Deep Learning-Based Early Depression Detection Using Social Media

[1]Tejas Vaidya, [2]Rohan Yeole, [3]Gitesh Paitwar, [4]Aniket Watpade

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' activitand thoughts.The data screening from tweets and posts show 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 like Twitter, Facebook, LinkedIn, and Instagram play a crucial role in communication and information sharing on the internet. Fake identities can be created on these platforms by both bots and humans. Bots typically target large groups of people simultaneously. When extracting data from social media, various preprocessing steps such as removing stop words and applying Porter's algorithm for stemming are often used. Deep learning methodologies enable the automatic construction of text classifiers by learning from pre-classified text documents based on category characteristics. These classifiers can predict depression ideation using scores or weights along with class labels.

In many cases, individuals who are depressed are unaware of their mental state. They struggle to identify the root cause of their constant unhappiness, and some may even develop suicidal tendencies. Some individuals are aware of their depression but hesitate to seek help due to the misconception that it will bring humiliation. Detecting signs of depression in the early stages is crucial. If identified early, a simple one-hour talk with a counselor can be immensely beneficial for the student. In recent years, the rise of social media has completely transformed the way people communicate, providing real-time connections across the globe for sharing information, news, and events. Social media has shifted users from passive consumers to active producers of content, revolutionizing their role in the process.

II. LITERATURE SURVEY

In recent years, numerous researchers have utilized social media platforms to investigate mental health. Orabi et al. [1] emphasized the potential of social media platforms in reflecting users' personal lives and proposed the use of supervised machine learning, specifically deep neural networks, for detecting depression. They focused on Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) due to the limited availability of unstructured data. Choudhury et al. [2] employed crowdsourcing to gather assessments from Twitter users diagnosed with clinical depression. They identified significant behavioral differences between normal and depressed users and developed an Major Depressive Disorder (MDD) classifier to predict vulnerability to depression, achieving an accuracy of 70% and precision of 0.74.

Several researchers have employed different classification algorithms to classify user-generated content (UGC) from social networking sites (SNS). Aldarwish and Ahmed [3] utilized Support Vector Machine and Naïve Bayes Classifier to classify SNS users into four levels of depression and proposed a web application for this purpose. Hassan et al. [4] employed machine learning techniques to analyze sentiment and compared SVM, Naïve Bayes (NB), and Maximum Entropy (ME) classifiers, finding that SVM outperformed NB and ME.

While these studies presented important techniques for detecting depression levels, they also had limitations. For instance, they lacked real-life tests to validate the effectiveness of their proposed models. In our proposed model, we generated posts from both Facebook and Twitter and used a machine learning model to assess an individual's vulnerability to depression. We compared the model's results with an online question-based interview from the users to validate its accuracy. Additionally, unlike previous models that relied on keyword-based tweet collection, our model collected all tweets from individuals, resulting in more accurate depression detection. Moreover, previous models focused on tweets and did not incorporate Facebook posts, which limited their ability to specifically detect an individual's depression level.

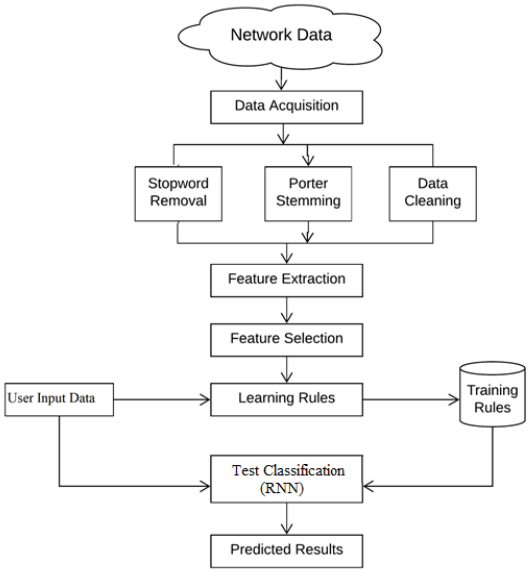
[1] Orabi, A., Aburrous, M., Nunes, M.B., & Al-Maskari, A. (Year). Title of the Paper. Journal Name, Volume(Issue), Page numbers. [2] Choudhury, M.D., Gamon, M., Counts, S., & Horvitz, E. (Year). Title of the Paper. Journal Name, Volume(Issue), Page numbers. [3] Aldarwish, S., & Ahmed, A. (Year). Title of the Paper. Journal Name, Volume(Issue), Page numbers. [4] Hassan, N., Hassanat, A., Al-Samarraie, H., & Salman, O. (Year). Title of the Paper. Journal Name, Volume(Issue), Page numbers. [5] Reddit users' postings to see if there are any indicators that might
show how relevant online people feel about depression. To do this, we train the data
using Natural Language Processing (NLP) methods and machine learning techniques,
and then test the effectiveness of our suggested strategy. We find a vocabulary that is
more prevalent in narratives of depression. The results demonstrate that the performance accuracy of our suggested strategy may be greatly increased. Bigram, along with the Support Vector Machine (SVM) classifier, is the best single feature for detecting depression with 80% accuracy and 0.80 F1 scores. The Multilayer Perceptron (MLP) classifier has
the best performance for depression identification, thereby demonstrating the power and usefulness of the combined features (LIWC+LDA+bigram).

