

Deep Learning-Based Early Depression Detection Using Social Media

Tejas Vaidya, Rohan Yeole, Gitesh Paitwar, Aniket Watpade
Guide, Dr.Namita Kale.

B.E Student, Information Technology, MET Institute of Engineering, Nashik, Maharashtra, India

Abstract—Depression is a serious mental health issue for people world-wide irrelevant of their ages, genders and races. In this age of modern communication and technology, people feel more comfortable sharing their thoughts in social networking sites (SNS) almost every day. The objective of this paper is to propose a data-analytic based model to detect depression of any human being. In this proposed model data is collected from the users' posts of popular social media websites: twitter. Depression level of a user has been detected based on his posts in social media. The standard method of detecting depression of a person is a fully structured or a semi-structured interview method (SDI) [1]. These methods need a huge amount of data from the person. Microblogging sites such as twitter and Facebook have become so much popular places to express peoples' activity and thoughts. The data screening from tweets and posts shows the manifestation of depressive disorder symptoms of the user. In this research, machine learning is used to process the scrapped data collected from SNS users. Natural Language Processing (NLP), classified using Deep Learning and Naïve Bayes algorithm to detect depression potentially in a more convenient and efficient way.

Keywords—Depression, Mental Health, Social Network Sites(SNS), Data Analysis, Deep Learning(DL), Natural Language Processing (NLP).

I. INTRODUCTION

Social media platforms (such as Twitter, Facebook, LinkedIn, and Instagram) are one of the crucial means for communication and information dissemination over the internet. These fake identities can be created by bots or humans. The fake identities by bots generally target large group of peoples at a time. Also various pre-processing steps such as stop word removal, Porter's algorithm for stemming lexical analysis are applied on the data extracted through social media data. Deep learning methodology, according to which we can automatically build an automatic text classifier by learning, from a set of pre-classified text documents

based on the characteristics of the categories of interest. Predict depression ideation based on score or weight with class label. In many situations humans who are depressed are totally ignorant of their disturbed mental condition. They are unable to identify the cause of constant unhappiness in them and eventually such students fall into a state of mind where they start having suicidal tendencies. In some cases students do know that they are suffering from depression, but they are hesitant to seek any kind of help from anyone mainly due to the wrongly conceived notion of "humiliation" associated with depression. It is better to identify the signs of depression at initial stages of depression. Depression if identified in the initial stages, just a simple one hour talk with a counsellor may be of immense help for the student. Over the last years the rise of social media has changed completely the way of communication and they provide new means that connect in real time people all over the globe with information, news and events. Social media have changed completely the role of the users and have transformed them from simple passive information seekers and consumers to active producers.

II. LITERATURE SURVEY

Over the last few years, social media has been used to examine mental health by many researchers. Orabi et al.

[1]considered that social media platforms can reflect the users' personal life on many levels. They proposed adopting supervised machine learning approaches such as deep neural networks. Their primary objective was to detect depression using the most effective deep neural architecture from two of the most popular deep learning approaches in the field of natural language processing: Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs), given the limited amount (i.e. in comparison to most of the deep neural network architectures) of unstructured data. Choudhury et al.

[2] used crowdsourcing to collect assessments from several hundred Twitter users who are already diagnosed with clinical depression. Comparison of behavior between normal user and depressed user has been shown by them which indicates a lot of differences. They also proposed to build an MDD (Major Depressive Disorder) classifier to predict whether an individual is vulnerable to depression. The model had an accuracy of 70% and a precision of 0.74.

Different methods of classification algorithms are being used by many researchers to classify the user-generated contents (UGC) from SNS. Such as, Aldarwish and Ahmed [3] used Support Vector Machine, Naïve Bayes Classifier. They proposed a web application that can classify SNS user into one out of four depression levels.

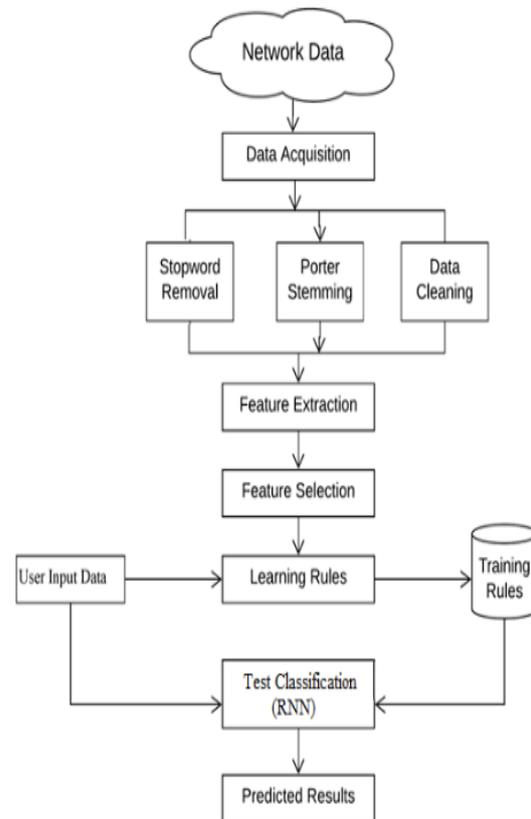
Another research done by Hassan et al. [4] presented machine learning techniques to analyze sentiment and made a comparison of three classifiers: SVM, Naïve Bayes (NB) and Maximum Entropy (ME) regarding the topic. They observed that SVM shows superior results than NB and ME.

