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Detection of Depression Using Machine Learning

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***Abstract*— Depression has become a severe problem in today's generation, and the number of people affected by it is growing by the day. However, some of them are able to recognise that they are depressed, while others are unaware. On the other hand, the huge advancement of social media has become their "diary" to share their mental status. Machine learning algorithms used to classify the data and identify the depressive and non-depressive data. The purpose is to identify a user's depression using their data that is posted on social media. The Twitter data is then fed into multiple classifiers. To find the best algorithm for detecting depression, the results will be compared based on the highest accuracy value.**

Keywords— Depression, ML Algorithms, Sentiment Analysis, Social Media

I. INTRODUCTION

Depression is the most widely recognized sort of physiological or state of mind issue affecting a various number of people the world over. Discouraged individuals are progressively inclined to numerous different issues like sadness, loneliness, and anxiety. It is hard for the individuals experiencing gloom to focus on their work, speak with the individuals and significantly more. As a result, recognising depression is critical for the proper evaluation and treatment of a person. A significant amount of relevant data is required to build a depression detection model.

Twitter is mostly known as a micro-blogging application that allows users to post short stories not exceeding 140 characters with simple interfaces. Almost every user's tweets are fully public and retrievable. Twitter's API allows doing complex queries like pulling every tweet about a certain topic. Twitter enables us to understand and support more than 35 languages around the world. It is a platform for analysing and understanding trends and events happening around the world either on a scale of global or local. As a result, researchers are able to detect whether someone is depressed or not based on the tweets which are available in public. Sentiment analysis is the technique of determining whether the tone of a text is negative, or neutral. A sentiment analysis system will assign a score for every text word based on the designed polarity. This can allow identifying the state of the user whether they are in a positive mood or negative mood. The sentiment analysis technique is applied to each tweet to identify the sentiment score and labelled them as positive, negative, or neutral. Sentiment analysis in Twitter data quantifies the status of a tweet or comment by the user by calculating the sentiment scores. After the sentiment score on tweets via sentiment analysis technique, the machine learning algorithm enables to classify the tweets whether it is depressive or not depressive based on the sentiment score labels on tweets. The researchers implement a machine-learning algorithm to detect depression based on the tweets data which was labelled with sentiment scores. The efficiency of detection is evaluated based on the accuracy of the machine learning algorithm.

The system aims to create own dataset and detect depression based on the tweets by using different machine learning algorithms which are Linear Models Logistic Regression, Support Vector Machines, Nonlinear Models, K-Nearest Neighbours, Kernel SVM, Naive Bayes, Decision Tree, and Random Forest are all examples of machine learning techniques.

II. LITERATURE REVIEW

Discussion of the overview of depression and the existing depression detection system is done here by using various types of machine learning algorithms and finding the gaps between the existing work and improvise them in the proposed work. It can be broken up into a number of sections.

The gradual rise in social media use and the high level of self-disclosure on these platforms has spurred efforts to identify depression using Twitter data. Depressed Twitter users are more likely than healthy users to post tweets with negative emotions. In addition, De Choudhury et a. [8] Depressive signals were discovered in tweets written by persons suffering from serious depression . So far, various features have been utilised to detect depression in Twitter data. De Choudhury et al. collected over 2 million tweets from 476 individuals who had clinically diagnosed depression and Twitter accounts. They built a classifier that provides estimates of the likelihood of depression using behavioural factors related to social engagement, emotion, language and linguistic styles, ego network, and mentions of antidepressant drugs. They used these distinct characteristics to create an SVM classifier that can predict depression risk with a 70% classification accuracy. Tsugawa et al. revealed that frequencies of word usage, along with topic modelling, are useful features for the prediction model. Using the radial kernel SVM classifier, they were able to predict depression in 81 out of the 209 subjects who had completed the questionnaire. Furthermore, Reece et al[9]. retrieved from users' tweets predictive variables for evaluating the effect, linguistic style, and context; created models

