

Mental health posts classification using Deep learning

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¹ **Abstract**—According to a WHO report of 2019 970 million people around the world were living with a mental disorder these factors are alarming. Amongst the mental disorders anxiety and depressive disorders are the most common mental disorders. The rate of disorders rose significantly during the COVID-19 pandemic from 26 percent to 28 percent. In this study, we are proposing mental disorder classification using deep learning techniques. Data for this study is collected from subreddit posts post-COVID-19 from 2018-2020 to analyze post-COVID trauma. The proposed model analyses the text and classifies it into one of 7 categories which include mental disorders and nonmental disorders i.e. anxiety, depression, loneliness, bipolar, and mental disorder parenting and teaching. To classify the posts LSTM model is used. The proposed model achieves 60 percent validation accuracy. To enhance the comprehensiveness of our analysis, we conduct a comparative study on data that includes explicit words related to mental disorders and data without such explicit language.

Index Terms—COVID-19, LSTM(Long Short Term Memory), mental health disorders, post COVID trauma, Reddit posts

I. INTRODUCTION

In the past, mental illness was stigmatised, and individuals hesitated to openly discuss their mental health challenges. As knowledge and understanding of psychology have advanced, there is a growing

recognition of the significance of acknowledging and appropriately treating mental illness. Examining historical perspectives reveals the alarming perceptions of mental illness during the 18th century when it was attributed to supernatural forces. In the 2000s, legislative measures were implemented to combat stigma and ensure proper care for mental health issues.

Recognizing the significance of mental health is crucial, yet identifying specific mental health conditions poses challenges due to their diverse nature. A reliable approach involves seeking professional medical advice and obtaining a formal diagnosis. Key indicators encompass emotions such as sadness, low energy, mood swings, and difficulties in concentration. Discerning these primary symptoms may be intricate. Even in the absence of explicit expressions of stress, depression, or anxiety, individuals often manifest these sentiments indirectly on social media platforms. Research indicates that social media posts can provide insights into an individual's mental state, offering glimpses into their behavioural patterns. Users frequently turn to social media platforms to articulate intense emotions, particularly during challenging circumstances.

There are different kinds of mental disorders, such as anxiety, depression, bipolar disorder, suicidal thoughts, and loneliness. Bipolar disorder involves mood swings, and although its exact cause

¹<https://github.com/RohilaPotluri/NeuralNetwork/tree/master/Mental-Health-Sentiment-Analysis>

is unknown, genetic examination can provide some clues about its origins. Anxiety is another mental disorder that can cause physical changes like sweating and trembling, and it is associated with feelings of fear and uneasiness. Depression, on the other hand, is a form of intense sadness.

WHO(World Health Organisation) states that anxiety and depression are the most common mental health issue categories and the second leading cause of death is suicide. WHO is also passing preventive measures to reduce the cases of mental illness it launched various programmes mental illness awareness programmes and preventive measures. It also increased the accessibility to mental health care. Statistics show that it implemented these programs in 110 countries successfully. A few of those programs are HIV, Tuberculosis patient recovery, awareness of mental health policies and rights, psychological support in emergencies, and enforcing mental health policies at the workplace. Despite these initiatives finding the right people and their diagnosis is difficult.

Social media platforms play a crucial role in finding persons or users through their daily activity posts. This platform reveals their mental behaviour. According to the Statista website or source, people spend 151 minutes online which is a 1 percent rise from last year's 147 minutes. As shown in the figure 1 The average spend in 2022 is around 2.5 hours which is huge. The daily post of a person is 1-2 this tells the person's presence of mind.

In our paper, we are collecting the posts from Reddit and analyzing the mental issues of 5 categories and 2 types of nonmental issues as well. We considered the most common types of mental issues anxiety, depression, loneliness, suicide, and bipolar and in the nonmental category parenting and teaching categories are collected.

