Product Review Analysis Using Deep Learning Approaches

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***Abstract*—In today's commercial market, product reviews play an important role in online shopping. Most people verify product reviews before buying them online. Reviews can be positive or negative for any product. Positive product reviews attract customers more than negative product reviews. Reviews bring benefits and losses to any business. Customers share their product reviews on social media after purchasing the product. Product reviews are usually presented through e-commerce websites like Amazon, Flipkart, and other applications. Sentiment analysis is a rapidly thriving space in research in the space of natural language processing (NLP). It has gained a lot of attention in recent years. The data used in this study is a review of online products collected from the Amazon website we created. With the rapid increase of internet users, there is a huge number of Bangla Content generation. Though there are novel efforts in researches of resource-rich languages like English, Chinese, etc. Less work had been done yet for the Bangla language in this regard. In our proposed system, several deep learning approaches are used. With the deep learning approach, a good accuracy of 91.49% has been achieved with the CNN approach in the case of sentiment analysis and an accuracy of 91.01% has been achieved with the convolutional neural network with LSTM. Using the Bidirectional LSTM approach a fair accuracy of 92.13% has been achieved.**

Keywords—Sentiment Analysis, Deep Learning, Review Document, NLP task, Bangla NLP

I. INTRODUCTION

E-commerce is growing at an unprecedented rate all over the globe. With its growth, the impact of online reviews is increasing day by day. Reviews can influence people's purchasing decisions. Customers post their opinion about a product they purchase which may be positive or negative. Therefore, An NLP task of our proposed system identifies the expression of the review based on the opinions type to be considered. This is the process of deducing opinions is known as sentiment analysis. There are five basic needs for our livelihood, but nowadays shopping plays an necessary role in our daily life. For daily needs every day we purchase various things. In the era of innovation, we very much rely on technology. Before purchasing anything we prefer to check reviews on the specific item because review helps consumers buy from a trustworthy platform. This pandemic COVID-19 people can't go out for manual purchase. So, in terms of the previous situation nowadays people much more depend on online shopping, any kind of grocery items, fast food, cloth, shoes, etc. are purchased from an online platform. Bangla is a kind of language which has so many variations. So, a large number of people give their opinion on social media and any other site by using this language. But there is less research work done in the Bangla language. The Sentiment is a way by which opinions, emotions are expressed. Sentiment analysis is a broad part of data mining that is implemented with text mining. Sentimental analysis is an elaborate field of opinion mining that deals with people's opinions, sentiments, attitudes such as products, services issues and even their features. Product reviews express the people perceptions of the product either it is positive or negative. Product review helps the customer to buy a product on the basis of recommendation can be prepared by sentiment analysis. But problems arise when people give negative reviews about products which makes a hassle for customers. Sentiment analysis can be accomplished with the help of Natural language processing and Deep learning. Fake reviews also detect a major part of sentiment analysis. The area of study dealing with such sorts of topics is known as "NLP (Natural Language Processing)". In our proposed work, we will utilize a number of deep learning techniques on the data of product review for review analysis. In our research, we will work with our native language (Bangla) with natural language processing techniques.

II. RELATED WORK

A. Related work in the field of sentiment analysis

Sentiment analysis is a process that finds opinions, emotions from texts, tweets ,and other sources of natural languages [2]. All the opinion/emotion is captured using natural language processing [1]. In a real sense, sentiment analysis indicates that the summing up of underlying effective information exploring through the millions and millions of documents like reviews, opinions, news, interviews, and so on. Manually excavating this huge document and identifying the published opinions by arranging the data system can be both tedious and labor-intensive. With a view to solving this problem, diving through one of the most important branches of NLP i.e sentiment analysis is conspicuous. This territory is a large-scale problem domain. The fundamental challenging task in this field is to understand the complex semantic structure of languages and inspecting through vague statements in which positive words may point out negative meanings or vice versa. Previously works on sentiment analysis in Bangla included supervised and unsupervised techniques of machine

learning. But with the advancement of natural language processing approaches tremendous scrupulous results have been achieved by deep learning methods. Therefore, a deep learning-based technique will be deployed for our proposed methodology focusing on sentiment analysis in a product review in the Bangla language.

Experiencing an investigation of different writing studies, it tends to be presumed that much of the research work has been done in English not only the Bengali language. There is less research work done in the Bengali language. On the other hand, other groups of researchers focus on the behavior of reviewers rather than review content. There has been a lot of effort in NLP work like sentiment analysis. This section provides an overview of literature reviews.