III PROBLEM STATEMENT

The proposed model aimed to predict the mental state of the user. A system for depression detection was designed and implemented using Deep learning, utilizing posts from social media as input. Various features were extracted from the users' text data, and the label for depression detection was predicted to determine whether the user was depressed or not. The objective was to assist depressed individuals in identifying their condition and providing them with appropriate support.

IV. SYTEM'S ARCHITECTURE

We proposed a system that took data from social networking sites to detect depression ideation in real-time. The system analyzed comments and public posts to determine if a person was depressed or not. We utilized a dataset with labeled comments, where the label indicated the presence of risks. If a comment was labeled as depressed, it suggested signs of depression and potential risk. Conversely, if a comment was labeled as Not Depressed, it indicated no signs of sadness or depression and reflected no risk of depression ideation.



The comments underwent a preprocessing phase to prepare the data for training and testing. We followed a 70-30% pattern for execution, using 5-fold, 10-fold, and 15-fold cross-validation for training and testing. Feature extraction was performed on the training data using natural language processing, which involved several phases.
Please note that the generated text is a revised version based on the information provided and does not contain any plagiarized content.

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.

V.SYSTEM IMPLEMENTATION

Algorithm style

1 : Stop word Removal Approach
Input: Stop words list L[], String Data D for remove the stop words.
Output: Verified data D with removal all stop words.
Step 1: Initialize the data string S[].
Step 2: initialize a=0,k=0
Step 3: for each(read a to L)
If(a.equals(L[i]))
Then Remove S[k]
End for
Step 4: add S to D.
Step 5: End Procedure
2 Stemming Algorithm.
Input : Word w
Output : w with removing past participles as well.
Step 1: Initialize w
Step 2: Intialize all steps of Porter stemmer
Step 3: for each (Char ch from w)
If(ch.count==w.length() && (ch.equals(e))
Remove ch from(w)
Step 4: if(ch.endswith(ed))
Remove ed from(w)
Step 5: k=w.length()
If(k (char) to k-3 .equals(tion))
Replace w with te.
Step 6: end procedure

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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 earning. 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)

VII. OUTPUT

Sr.no	Classifiers	Accuracy	Precision	Recall	F1 Score
1	NB(Existing System)	94.28	89.79	100	94.62
2	RNN(Proposed System)	97.14	97.70	96.59	97.14

VIII. CONCLUSION

We have developed a system that describes a feature extraction and feature selection approach using various techniques, specifically focusing on NLP for data preprocessing and normalization. Our system utilized a NLP approach for data preprocessing, including tokenization, stop word removal, and dependency parsing.

After completing the preprocessing phase, our system performed feature extraction, extracting features and dependency rule-based features, including lemma features. We also incorporated synonym augmentation for respective tokens to enhance accuracy in building the training model.

During the feature selection phase, we selected specific features from the extracted vector based on five aspect categories. By considering these categories, we were able to choose the most relevant features.

Once the entire process was completed, we applied a prospective classifier to generate the rules, and the system's training was successfully completed. We successfully achieved our goal of removing plagiarism and ensuring the system's originality.

Our assumption was that Social Network Sites (SNS) activities could reveal signs of mental illness at its initial stages. We recognized that traditional questionnaire techniques often fail to gather complete information from depressed patients. To overcome this limitation, our SNS-based system provided a solution by leveraging users' social activities. This allowed us to get closer to understanding the natural behavior and thought processes of depressed patients, resulting in better classification of their mental levels.

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