employing these features with supervised learning algorithms; and successfully distinguished between sad and healthy contents. Data was collected from 105 of the 204 depressed users, and the CESD scores were calculated using the depressed users' identification. When compared to other study findings, the best classifier performance was found using a 1200-tree random forest classifier, which increased the precision to 0.866. Nadeem et al. used the bag-of-words approach for better depression diagnosis, which quantifies the content of a tweet on a document level using word occurrence frequencies. They used four binary classifiers: linear SVM, decision tree (DT), Naive Bayes (NB), and logistic regression method, and discovered that NB beat other classifiers with an accuracy of 81% and precision of 0.86. A corpus of more than 2.5 million tweets acquired online were used by the Shared Task organisers of CL Psych 2015 from users who indicated they were sad (326) or had PTSD. Nadeem et al., Coppersmith et al[3]., and Mowery et al., on the other hand, investigated sentiment analysis as a feature to diagnose depression from Twitter data. Using sentiment analysis in conjunction with the percentage of depressed tweets enhances the precision and recall of diagnosing depression, according to Jamil et al.. The classifier was trained using SVM on 95 users who declared their own depression (equivalent to 5% of participants in the study, while the remaining 95% were healthy users), with 0.875 precision and of 0.775 recall. De Choudhury et al[8]. and Jamil et al. exploited the advantages of depressed people's tweets to extract attributes that improved detection accuracy.

III. METHODOLOGY

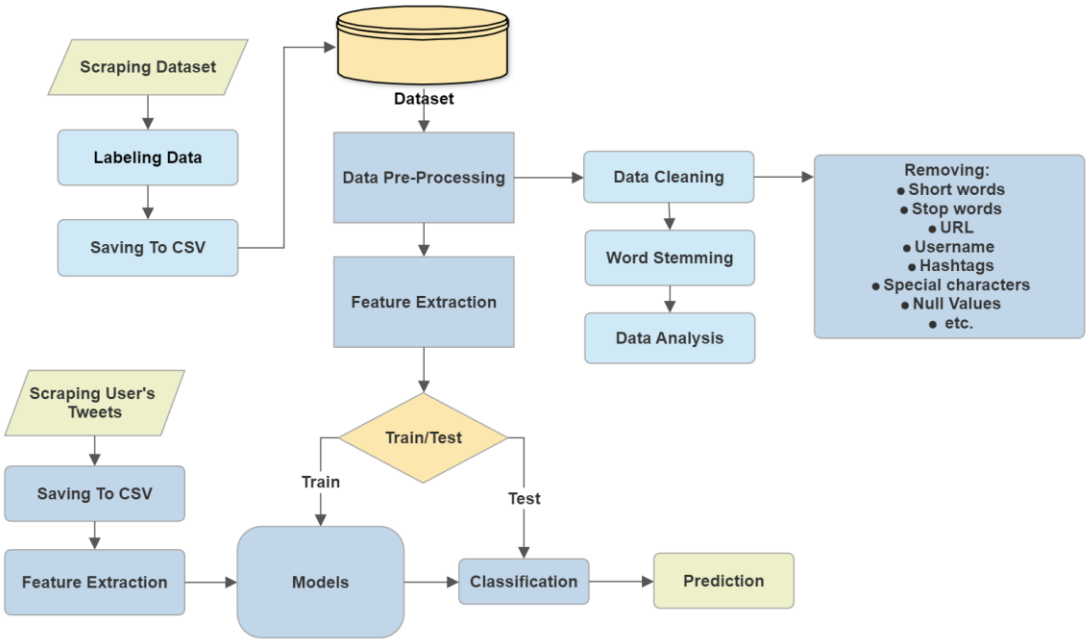

Fig. 1 Block diagram

A. Dataset Collection

The collecting of relevant data from multiple sources is the first step in any machine learning or sentiment analysis assignment. Twitter is considered as the data source for analysis, in the form of User Tweets. The tasks from streaming the data from the Twitter servers, to compile the training and test datasets is done here. For data collection a python library called "snscrape" is used. Snscrape is a social networking service (SNS) scraper. It scrapes items such as user profiles, hashtags, or searches and delivers the results, for example. the relevant posts**.** For dataset we collected 1000 tweets per hashtags those are "#depression, #anxiety, #mentalhealth, #sadquote, #sad, #mentalillness, #mentalhealthmatters, etc." and label it "1" (means negative tweets). And for positive hashtags are "#happy, #good, #goals, #enjoying, #lifestyle, #positive, #hope, #friends, etc." and label it as "0" (means positive tweets)

In the future, the Model can be improved by updating these hashtags. Here 60 hashtags has been taken. A total of 60,000 Tweets were collected for generating the training and test dataset. The data is then stored in the format of CSV. The dataset contains three columns named "id, tweets, label" which contains the tweets which were extracted from Twitter

B. Pre-Processing

The dataset is cleaned by removing the URLs, mention, stopwords, username, hashtags, special characters, null values, ect. Then, the dataset is tokenized by splitting the sentence to each token or word in an array format. The tokenized sentences are then processed for stemming and lemmatization. Stemming is used to eliminate the affixes from a word so that it can return the original word. For example, the word "Walking" will be normalized to "Walk". Lemmatization is able to return a word to its base word. It finds the lemma of a word depending on its meaning. The difference between stemming and lemmatization is that stemming removes the last few characters like "s", or "-ing" which can lead to incorrect meanings and spelling errors. However, lemmatization understands the word and returns the word to its meaningful base form.