The impact of mental illness affects individuals in several ways. Firstly, it disrupts sleep patterns, contributing to sleep disturbances for those grappling with mental health challenges. Moreover, mental illness amplifies the vulnerability to chronic diseases, particularly for individuals who are already contending with such conditions.

Presently, there is a notable increase in the prevalence of heart diseases among those experiencing mental health issues. Additionally, individuals

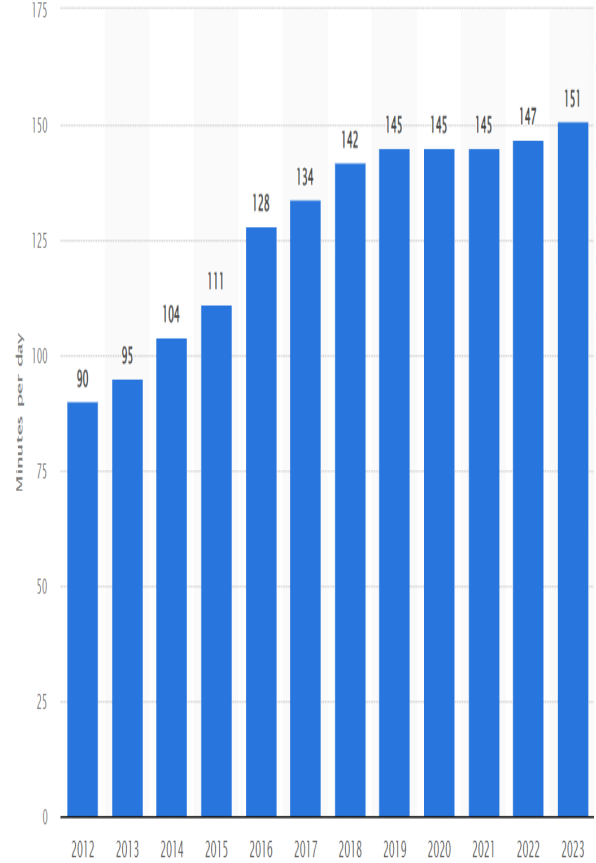


Figure 1. daily posts statistics

grappling with mental health concerns are more inclined to engage in behaviours that pose additional health risks, such as smoking and excessive alcohol consumption. This complex interplay underscores the need for comprehensive health interventions that address both mental and physical well-being. People with bad physical conditions may also develop mental health issues. One of the diseases is Psoriasis.

II. MOTIVATION

In recent years, mental health issues have emerged as a critical concern, affecting individuals across diverse demographics. Social media, particularly Reddit, has become a rich source of real-time expressions of personal experiences, including those related to mental health.

The motivation behind this work is firstly, to understand how individuals articulate their mental

health struggles in online platforms, thereby providing valuable insights. Secondly, the development of an effective classification model for identifying mental health issues. Leveraging deep learning techniques, specifically Long Short-Term Memory (LSTM) networks. LSTMs are specifically designed to overcome the limitations of traditional neural networks when processing sequential data, making them exceptionally well-suited for analysing the dynamic and context-dependent nature of language within these posts.

III. OBJECTIVES

The primary objective of the project is to develop an effective LSTM-based classification model to classify mental health issues. The main goal of this project is to use deep learning techniques to classify the posts and overcome the challenges of traditional machine learning models. Additional objectives of the project are:

- Analysing online posts of mental health issues: This objective is the cornerstone of the project. We analyse the posts and draw observations on how people express their struggle on online platforms.
- Analysing temporal nature of the text: This objective addresses the temporal nature of the text that is sequential patterns in the data.
- Adaptability to varied lengths of text: This objective focuses on model compatibility to varied length of texts in real time
- The final objective is to translate all these observations into practical solutions

IV. RELATED WORK

Excessive smartphone use may contribute to mental and emotional health issues among adolescents. This study's goal is to understand how teenagers' smartphone use in Indonesia is connected to their mental and emotional well-being. A cross-sectional correlational design method is used in this study. The gathered data is a sample of 350 adolescents aged 10-22 years sampling. The application of Kendall's method demonstrated that the correlation coefficient of -0.255 suggests a negative relationship. The above study is set in Indonesia. It specifically addresses smartphone addiction among adolescents. It proposes solutions to the smartphone

addictions like cognitive counselling and therapies depending on the severity [21].

