Vol.03/ No. 01 Pages: 24-39

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Analysis of Deep Learning Techniques for Early Detection of Depression on Social Media Network - A Comparative Study

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Abstract- The early detection or identification of emotional states plays a vital role in today's world, where the number of internet and social media users are increasing at an unprecedented rate. The psychiatric disorders are very dangerous and it is affecting 300 million people. This is the motivation behind addressing the research problem with novel research articles. Early detection is the key to reduce the number affected individuals due to this disorder potentially. This research study performs an analysis of a standard dataset obtained from online social media, where detection can be based on a machine learning algorithm. This research article proposes a machine-learning algorithm to develop an early prediction from their depression mode, which can be protected from mental illness and suicide state of affairs. The combination of support vector machine and Naïve Bayes algorithm will be used to provide a good accuracy level. The classification model contains many cumulative distribution parameters, which should be classified and identified dynamically. This identification or detection is the features obtained from textual, semantic, and writing content. The evaluation of various Deep Learning (DL) approaches is identifying the early prediction. The sensitivity and accuracy of the method are providing the significant conditions for early detection and late detection. The proposed hybrid

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Vol.03/ No. 01 Pages: 24-39

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method provides better results for early detection and retained good sensitivity and better accuracy of existing methods. The study from results can help to develop a new idea to develop a early prediction of various emotions of people present in social media.

Keywords: Deep learning, early prediction

1. INTRODUCTION

Non-depressed individual identification is very challenging for online social media. Their emotional status will be dynamic and unpredictable [1]. Their social interaction, awareness, and posting online will speak about their emotional conditions [2].

Internet propagations are unavoidable globally and in communication technology, social media networks are attracting people to interact with each other from any distance abode their domain [3]. Facebook, Twitter, and Instagram social media are most popular in many developing countries. Further, it will be used to help people to share their thoughts, feelings, emotions, desires, achievements, etc. [4]. They provide many topics online to discuss and respond in any forum openly and freely. Therefore, people are freely creating the opportunities to work in social networks and fight with each other about the conflict of opinion. Gradually, it will affect the mental state of every human, who wants to react to someone's shared thoughts [5]. It will create mental health disorders quickly that it's a kind of addiction. Finally, it will help to commit suicide by any sensitive human in society [6] [7] [8]. The categorization of the shared post and pictures are very important to analyze for saving a life of any sensitive human. Before affected by a psychological disorder, predicting is an essential one [9].

Machine learning techniques are used to classify the unique features and patterns potentially. The mental states are reading with some items 'happiness', 'Sad', 'angry', 'anxiety', 'depression' among all online social media [10] [11] [12] [13]. The depressive disorder with anxiety frequently will be a disaster. Anxiety and depression are having similar symptoms with features of depressive disorder [14]. Different types of depression consisting of continuous depressive posts and clicks and sharing the thoughts on social media. The depression severity and elevated parameter can be identified for risk of suicide with cardiovascular disease [15] [16]. These symptoms are classified into various contents and expounding reasons for anxious

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TCSST

25

Vol.03/ No. 01 Pages: 24-39

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depression with the psychological disorder [17] [18]. Social media is ubiquitous and provides people with self-opinion to maintain the connection as online for a long time. There are three

different disorders, they are as follows;

Anxiety disorder: The addiction to social media makes the person to get easily distressed by

using different conflict comments or posts that affect their mental health.

Anxious depression: The active social media users are sharing their feeling and thoughts

frequently in an unwanted period.

Social anxiety: The feelings of different people are connected virtually in the social media and

further it will be facilitating the psychological order related to anxiety and depression [19].

2. ORGANIZATION OF THE RESEARCH

This research article discusses about the related research works that has proposed solution for detecting depression in social media in section 3. Section 4 discusses about the proposed

methodology for early depression detection. Section 5 provides the discussion of results obtained

from the examinations. The conclusion and future task will be discussed in section 6.

3. PRELIMINARIES

Shen & rudzicz proposes classifying the anxiety level by N-gram language modeling of

emotional generate features and vector integration with topic analysis [20]. Choudhury et al

presents clinical depression with a twitter database and measure the behavioral qualities building

for a classifier. This was helped to identify the depression of a person. In another paper, he

analyses the emotions through Facebook data and developing a statistical model for prediction

[21].

