

# Depression Detection using Machine Learning and AI Techniques

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**ABSTRACT:** Depression is the most prevalent mood disorder worldwide having a significant impact on wellbeing and functionality, and important personal, family and societal effects. The early and accurate detection of signs related to depression could have many benefits for both clinicians and affected individuals. In this research we propose depression scale analysis for real-time users, various existing systems have already developed to extract the depression scenario based on social media text data set as well as some have developed based on visual features. The main gap analysis of such existing systems provides a classification label based on single values. Sometime such values carried wrong information for system-generated data. In this research, we calculate heterogeneous kind of features which cultivate the classification accuracy and provide the drastic supervision for depression detection. The first system deals with extract the information from the PHQ answer data set it is generated from a real-time QA system. According to extracted data system generate average weight in feature extraction phase and based on generating the trained model. It is model has executed similarly e as on training model and provides the classification accuracy accordingly. The experimental analysis shows the effectiveness of the proposed system and introduces the better classification accuracy than traditional machine learning algorithms..

**KEYWORDS:** Depression detection, Image processing, Machine Learning

## I. INTRODUCTIONS

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. This may totally change the negative state of mind of that student into a positive one. Such a student can be given good counselling of how to deal with mental stress and can be guided to follow the right path to success. The most important form of non-verbal communications is facial expressions of a person. Many studies have been done for finding out the facial expressions that are related to depression. The current work is mainly undertaken to find out the presence of depression in college students by studying their facial features. This system mainly uses different image processing techniques for face detection, feature extraction and classification of these features as depressed or non-depressed. The system will be trained with features of depression. Then videos of different students with frontal face will be captured using a web camera. Then the facial features of these faces will be extracted for prediction of depression. Based on the level of depression features the student will be classified as depressed or non-depressed.

- Facial mood detection according to time series image inputs
- Predict mood level based on score or weight with class label.
- Successfully implement the test model based on training set as supervised learning approach.
- Execute the proposed system maximum accuracy.

The proposed research to design and implement a system for depression level prediction using Machine learning, the visual features has extracted from users face to predict mood and predicts the scale of depression using the response of user for PHQ questionnaire. The proposed research also design and implement a system for depression level prediction using deep learning, the visual features has extracted from users face and predicts the scale of depression.

## II. LITERATURE REVIEW

Sridharan et al. presented the detection diagnostics on online social media with the help of Convolution Neural Networks (CNN) where emphasis was to get the data posted by different users while also ensuring algorithm [1] preserves the privacy with the help of separating agents which deal with data. An agent handles users' isolation requirement by creating different communities in the system. The dominant capacity through transfer learning and feature learning of CNN is used. A different filtering mechanism is proposed for the system where the filtering of redundant data set is done so as to increase the learning of CNN and hence reducing the faulty learning of the model. Online filtering threshold works via the help of Online Setup Assistant (OSA) practice. The OSA presents the user with the set of messages preferred for each meaning; the consumer tells the classification choice to recognize or to reject messages. This method helps in formulation of a proper classification and addition of certain messages from undesired creators into the Blacklist. It also ensures that all the future block sets for unwanted messages cannot continue feeding false information to the learning system. The system make an attempt to automatically identify the potential online users with SNMDD (Social Network Mental Disorder Detection) framework that explores the various features from different data logs of OSN's and a new tensor technique for deriving latent features from multiple OSN's for SNMD (Social Network Mental Disorder) detection.