Above researches have shown many important techniques to detect depression level but they had some limitations. Such as, there was no real life test to find out the effectiveness of the proposed models. In this proposed model, posts from both facebook and twitter are generated and a machine learning model is used to detect an individual's vulnerability to depression. To prove the accuracy of the model the received result has been compared with an online question based interview from the users. And another major difference is all the tweets were collected regardless of any keywords targeting specifically just one individual. That is why is model can detect depression of any individual more accurately. The models mentioned above used keywords to collect tweets and many of them did not use Facebook posts, for which those could not specifically detect an individual's depression level.

III. PROBLEM STATEMENT

The proposed model we are trying to Predict the what is the mental state of the user. To design and implement a system for depression detection using Deep learning with the help of posts of user on social media; various features have been extracted from users' input text data and predict the label of depression detection. Is He/she Depressed or not depressed to help the depressed person.

IV. SYTEM'S ARCHITECTURE



Proposed system Architecture

We here propose a system, which will take the data from social networking sites and will detect depression ideation eventually in the real time. The comments or public posts of the persons will be considered and these data will be further processed and hence the system will display the result as depressed or Not Depressed. Here we have used a dataset that contains comments with their respective label. The label of a particular comment indicates whether that comment is showing any risks or not. If the label is depressed then it means that the comment indicates that a person has some signs of being depressed and which could lead to risk eventually. On the other hand, if the label is Not Depressed that means that particular comment shows no sign of sadness or depression and hence reflects no risk of depression ideation. Now these comments are then passed through the preprocessing phase where the data are made ready for passing through either training or testing module. For training testing we consider 70-30% pattern for execution and 5 fold, 10 fold and 15 fold cross validation respectively. A natural language Processing has been applied to the training data for the feature extraction, which consists of the following phases:

Data Acquisition:

First of all the information for different social media accounts based on certain parameters is extracted from social network using API.

Pre-processing:

- Collection of text based on categories. Every text belongs to one category and has been corrected labeled.
- We divided this corpus into two sets: the training set and the testing set.
- Remove all the unnecessary elements in the text, such as lexical analysis, stop word, punctuation, or unreadable text.

Feature Extraction

- The appropriate set of features from the given document can be extracted such that it can improve the overall performance.
- In feature extraction, based on some counter measure the feature can be extracted.

Classification:

- After choosing proposed text classification algorithms deep learning and feed the training corpus to the classifier to get a training model.
- After we get the training model, we can feed the testing data into it and get the prediction of classification. The testing stage includes pre-processing of testing text and classification of the testing text.

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Execution Process

Step 1: We will extract data from our own web application which contains various comments as well as user reviews as well as we have some synthetic datasets.

Step 2: Apply NLP during the training, NLP consist below phases

- Tokenization
- Stop word removal
- Porter stemming
- Feature extraction
- Feature selection

Step 3: Once feature selection has done, each feature has stored on respective topic, at the time training phase execution has finished.

Step 4: we have used as base classifier for features extraction and generate the Background Knowledge (BK) of system as supervised learning. We used Recurrent Neural Network (RNN) for proposed new classifier on same.

Step 5: Similar NLP will be execute for testing and extract the features.

Step 6: Respective algorithm similarity mapping techniques has used to generate the weight and assign test label.

Step 7: evaluate the accuracy using confusion matrix evaluate the performance analysis of system (compare with weka if applicable)

Mathematical Model

Let S is the Whole System Consist of

$$S = \{I, P, D, O\}$$

I = Input data.

P = Process:

D = Dataset

Step1: User will enter the query.

Step2: After entering query the following operations will be performed.

Step3: Data Pre-processing.

Step4: Feature extraction and feature selection.

Step5: Training and Testing dataset.

Step6: Classification.

Step7: Final output optimized classifier and its performance indicator.

O= Output (Predicted class label)

VI. CONCLUSION

We are proposing system that describes feature extraction and feature selection approach using various techniques, basically the system proposed NLP approach for data pre-processing as well as data normalization. Select important features from entire data set all document it is much important for accurate classification. The system works with basic NLP features like tokenization, stop word removal and dependency parser respectively. Once the pre-processing has done system deals with feature extraction, in this phase we extract features as well as dependency rule base features including lemmas features. To select specific features from extracted vector according to aspect category, we will consider five aspect categories during the feature selection. In this phase we will also add some synonyms for respective tokens to achieve accuracy for build the train model. After completion of whole process we will apply prospective classifier to generate the rules and system training has completed. We assume that Social Network Sites (SNS) activities can reveal the mental illness at initial states. Using the traditional questioner techniques, the psychiatrist cannot get the complete information from the depressed patient. The Social Network Sites (SNS) based system can overcome the problems regarding self-reporting. From user 'as social activities, we may get closer to the natural behaviour of the depressed patient and his/her way of thinking, and better classify the mental levels.

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