Resnik et al introduced the supervised models with linguistic signals for predicting

depression based on the Twitter dataset [22]. Pedersen et al described the prediction of

depression with lexical features. They used the Twitter dataset for the training decision list to

identify [23]. Schwartz et al proposed a regression model for prediction with the Facebook

dataset. They used 28K Facebook users for developing their model based on status updates [24].

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26

Vol.03/ No. 01 Pages: 24-39

https://www.irojournals.com/tcsst/

DOI: https://doi.org/10.36548/jtcsst.2021.1.003

Reece et al discuss the effect of measuring predictive features with the help of a supervised learning algorithm for finding post-traumatic stress disorder. They used Twitter users in their research work to build a model in every linguistic style [25]. Coppersmith et al present the technique to identify post-traumatic stress disorder classifiers for social media. They used Twitter users for demonstrating their research work [26]. In another research work, he analyzed some mental sickness problems for post-traumatic stress disorder. Also, they detect many human mental health problems' disorders [27].

Orabi et al proposed a deep neural network method to analyze depression in social media. They used the Twitter dataset for analysis [28]. Trotzek et al compare many models with convolutional neural networks. It works based on linguistic Metadata for the prediction of emotions. They achieved good results with the proposed method to achieve the state of arts tasks [29]. Choudhury et al review the online social networking analysis for the prediction of public health. They used the Twitter database for prediction is based on the post and status of the people, social commitments, and timing they used, totally the behavior of the group of people [21]. The method of recognizing psychological wellbeing is used to predict the status of depression level, suicide conditions in the population. They examined with online Twitter account for programmed machine learning [30]. Nguyen et al present a machine learning prediction algorithm is based on statistical methods to categorize the depression levels based on their temperament and psychological behavior [31]. Park et al present online web-based social media to detect the emotional status of the people and described the solutions of it. They examined with semi-organized up final and personal users with many dynamic users of Twitter. They projected plan implications for social media to achieve better accuracy results for finding the depression towards discouraged user's issues and their status [32]. Nadeem et al investigate several statistical methods with machine learning algorithm and to provide a good prediction rate for the depression status of the person. They analyzed the variation of prediction rate with the Twitter dataset. Each tweet to influence the people is very essential in pathetic situations of anything [33]. Wang et al construct the model with 10 features and 3 classifiers to compare their obtained model on the Twitter dataset. Also, they developed the application of their proposed model to predict mental psychology disorder [34].

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Vol.03/ No. 01 Pages: 24-39

https://www.irojournals.com/tcsst/

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Reece et al present a machine-learning algorithm to detect the depression level based on their posting of photos on Instagram social media. They used image processing to detect the emotions from the images like face detection techniques. They extract the face details and analyze with statistical features from photos [25]. Kale et al focus on the Twitter data to analyze for identification of emotions due to mental health problems due to psychological disorder. They classify the emotional status based on their behavioral features by sentimental analysis techniques [35]. Mowery et al investigate two examinations to use the predictive power of supervised machine learning classifiers to study emotion interaction. They used classification methods to classify depression-related posts in social media [36].

4. METHODOLOGIES

This research article focuses on emotional procedure, language base, and temporal features for the prediction of data analysis as an online web media post. The separate classifiers can perform independently such as decision tree, support vector machine, Random Forest, Naïve Bayes method, and our proposed hybrid techniques combined with probability statistics.

4.1 Decision Tree Method

A decision tree is a supervised learning algorithm and layer-based process. Here the layer-wise splitting process has been done for the observations. A similar group is containing significant data and it is used to achieve an emotion tracking algorithm [30]. The features are denoted as nodes based on the feature weights. The recursion has followed in this procedure and features can be noted. This procedure is executing till the last emotion hints analysis of every category. This feature selection is made entropy-based. Figure 1 shows a basic structure of decision tree techniques.

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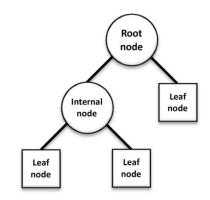


Figure 1 Structure of DT approach

4.2 Random Forest approach

Random Forest procedure consists of many trees and it increases the trees that are becoming stronger and accurate with the model [37]. This task can be ensemble learning with the construction of a multitude outputting class. Figure 2 shows the structure of the Random Forest method.