Melissa N Stolar, Margaret Lech, Shannon J Stolar, Nicholas B Allen approach [2] for the detection is very interesting and quite different from others. The model uses an optimized spectral roll off parameters for detection of depression symptoms from speech signals on the clinical dataset obtained. The adolescent speech signals were preprocessed and cleaned to remove background noise and also the cross talk of parents over the microphone. Further, the decimation of sampling frequency is done to achieve minimal amount of data and hence, achieving minimal processing time and memory requirements. A number of other pre-processing techniques such as Blind Source Separation (BSS) for reducing background noise recorded on microphone, Frame/Windowing were cleaned signal is normalized to within the amplitude range of -1 to 1 based on max amplitude, Voice Activity Detector (VAD) which works according to the production process of speech to categorize it as voiced or unvoiced. The feature analysis from the verbal inputs is done via different component algorithm for detection of feature and optimization of detected features for proper classification. Different technique employed was Spectral category ( $S^*$ ) and Spectral category (S). The  $S^*$  category works on the principle of flux, Centroid, Entropy, Power spectral density, Formants and single roll-off whereas the spectral category S defines  $S^*$  as the basic step upon which it adds optimized roll-off ranges. The classification of these features is done with the help of simple SVM classifier. In past studies gender dependence has improved depression classification either best for females, males and varied amongst features.

In this study depression detection was more effective in males than females et al. A nationally-representative study [5] among U.S. young adults was done by Brian et al. using multiple social media platforms. Affective content analysis of Online Depression Communities was done by Thin Nguyen et al. [6]. The main aim of these systems is to efficiently design the algorithm for detection of the depression stigma. The data set is collected from websites such as Weibo and Twitter. First the collected dataset is analyzed with the help of syntax and semantics analysis which gives the sense of depression stigma among posts posted by different age groups. In this process the syntax is analyzed for finding certain key words and relevance of those key words is made with the help of semantic analysis which finds the general emotion of the paragraph via understanding the emotion of the text also known as Emotion Detection Systems. Then the posts are classified according to the depression symptoms. First, to minimize the effects of the keywords i.e. depressive disorder on data modeling, the posts which matched the keywords but did not reflect any stigma were categorized as non-stigma posts. Then, a certain number of posts were randomly selected from the pool of non-stigma posts to balance the number of posts in each class (i.e. stigma and non-stigma). Second, to improve the performance of the data modeling, the linguistic features which were reliable for differentiating between stigma and non-stigma posts were selected. Third, to maximize modeling performance, a series of classification models were built based on key features using four different classification algorithms, respectively, including Simple Logistic Regression (SLR), Multilayer Perceptron Neural Networks (MLPNN), Support Vector Machine (SVM), and Random Forest (RF). Each model was tested by 5-fold cross-validation. Specifically,

the data was randomly divided into five subgroups with equal size. Each subgroup was then used to test the model that was built using the opposing four subgroups. After five rounds of model training, results of model training were integrated into a final model. The results of this study confirmed that incorporating linguistic analysis methods into online detection of stigma can be useful to improve the performance of stigma reduction programs. First, social media data can be used to monitor users' stigmatizing attitudes towards mental illness. In this study, two human coders were recruited to perform content analysis on Weibo posts with keywords. The results showed that 6.09% of relevant Weibo posts reflected stigmatizing attitudes towards depression. This is inconsistent with a previous study conducted outside of China, which also employed human coders to manually process tweets and found that only 0.7% of relevant tweets reflected stigmatizing attitudes towards depression. Such inconsistency might be partly due to poor mental health literacy among Chinese people, and partly due to the role of anonymity in encouraging users to be more likely to express their stigmatizing attitudes on Sina and Weibo compared to Twitter. Besides, there were gender differences in depression, which suggests that attempts to reduce depression stigma should be gender specific.

A meta-analysis by Sven Thönesl, and Daniel Oberfeld analysis of time perception of the person is done [7]. Depressive patients frequently reported to perceive time passing as slow. Effects of depression on time passing judgments have been investigated in this model with the help of tasks such as: verbal time estimation technique, time production technique, time reproduction technique, and duration discrimination methods. Different ratings of the subjective flow of time are obtained as a result of these techniques. By using method of a classical random-effects meta-regression and robust variance estimation, the met analysis is aimed for evaluating the irregular results from 16 previous studies on similar topic. Furthermore, it represents a collective data of 433 depressive patients and 485 healthy subjects. As a result, it was found that the depressive patients perceive time as going slower relative to control subjects. The meta-regression also showed that there are no significant effects of interval duration. Thus, stating that the time interval analysis as not accurate method for predicting the results. However, there was a tendency of over production of short durations and underproduction of long durations in depressive patients compared to healthy controls. Depression has normal effects on the subjective flow of time and has no effect on duration based judgments.

