented with multiple supervised classification algorithms. These includes traditional statistical classifiers Naive Bayes (NB),Logistic Regression (LR), K Nearest Neighbors(KNN), Decision Tree (DT), Random Forest (RF) and Support Vector Machine (SVM). Each of these classifiers were used with their default parameter settings as provided by Scikit-Learn [22].

To improve the performance of the system we have also used the deep learning technique – Convolutional Neural Networks (Continuous Bag Of Words) model [23] as shown in Table V.

In CNN for any text classification word embeddings are used for representing words and a Convolutional Neural Network is used for learning how to discriminate documents on classification problems on the basis of their underlying sentiment. The architecture of the CNN model comprises of three steps:

- Word Embedding Model: A distributed representation of words where different words that have a similar meaning (based on their usage) also have a similar representation.
- Convolutional Model: A feature extraction model that learns to extract salient features from documents represented using a word embedding.
- Fully-Connected Model: The interpretation of extracted features in terms of a predictive output. This type of model can be defined in the Keras Python deep learning library.

VI. RESULTS

The performance of any emotion/sentiment system is evaluated by several metrics including precision, recall, F–score (F1 score or F–measure), accuracy to justify the acceptance of the system under considerations. Final output of the sentiment classification system depends on each of these 3 parameters. Therefore, experiments were carried out to select the best for

[1]Some songs were not added as they didn't clearly fall into positive (happy) or negative (sad) sentiments, neither could they be distinguished as neutral.

[2]The dataset is available at – https://github.com/devjyotinath/Sentiment_analysis

[3]Available at https://github.com/stopwords-iso/stopwords-bn/blob/master/stopwords-bn.txt

each parameter. The train-test splitting for the experiment was done in 80:20 ratio.

Table V shows the performance of the classifiers for each of the feature representations in the feature categories. Table III shows the details of the performance of each of the classifiers for the word2vec as a feature. Table VI shows the feature+classifier combinations which showed best results in the feature categories. It may be seen that the best results were obtained with the Linear kernel SVM classifier with tf-idf, then followed by the Random Forest classifier (Gini importance) with tf. To check whether there is any overfitting of the data for our best working models we have done 10-fold cross validation. The cross validation results as give in Table IV show that the results very well support the performance of the model with basic classifiers like SVM with linear kernel and also the Random Forest. We also did 10-fold cross validation to check if there was any overfitting or not. The cross validation results showed that the cross validation results agreed with the accuracy values we have got, indicating absence of overfitting of our dataset.

Next we tested our data with a deep learning algorithm. When this data was fed to the CNN using CBOW the results improved substantially. The tokens were generated for the CNN algorithm over the cleaned positive and negative datasets separately. We have used dropout(0.2) for CNN to avoid any overfitting.

TABLE III
CLASSIFIER PERFORMANCE OF WORD2VEC FOR WORD UNIGRAMS.

Algorithm	Accuracy	Precision	Recall	F1-Score
Logistic Regression	0.57	0.59	0.58	0.55
SVM	0.53	0.53	0.53	0.50
Random Forest	0.62	0.66	0.62	0.60
Naïve Bayes	0.60	0.68	0.61	0.58
LSVM	0.56	0.56	0.56	0.55
LSVM(rbf)	0.53	0.53	0.53	0.50
PSVM	0.54	0.64	0.55	0.44
KNN	0.56	0.57	0.56	0.56
Decision Tree	0.58	0.59	0.58	0.55

TABLE IV
10-FOLD CROSSVALIDATION RESULTS FOR THE BEST MODELS.