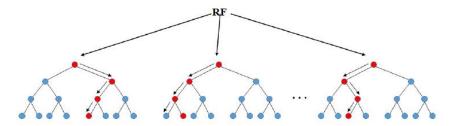


Figure 2 Structure of Random Forest

4.3 Support Vector Machine method

Generally, the SVM method is used for recognition of problems, which are having more capabilities to separate various classes based on the labels of the object. This class problem can be solved in a very easy manner as like the multiclass issues. Here, the iterative training algorithm error and loss will also be reduced by using vector machine. Besides, this algorithm behaves well in the prediction of emotion with different classes and it is comparatively good than other individual classifiers [38]. Figure 3 shows the simple structure of SVM.



Vol.03/ No. 01 Pages: 24-39

https://www.irojournals.com/tcsst/

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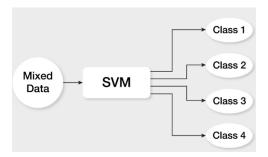


Figure 3 Structure of SVM

4.4 Naïve Bayes Approach

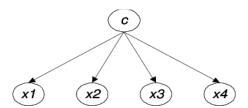


Figure 4 Basic Structure of Naïve Bayes approach

The probability model technique with Bayes theorem is used for the prediction of more membership probabilities with each class. This probability assumes a more emotional statement with more number of statuses given by users. This assumption of prediction is that, particular features in the group are having the presence of any other feature [39]. The basic structure of the naïve bayes approach is shown in figure 4. The basic formula is used for the prediction of emotion in social media. The experiment conducts for this class was distributed to normal distribution.

$$\hat{u} = \underset{n \in \{1,\dots,N\}}{\operatorname{argmax}} P(C_n) \prod_{i=1}^n P(x_i \mid C_n)$$

Where C is class variable, x is mutually independent.



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https://www.irojournals.com/tcsst/

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4.5 Proposed Hybrid Algorithm

The proposed hybrid algorithm technique is used to predict the emotion from the social media content with very accurate and sensitive. The following steps are considered for developing a proposed hybrid framework. Figure 5 shows the workflow of the proposed hybrid technique.

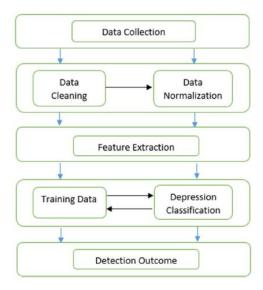


Figure 5 Proposed framework

Step 1: Input emotions database with various dataset.

Step 2: Pre-processing helps to increase the accuracy

Step 3: Feature extraction and processing by tokenization process.

Step 4: Train the framework with different classifiers

Step 5: Calculate the performance measure with individual classifiers.

Step 6: Emotion prediction from the twitter dataset.

Step 7: The estimation function is ranging between input and output,

$$P\left(\frac{t_j}{y_j}\right) = P(y_j) \prod P\left(\frac{x_{ij}}{y_j}\right)$$

Step 8: The class value can be found probabilities with each vector for the further update,

$$P(y_j/t_i); y_j = y_i \rightarrow p(\frac{y_j}{t_i})$$

31



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Vol.03/ No. 01 Pages: 24-39

https://www.irojournals.com/tcsst/

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Step 9: Combining the two classifiers for prediction parameters; the fusion of support vector machine and naïve bayes theorem is used to acquire high accuracy and sensitive metrics for conditional probabilities.

Step 10: Individual classifier mistakes can be solved by reclassified and expecting high gain with attributes for each subset in the class.

5. RESULTS DISCUSSION

This research article tested 2500 sentences for emotion prediction from a Twitter dataset. The validation of the dataset gives more accuracy than other existing individual classifiers. The emotion recognition and depression finding is a very challenging task in single classifiers. But our proposed method is performing dual classification with the fusion of SVM and Naïve Bayes algorithm. The proposed algorithm has more variation parameters to tune the performance measures. The following sample emotions keys for our prediction early in an online web social media are reserved with confusion matrix [40]. Finding a loss during training and testing the dataset for a single classifier is showing in graph 6.