The filtering mechanism constitutes the system for preprocessing [8] of the input where the aim is to provide the data set to the learning algorithm without any redundancies. The aim is to get proper learning dataset so as to improve the accuracy of classification of the problems by the system. The detection systems run on classification algorithms which bring out a feature in the entity that is useful for characterizing the entity accordingly. When it is fed with wrong or redundant dataset then, the learning algorithm fails to comprehend the meaning to the data set and that can lead to misclassifications of the input. The varying nature of input dataset can prove challenging to these filtering algorithms where at a time an algorithm has to filter the discrepancies in data set input in text, speech or in image. According to different sets of input the filtering mechanisms differ and their redundancies also differ. So, the filtering system must be able to overcome these all problems. For example, speech filtering systems as shown in fig. 1, here, there might be overlapping of sound in input, frequency ranges which can be non-essential for the detection of goal, and unrecognized words which might cause redundancies. In case of image there are number of agents that might lead to misclassification of a feature which may be arise because of uncertainty handling in processing systems because of incomplete information, noisy images, fragmentary, imprecise, unreliable images, vague imagery, contradictory images leading to state of indecision, deficient images and overloading. However, a number of fuzzy logics and neural networks based methods have shown a great potential in determining the meaning of an image to the learning algorithm.

The field of image processing [9] is very broad and encompasses wide variety of issues and with the limitations of dimensions removed new vast scopes provides large number of variances in the general learning of image. With 2D and 3D processing involved in a number of video and image inputs. The new findings in perceptron based networks enabled the detection of such systems. In the case of textual inputs from different posts on social media algorithm tries to find the possible and probabilistic meanings of the text via active and passive construction of all the grammatical and general features of text and via using semantic algorithms to find out the emotion of user in case of depression analysis. The main constraint of the algorithm is to find the scenarios which are possible in the context and accordingly prediction of probabilities according to the implications of text implying to different emotions. The method of analysis includes the identification of grammatical meaning and trying to build the passive and active model for reaching probabilistic conclusion and often includes intermixing of scenarios also called as action mixing.

Classification [10] is the backbone of the analysis system which aims to produce the result on the basis of the particular features of the entities constituting the dataset. Data obtained after the process of filtering is inputted to the classifier algorithms. In depression analysis model, we have different sets of inputs such as text, speech and image and according to different sets of these we use the different classifiers to properly classify them. In case of input in the form of speech, the model tries to recognize the words implied from speech and it works similar to text analysis but has added implementations of voice data which provides the information about pitch variations, intensity as well as depth of the speaker which could imply a lot towards the determination of mental state as well as emotional stability. In case of image analysis, a 2D feature vector is used to store the feature of every array of image which are divided into a number of different fragments so as to divide and study each individual part of the image. This feature vector is stored in the form of perceptron based neural networking scheme which represents the layer of information about an image vector. A popular technique in classification is SVM (Support Vector Machines) , a classifier formally defined by decision planes which define the decision boundaries of the system. The process of classification of an input dataset into result is step by step process and may involve the repetition of procedures to attain maximum accuracy at different levels of analysis. The model of depression analysis cannot be built upon a single group of classifiers and contains a number of classifiers in different groups. These groups are executed on a similar dataset for gaining the accuracy in the prediction. In depression analysis the first group of classification models was built to differentiate between posts with and without depression stigma. Second, to improve the performance of the data modeling, the linguistic features which were reliable for differentiating between stigma and non-stigma posts were selected. Third, to maximize modeling performance, a series of classification models were built based on key features using four different classification algorithms. The similar approach has been proposed by YK Sharna and Monika Roakde in [11] using deep learning techniques.

### III. PROPOSED SYSTEM DESIGN

System initially works with extract phq answer data for different cross users using PHQ questionnaire.