This study is set in Sri Lanka. It focuses on the broader behavioural patterns like sleep patterns through sensors like accelerometer, and GPS sensors. The data is collected using questionnaires without informing the study purpose. In this the patterns are divided into active and passive in these two categories mental health status is analysed using various techniques. In conclusion the results show that the location variance and sleep patterns are highly correlated. And it also shows that the smartphone samples are effective data points to analyse the mental health problems [9].

The current mental health challenges underscore the necessity for research in today's society. The data uses mental IQ tests. According to this study Artificial Neural Network (ANN) algorithms overcome the limitations of existing methods. For that the study introduces integration of decision trees with compound learning algorithms and the system analyses and classifies mental health IQ tests [5].

This study investigates the mental well-being of students amid the COVID-19 pandemic. It focuses on undergraduates from Wuhan University of Science and Technology, gathering data through questionnaires. The goal is to pinpoint factors affecting psychological stress responses. Using SPSS software, the study analyses correlations in the data. Results reveal no noteworthy difference in psychological stress levels between students who were infected and those who were not. In summary, the findings indicate that Wuhan college students displayed diverse degrees of psychological stress reactions following the COVID-19 outbreak [14].

The goal of this study is to draw insights into the public's perception and awareness of mental health in the Malaysian community. This study considered the data of the Malaysian community and the data is gathered from Non-Governmental Organization (NGO) Twitter accounts. The study used experimental methods, with sentiment analysis to gauge the Malaysian community's awareness of mental health problems. The implementation process involves data collection, preprocessing, and the application of machine learning techniques and deep learning techniques, Neural Networks (NN), Support Vector Machine (SVM), and Naive Bayes

(NB). The results of the study revealed that positive tweets are the dominant class. From the above research, we can say that mental health awareness can be enhanced by fostering positivity in tweets [19].

In the pursuit of understanding the relationship between technology use and mental well-being using machine learning, the paper delves into the application of machine learning algorithms and the algorithms include K-Nearest Neighbour, Random Forest, Decision Tree, and Logistic regression. The main goal of the study is to compare the performances in predicting mental health status. The main challenges in this study are the limited size of the data and the potential bias of the data [7].

Not only is the prediction of mental health crucial but also assessing the severity of mental health issues holds paramount importance. The paper introduces a comprehensive framework using data science principles to predict the severity of mental health into 3 categories of severity low, medium, and high. To put the theory into practice an empirical approach is proposed to assess the health conditions of both healthy individuals and people with mental illness. The novel framework for predicting public mental health faces challenges in data categorization due to issues of quality and accuracy. Additionally, assessing individuals' health conditions in sample tests becomes complex, especially when handling sensitive mental health information [17].

The discussion emphasizes how AI can enhance patient care and mental health issues. This paper introduces 28 studies focused on emotional stability highlighting the promising outcomes of machine learning algorithms [16].

The study employs the DMADV (Define-Measure-Analyze-Design-Verify) methodology. Data for the study is gathered through an online survey PHQ-9 (Patient Health Questionnaire) and the factors include personal, social, and academic. The results of the study show that there is a tangible effect of a pandemic on the student's emotional well-being. During the pandemic, the mental state of the students shifted from mild to moderate negative emotions [3].

This study explores a range of mental health concerns such as schizophrenia, bipolar illness, anxiety, depression, and PTSD. The study envisions

future possibilities for research and development, seeking to make the most of emerging opportunities in utilising machine learning for mental health. The review carefully analyses findings and considers the challenges encountered by the research community [18].