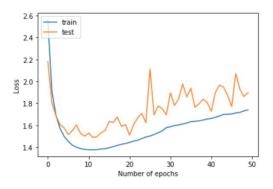


Figure 6 Loss During Training and Testing for Single Classifier

This research article examines various cues and to detect the emotions of the people and categorizing based on cause events. Some emotional keys are given here; for positive emotions are 'happy', 'nice', and 'good' and so on. For negative emotions are 'lose', 'hurt', 'nasty', 'waste'. For sadness are 'worry', 'no sleep', 'sad about up. For anger, emotions are 'enough', 'stop', 'shit', 'kill', and 'hate'. For anxiety emotions are 'fearful', 'worrying'. This research



Vol.03/ No. 01 Pages: 24-39

https://www.irojournals.com/tcsst/

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article contained many individual classifiers for predicting emotion very accurate and sensitive. Comparing all these techniques with our hybrid method which is fused by two individual classifiers is investigated of the same dataset for finding good performance from the validation.

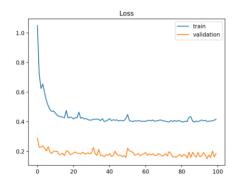


Figure 7 losses in Training vs. Validation

Figure 7 shows the validation during training a model. In the solvation of exists paper problems, the proposed research work attempts to identify the depression prediction in early identification in the Twitter dataset. Graph 10 is showing our hybrid techniques are superior to single classifier techniques.

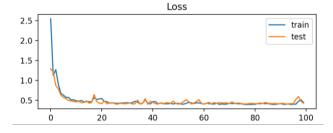


Figure 8 proposed model loss during training and testing

Figure 8 shows the loss function of the proposed model. This research article consists of many social media depression measures and different features of a Twitter dataset. We applied fused techniques that can be measured for emotion prediction in early-stage who are suffering from depression. This behavioral exploration and prediction for depression people in an early stage are based on the Twitter dataset.



Vol.03/ No. 01 Pages: 24-39

https://www.irojournals.com/tcsst/

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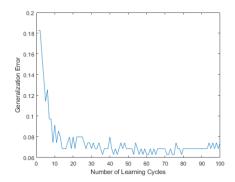


Figure 9 Error Minimization in our proposed hybrid classifier

Our proposed work has minimized the error in classifiers as shown in graph figure 9. This research article analyses the qualitative data analysis that is used to enable unstructured data with open statement survey keys with many interviews and sharing the post from a different place on the internet. This can be arranged the deal with good discover and proficient issues. From the graph, our hybrid proposed system is performing well when compared to other single classifiers.

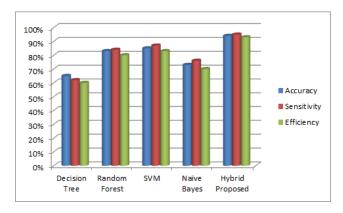


Figure 10 Performance Measures of Proposed Method with Single Classifiers

6. CONCLUSION

The proposed hybrid algorithm has examined and proved a well recognition of the emotions efficiently. Besides, higher prediction accuracy has been achieved rather than a single classifier. The proposed paper highlights the capability of utilizing the Twitter dataset for measuring the depression of people from their posts and other activities in the web media forum. The analytical



Vol.03/ No. 01 Pages: 24-39

https://www.irojournals.com/tcsst/

DOI: https://doi.org/10.36548/jtcsst.2021.1.003

performance on the selected dataset, higher accuracy and sensitivity has been achieved to show the early prediction of depression phenomenon. The following factors can be observed and answered in the proposed examination:

- 1. Type of depression with common factors, which is available in the dataset.
- 2. Encounter the emotions in the time and date appropriately with apparent reason.
- 3. Misery from a low state of mind it should be protected and a genuine condition based on their individual emotional feelings.
- 4. Physical and emotional synchronization of changes is based on growing state and family attachment.
- 5. Depression factors measurement is ensemble for early prediction of tweets.
- 6. The symptoms of early depression in various categories with positive and negative factors respectively.

In summary, the proposed model is trained with many features of comments and posts from Twitter. The finding is confirming that, the proposed hybrid classifier results for attaining a better accuracy. The extended version of the emotional features dataset should be used in future work. Besides, more datasets should be used to verify the effectiveness of the proposed system. A more number of attributes will be found from the emotional process factor that should be included in our future work. More depression analysis from many domains of social media is needed for better accuracy and sensitivity that are focused on in our next research article.

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35

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