- It first generate 5-fold, 10-fold and 15-fold cross validation respectively.
- The data is already reprocessed in trained module so system directly build a train module for respective scaled images.
- For test can be perform on real time as well as synthetic dataset respectively.
- The different features has been extracted from test input images.

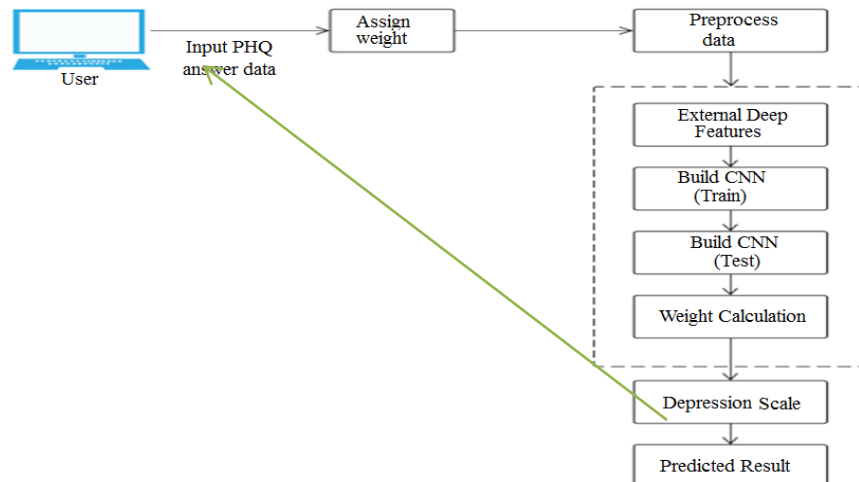


Figure 1 : Proposed system architecture

The proposed research to design and implement a system for depression level prediction using deep learning, the visual features has extracted from users face and predicts the scale of depression.

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#### IV. ALGORITHM DESIGN

##### Recurrent Neural Network

**Input:** Test Dataset which contains various test instances TestDBLits [], Train dataset which is build by training phase TrainDBLits[], Threshold Th.

**Output:** HashMap <class\_label, SimilarityWeight> all instances which weight violates the threshold score.

**Step 1:** For each read each test instances using below equation

$$testFeature(m) = \sum_{m=1}^n (.featureSet[A[i] \dots \dots A[n] \leftarrow TestDBLits)$$

**Step 2 :** extract each feature as a hot vector or input neuron from  $testFeature(m)$  using below equation.

$$Extracted\_FeatureSetx[t \dots \dots n] = \sum_{x=1}^n (t) \leftarrow testFeature (m)$$

Extracted\_FeatureSetx[t] contains the feature vector of respective domain

**Step 3:** For each read each train instances using below equation

$$trainFeature(m) = \sum_{m=1}^n (.featureSet[A[i] \dots \dots A[n] \leftarrow TrainDBList)$$

**Step 4 :** extract each feature as a hot vector or input neuron from  $testFeature(m)$  using below equation.

$$Extracted\_FeatureSetx[t \dots \dots n] = \sum_{x=1}^n (t) \leftarrow testFeature (m)$$

Extracted\_FeatureSetx[t] contains the feature vector of respective domain.

**Step 5 :** Now map each test feature set to all respective training feature set

$$weight = calcSim (FeatureSetx || \sum_{i=1}^n FeatureSety[y])$$

**Step 6 :** Returnweight

#### V.CONCLSUION

A quantitative meta-analysis of reported results, relying on performance metrics robust to chance, is included, identifying general trends and key unresolved issues to be considered in future studies of automatic depression assessment utilizing visual cues alone or in combination with visual cues. The optimal performance of geometrical features in the gender independent mode can be attributed to that they do not carry gender based information as opposed to appearance based features. This pattern of performance is common among screening tools. The proposed research carried out depression scale analysis based on visual as well as facial features. The effectiveness of proposed system illustrates better accuracy than classical machine learning algorithms.

#### V. FUTURE WORK

To extract various synthetic as well as some real time features and predict the depression scale using various machine learning and deep learning algorithms. We can also focus on extract different vocal as well as facial features for classification.

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