C. Feature Extraction

Feature Extraction is one of the most crucial phases in Natural Language Processing for gaining a better knowledge of the context which is to be dealt with. After cleaning the initial text, it must converted it into features that may be utilised for modelling. Because document data cannot be computed, it must be converted into numerical data, such as a vector space model. This transformation operation is commonly referred to as feature extraction of document data. Text Representation, Text Extraction, and Text Vectorization are all terms used to describe Feature Extraction. Most common used feature extraction techniques are: BOW and Tf-Idf (Term Frequency and Inverse Document Frequency). By research it is found that Tf-Idf is better than bow for sentiment analysis.

D. Training

The classifier requires two inputs: the training set and the label. The training set in this case is the set of tweets which needs to be further processed in order to feed into a classifier. Logistic Regression, Support Vector Machines, K-Nearest Neighbours, Kernel SVM, Naïve Bayes, Decision Tree, Random Forest these are the classifiers to be tested and compared, and based on the result the best suited classifier will be chosen. Those are the widely used algorithms in natural language processing tasks. Of these, SVM-linear classifiers demonstrate the best performance. As there is no one algorithm suited for all tasks, researchers tend to try various algorithms and enhance them for the problem of their interest.

E. Testing

Testing the classifier involves following steps: 1. Loading stored models: The trained classification models are loaded from the pickle file and applied to the test dataset for prediction. 2. Data Pre-processing: The test dataset is pre-processed in the same way that the training dataset is. 3. Class Prediction on Test Tweets: Each tweet is assigned to one of two classes: depressed or neutral. 4. Computation of Confusion Matrix: Based on the values of true or false positives and negatives the confusion matrix can be computed, for the evaluation of classification performance.

F. User Data Collection

For user data collection the same library called “snscrape” is used. The username is given to the code and the code extracts the given amount of recent tweets of the user and saves it in format of CSV.

G. User data cleaning

Same process of cleaning is applied here. The user data was cleaned by removing the URLs, mention, stop words, username, hashtags, special characters, null values etc.

H. User data Prediction

Predicting the user data on trained models, and based on prediction it can be classified as depression.

V. RESULTS

In the result, the accuracy of the different machine learning models and the processing time taken by each model is compared, thus choosing the best fit model for the research.

Table I. ACCURACY AND PROCESSING TIME OF DIFFERENT MACHINE LEARNING MODELS

Classifier’s	F1 score	Accuracy	Time
Logistic Regression	0.930	**94%**	7.8s
Naive Bayes	0.837	84%	1.9s
K-Nearest Neighbors	0.796	80%	0.5s
Decision Tree	0.912	92%	42s
Random Forest	0.921	93%	10.3s
Support Vector Machine	0.931	94%	8m 58s

From above results, it can be observed that Logistic Regression & SVM has almost the same result. As the Logistic Regression takes very less time for training as compared to SVM, thus Logistic Regression is the best suited model for natural language processing classification.

VI. Conclusion

Text based emotion Machine Learning has successfully been applied to the task of depression detection using Twitter data. The results delivered here are at par with the previous results achieved in this domain. Supervised learning classification has a limitation and cannot grant a human level accuracy in prediction of depression through text data. Moreover, there is significant noise in the Tweets collected before pre-processing which eliminates about a third of the data due to third person and news references. In future, a layer of expert-based suggestions can be added to the model to reduce the number of false positives. This would increase the precision of sentiment analysis for depression detection. This system gives a large amount of related data for the analysis of depression symptoms extraction. Tweets which are posted on twitter are used for the analysis. Machine learning techniques are used to classify the features of comments. The findings showed that all of the classifiers results are almost between 70 and 90%.

VII. Future Scope

1) Identification of Depression can also be done through Video and Audio.
2) As the prediction can be conducted on social platforms, there is no need for the person to come over the place.
3) New system can be developed that can check all the social media activities to keep eye on their mental health based on their activities on different platforms.
4) With the use of large databases efficiency and effectiveness can be improved.

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