In the swiftly evolving times, future generations, particularly students, are facing significant stress, due to intense competition, societal issues, and constant pressure. This paper addresses five prevalent disorders affecting young individuals: bipolar disorder, anxiety disorders, depression, eating disorders, and sleep issues. The research uses Machine Learning (ML) algorithms to screen mental health, utilising a Mental Disorder Questionnaire (MDQ) [11].

The big challenge in organizations is big data management with the constant immense daily data, the majority of big data is unstructured (about 85 percent). The paper delves into dimensions of big data quality, explores big data analytics during the COVID-19 pandemic, and addresses both physical and mental health issues arising post-COVID [10].

The study centers on overlooked physical and mental health needs of older adults, particularly in the context of challenges posed by new coronavirus variants. This study implements iAssist, a comprehensive platform designed to deliver prompt medical aid. iAssist includes functionalities like doctor appointments, medicine orders, and lab appointments, with a primary aim to benefit caregivers such as family members and healthcare professionals [6].

The study addresses the challenge of mental health in today's modern world, considering traditional factors like family pressure, unemployment, homesickness, and unhappy relationships as common triggers for mental illness. The study conducts a comparative analysis of Conv-LSTM and BERT models. The study proposes a user-friendly, deep learning-based chatbot framework. The proposed framework includes a module to track social media activity, a chat module for real-time conversations, and a deep learning-based mental illness detection [1]. This study presents a two-phase mental status detection system for schizophrenia patients. The proposed framework uses a Cross-Modality Graph Convolutional Network (CMGCN) to integrate visual features from diverse modalities. Experiments

exhibit substantial advancements compared to existing methods, achieving real-world mAP of 69.52 [13].

The proposed approach involves employing NLP BERT with a deep neural network to analyze social media conversations over time. The primary goal is to assist the Omani Ministry of Health in delivering comprehensive mental health care services. The dataset is evaluated for emotional behaviors, specifically focusing on identifying signs of depression. The system not only urges users to prioritize mental health but also informs the mental health sector about individuals' mental health status. [2]

This study explores the machine learning techniques' efficiency in the health informatics sector. The experiment evaluates various convolutional neural network architectures, commonly used in text classification tasks. The data for the experiment is Electronic Health Records. The experimental results show that the multi-channel model outperformed others, achieving a 92 percent accuracy, while the attention and sequential models achieved accuracies of 90 percent and 89 percent, respectively [20]. The research employs data mining techniques, including statistical reports, machine learning, and deep learning, to analyze users' mental health statuses. The study identifies depressive indicative words and proposes methods to enhance efficiency, accuracy, and scale in mental health analysis. By integrating technology such as data mining and machine learning [8]. This research introduces SPRSound, the inaugural freely accessible pediatric respiratory sound database. The initiative aims to enhance objectivity and alleviate the workload on doctors by automating respiratory sound analysis. The success of such methods is contingent on the quality and comprehensiveness of the respiratory sound databases utilized, emphasizing the significance of SPRSound in advancing this field [4].

Analyzing respiratory sounds is critical for evaluating lung health, and there is an increasing demand for automated software to streamline the process. Our study focuses on distinguishing between typical lung sounds and those affected by airway blockages using a wearable sensor paired with a smartphone. This innovation has the potential to revolutionize asthma care, making it more efficient and cost-effective. The use of this technology simplifies

signal collection for battery-powered systems [12].

In recent years, there has been a growing interest in automating the categorization of respiratory sounds. However, the effectiveness of current deep learning approaches is hindered by small and unevenly distributed datasets. Our study introduces a novel technique called MBTCNSE, which combines a multi-branch Temporal Convolutional Network (TCN) with a Squeeze-and-Excitation Network (SEnet) to enhance the classification of respiratory sounds [4].

Respiratory sounds offer valuable insights into lung function, and diagnosing lung issues often involves listening for abnormal sounds during auscultation. To make this process less subjective and reduce the burden on doctors, many methods automate sound analysis. However, the success of these methods depends on the quality and breadth of the respiratory sound database they use. In our research, we've developed SPRSound, the first freely accessible pediatric respiratory sound database [2].