Algorithm	Accuracy	Precision	Recall	F1-Score
Logistic Regression	0.57	0.59	0.58	0.55
SVM	0.53	0.53	0.53	0.50
Random Forest	0.62	0.66	0.62	0.60
Naïve Bayes	0.60	0.68	0.61	0.58
LSVM	0.56	0.56	0.56	0.55
LSVM(rbf)	0.53	0.53	0.53	0.50
PSVM	0.54	0.64	0.55	0.44
KNN	0.56	0.57	0.56	0.56
Decision Tree	0.58	0.59	0.58	0.55

It may be noted from the Table VI that mostly word unigram feature category shows better performance than the stopwords with the feature representations – tf, tf-idf, and word embeddings (word2vec model). The best performing method was the CNN which has been proved to be a good tool for natural language processing. Most of our best performing models were better than the models for the similar type of language - Hindi [23]–[25]. Even our system was able to capture the underlying sad emotion of the songs – "Anirban" and "Briddhashram" (old age home) by Nachiketa Chakraborty [30]. The specialty of his songs lie in that they come under the *jeevan mukhi* songs in Bengali and have got irony or sarcasm as the undertone. Figure 1 shows an example of the output generated by our models (Linear SVM and CNN).

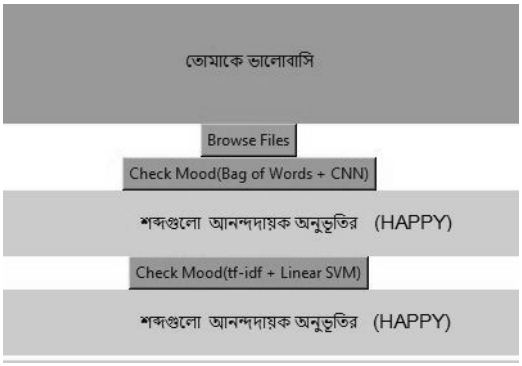

Fig. 1. Screen shot of the application based upon our system.

VII. CONCLUSION

In this paper, we have tried to analyze if connotations of songs can be identified only based on the lyrics or not. We have proposed methods to classify the Bengali songs into two classes - positive emotions and negative emotions. For now we have used an annotated dataset of 684 songs by Rabindranath only for our work. On analyzing we find that amongst all the classifiers CNN with Bag-of-words gives the best accuracy value of more than 81% followed by the model Linear Kernel SVM classifier + tf-idf for unigrams (>73%), which for Bengali songs lyrics only, is quite a good value using simple and basic features. Moreover, since all the Bengali songs can't be categorized simply as demonstrating either positive or negative or even neutral emotion/sentiment, specially for the contemporary songs, we can say that our system did performed fairly well. We plan to incorporate other emotions such as irony and sarcasm, which are so typical of Bengali songs specially the contemporary songs called *jeebanmukhi gaan* (life oriented songs). We also plan to work with a bigger dataset and with other low-resourced languages as well, in future.

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TABLE V
ACCURACY VALUES (%) OF THE CLASSIFIERS USED FOR THE FEATURES USED.

Features	NB	SVM	LSVM	LSVM (rbf)	PSVM	KNN	LR	DT	RF
Unigrams + Tf	50.34	55.12	57.0	55.23	54.34	53.24	55.0	60.98	62.12
Unigrams + Tf-idf	60.35	50.230	73.34	53.23	53.25	53.25	58.34	53.28	67.12
Unigrams + Word2Vec	60.56	53.52	56.75	53.76	54.95	56.34	57.45	57.34	62.56
SW + Tf	47.29	63.97	63.56	53.45	59.42	49.34	50.56	51.34	68.56
SW + Tf-idf	47.8	63.7	57.9	53.6	54.6	60.4	54.3	55.8	65.2
SW + Word2Vec	54.34	56.67	56.45	56.45	56.21	57.87	58.45	58.34	59.21

TABLE VI
BEST RESULTS FOR EACH OF THE FEATURES AND THE ALGORITHMS USED.

Algorithm	Accuracy (%)	Precision	Recall	F1-Score
Unigrams + CNN (CBOW)	80.53	82.03	77.45	78.49
Unigrams + Linear SVM + tf-idf	73.34	75.45	73.31	73.56
Unigram + Random Forest + tf	67.12	69.23	66.23	64.06
SW + Random Forest + Tf-idf	65.2	67.22	64.96	64.98
Unigrams + Naive Bayes + Word2Vec	60.56	68.34	61.76	58.12

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