From the literature survey being carried out, it is seen that researchers have given incredible consideration in this field of sentiment analysis on online product reviews. Researchers have done their research in this field for the English language but very few works have been performed for the Bangla language. For example, Peter D. Turney [1] utilized an Unsupervised learning algorithm for classifying reviews. He classifies the reviews as thumbs up or thumbs down by the average semantic orientation. The semantic orientation of a phrase is calculated as the mutual information between the given phrase and the word “excellent” minus the mutual information between the given phrase and the word “poor”.

Fang and Bi Chen [2] utilized two typical approaches to sentiment analysis -lexicon look-up and machine learning approaches such as SVM. Lexicon look-up begins with a lexicon of positive and negative words. Current sentiment lexicons do not capture such domain and context sensitivities of sentiment expressions.

Hu and Liu [4] summarized a list of positive words and a list of negative words based on customer reviews. The positive list contains 2006 words and the negative list has 4783 words. Both lists also include some misspelled words that are frequently present in social media content

Istiaq et al [17], proposed a hybrid approach to detect review spam (HDRS). At first, they detected duplicate reviews and then created hybrid dataset with the help of active learning. Lastly, they used a supervised approach to detect fake reviews.

Research from the University of Pittsburgh demonstrated that humans can only agree on whether a sentence has positive or negative sentiment, up to 80% of the time. Because of this any Natural Language Processing technique which scores up to 80% is working greatly with high accuracy [5] This mainly focuses on the feature extraction for sentiment analysis and also modifies the way in which the product sentiment analysis is done.

III. METHODOLOGY

The research subject is a term that traces out the systematic exploration by facts and analysis and worked with a fine outcome of a specific topic.it is dispensed with different methods and throughout the methods, new knowledge is identified to imply the proposed work. Sentiment analysis best on text classification can be performed by deep learning approach in term with CNN (Convolutional neural network), RNN (Recurrent neural network), BLSTM (Bidirectional Long Short Term Memory), HNN (Hybrid neural network) etc.

A. Data collection

Data plays an important role in data mining. Data mining refers to extract new knowledge by analyzing the data . There is no available dataset in the Bangla language in terms of a product review. So dataset were collected from Amazon platform. 15000 thousand Bangla product reviews were used as dataset which was collected from amazon platform and translated in Bangla. This dataset contains 7500 positive data and 7500 negative data which is balanced data.

B. Data Preprocessing

Data preprocessing is a technique of data mining that involved the process of making an understandable data format. Data preprocessing makes the dataset in a convenient form so that data can be processed easily. Few steps of preprocessing were accomplished who make the dataset in standard form

- Tokenization- Tokenization is a technique that splits the text into tokens. The task of segment a bunch of texts into words or linguistic tokens or segments is known as tokenization. Two kinds of tokenization one is word tokenization and another is sentence tokenization. Sentence tokenization is used for proposed methodology Sentence tokenization split the sentence into single words. Tokenization can be done with the NLTK library Or Keras library etc.

- Punctuation Removal- In the data preprocessing after segmentation of text, removal of delimiter is processed. Punctuation marks make a document in a readable format, those punctuation having no importance on text classification. A clean text document is easy to process and help to get a more authentic result. In punctuation removal (!"#$%&'()*+,-./:;<=>?@[\]^_`{|}~) are removed.

- Digit removal- Datasets are based on Bangla product review, these reviews contain some English Or Bangla numeric symbol which has no significant meaning in the text. This symbol can make an effect on data redundancy which can make an impact on the negative results, it has to be removed.

- Stop word removal- Stop words are a list of those words which are frequently used in a sentence. In-text mining often worked with removing stop words. In the Bangla language, there are so many stop words, 335 Stop words are listed down., and worked on it. By removing those stop word from the dataset clean text were processed for further processing

C. Implement with Deep Learning

Deep learning is a key technology behind driverless vehicles that enables them to detect a stop sign or separate a pedestrian from a lamppost. In deep learning model are CNN, BLSTM, A hybrid of CNN with BLSTM are implied with Dataset

CNN: In CNN it worked with 4 steps – Convolution Layer, Maxpooling1D, Flatten, and Fully connected.in NLP when applied with CNN 1-D vector is represented the texts. When conv Net is used in text classification it classifying the sentence in terms of text to sequence or pre-trained model. A sequence of words where each sequence is correlated with an embedding vector of dimension. A convolution filter or kernel will be applied in the convolution layer, embedding layers with different embedding nodes, optimizer, several regularizer ,different kind of activation function and metrics are used.

BLSTM: LSTM is a special type of recurrent neural network. In LSTM for text classification. LSTM is a kind of sequence to sequence learning. The addition of traditional LSTM is known as Bidirectional LSTM. In this kind of network, training is accomplished on two sides, where available timesteps of the input sequence are found. Bidirectional LSTM network which is special LSTM which is capable of train to LSTM at a time and remembered the information over a long time.