Abnormal respiratory sounds, such as crackles, are crucial indicators of various respiratory diseases. Understanding the characteristics of crackles is essential for developing a computerized diagnostic approach. Our study proposes a methodology that integrates a random forest classifier and Empirical Mode Decomposition (EMD) to classify subjects into six respiratory conditions: healthy, bronchiectasis, bronchiolitis, COPD, pneumonia, and URTI [6].

V. DATA DESCRIPTION

From the subreddit repository, the data is gathered. We used this dataset to understand the impact of COVID-19 on mental health support groups [15]. We have selected 4 mental health-related posts anxiety, bipolar, depression loneliness, and suicide on the other hand we have selected 2 categories of nonmental health posts also are parenting and teaching. Each category of the file is downloaded in CSV format and combined with the data using the pandas framework. The total number of posts is 42865. The dataset contains various features but removed all the unnecessary features and retained only posts and subreddits (the emotion or label). Another data frame is created by removing explicit words like anxiety, depression, and loneliness. After

removing the explicit words we are left with 24018 posts.

VI. PROPOSED FRAMEWORK

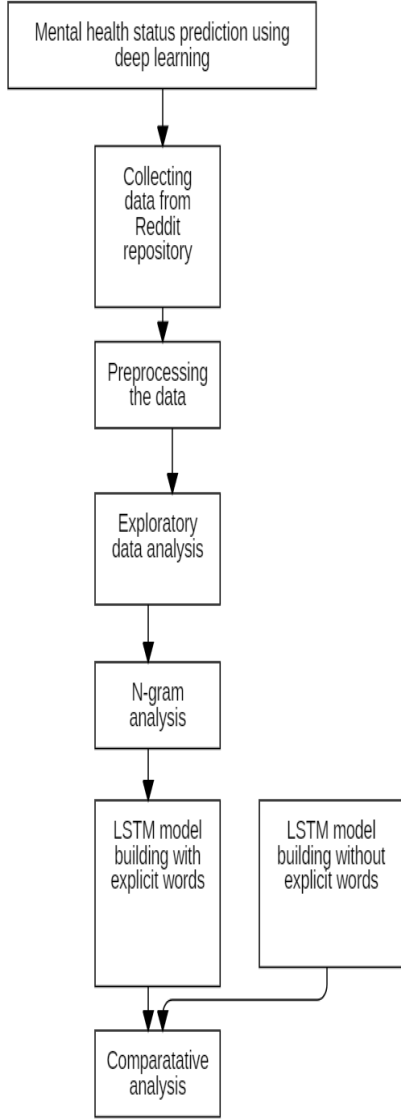


Figure 2. Workflow

As shown in figure 2 the proposed work is divided into data preprocessing, EDA(Exploratory Data Analysis), and methods.

A. Data collection and preprocessing

Reddit Mental Health Dataset is collected from the Zonado open-source repository. The main goal of this project is to classify the type of post using the

LSTM model. In the data collection preprocessing stage though the repository contains 15 types of posts for this study we have picked 7 types of posts for analysis. These 7 individual files are concatenated using pandas. In the stage of preprocessing cleaned the data by removing stop words and separated the data into containing explicit words and non-explicit words. In this, we analyze the data in two different ways.

B. Exploratory data analysis

In exploratory data analysis class distribution for different categories is analyzed, and the distribution is again broken into mental and nonmental post categories, the average length of posts is analyzed and word frequency distributions are plotted. As shown in figure 3 In the database we have 15 different categories of mental health we have considered 4 major categories depression, anxiety, lonely, bipolar, and suicidal 2 categories of non-mental health (parenting and teaching) dominant class is depression and non dominant class is teaching Figure 4 represents the