CNN with BLSTM: A hybrid model is a combination of CNN with BLSTM. was implied with as a model with dataset. After the convolutional layer, Bidirectional LSTM are used for this model. Various dropout layer regularizer were used for reducing the overfitting.

Confusion metrics: Confusion metrics are used to evaluate the classification model. Confusion metrics portrayed a view of true values and predicted values. ROC curve, precision recall andf1 score are calculated by python library.

IV. Experiment and Result

Sentiment analysis on the basis of text classification done with different deep learning algorithms. Text classification implemented with CNN, Special type of LSTM named Bi-LSTM, CNN with Bi-LSTM By using all these algorithms different types of results are obtained. Training and testing are some of the biggest parts of the implementation. Training refers to the part of the task by which a portion of the dataset is applied to the framework to learn the machine. In the text classification training portion classify the text and extract the features and gain the characteristics for the test. Testing tends to the part of that task by which a portion of the dataset is being tested. Among 15000 as 70% which is 10500 data which is used for training and 30% as 4500 data for testing 5- fold cross validation are also applied for optimal output. The obtained result for various kind of deep learning model in term of accuracy metrics, roc curve, confusion metrics, f1 score are elaborated below.

Model	Percentage split validation Approach	Cross Validation approach.	Confusion metrics	F1	ROC
CNN	91.49%	93.45%	4117 out of 4500	92%	0.91
BLSTM	92.13%	94.75%	4139 out of 4500	92%	0.92
CNN With BLSTM	91.01%	91.95%	4104 out of 4500	91%	0.91

It can be observed that BLSTM model achieve highest accuracy which is 92.13% .It can be said that BLSTM model performed very well.

A. Figures

a) Figures:

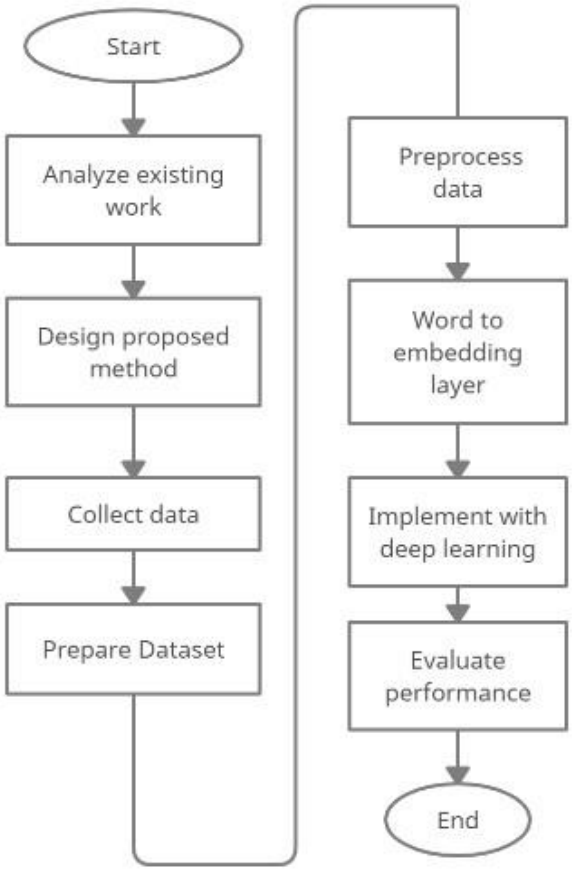

Fig 1 Architecture for proposed work

CONCLUSION AND FUTURE WORK

In the summary of the study, there is no doubt that there is a lot of research work in natural language processing, especially in the English language. Due to textual complexity, review analysis from the Bangla language is very hard. Extensive research has been done on social media to analyze the content of English texts, but less one has done this work with Bangla data yet. While the results of this type of work are revolutionizing change in our computing life, recently, such kind of research is being increased this time. With the blessings of such research work, get some outstanding real-life applications. However, it is very unfortunate that there is less research work on the Bengali language. But the hope for us is that many researchers from different countries have started researching in this field. In our research work, do some approaches to classify product reviews in the Bangla language. With the deep learning approach, a good accuracy of 91.49% has been achieved with the CNN approach in the case of sentiment analysis. Implementation of sentiment analysis yields an accuracy of 91.01% with the deep learning approach convolutional neural network with LSTM. In the case of sentiment analysis using the Bidirectional LSTM approach a fair accuracy of 92.13% has been achieved. The future scope of research work is Enlarging the dataset Making an approach that can detect fake reviews. Working with neural layer. Adding neutral polarity in sentiment analysis. And Implement with other deep learning methods including HAN.

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