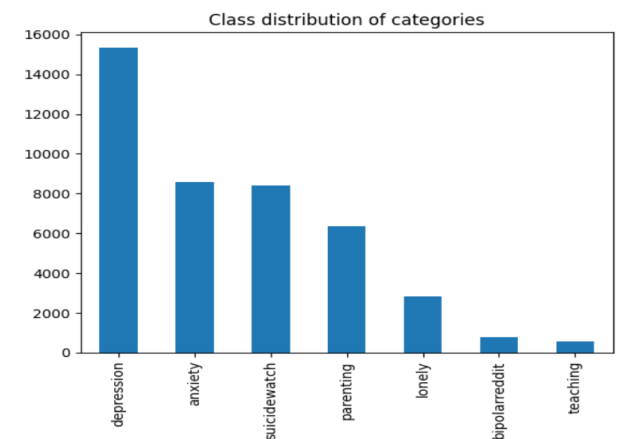


Figure 3. Post distribution

distribution of posts in the context of mental health vs nonmental health.

Figure 5 represents the average length distributions of different posts. mental disorder posts have long sentences compared to mental health disorder-related posts In the category of mental health issues category bipolar and depression categories have lengthy sentences. This analysis helps to build better models and word embedding sizes.

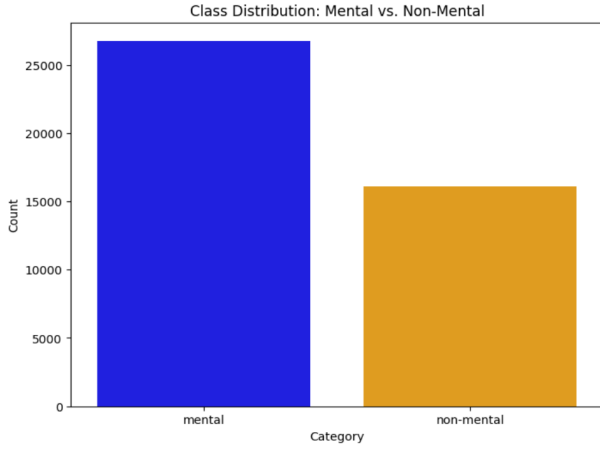


Figure 4. mental vs nonmental distribution

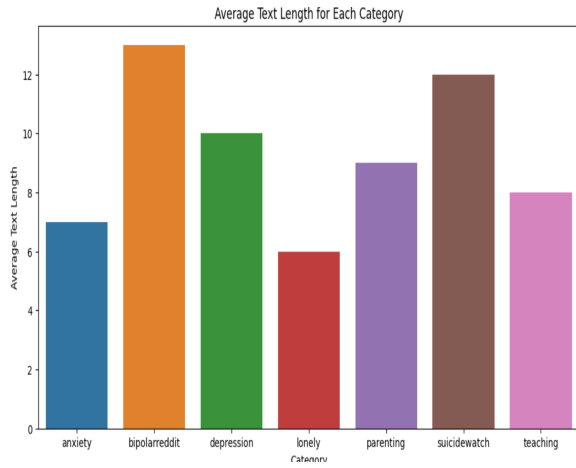


Figure 5. Average lengths of posts

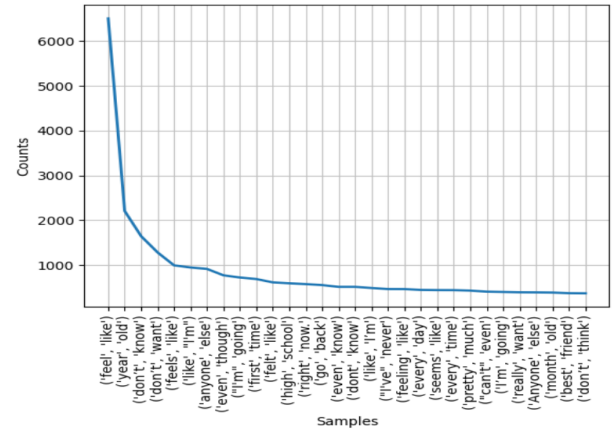


Figure 6. Bi-gram analysis

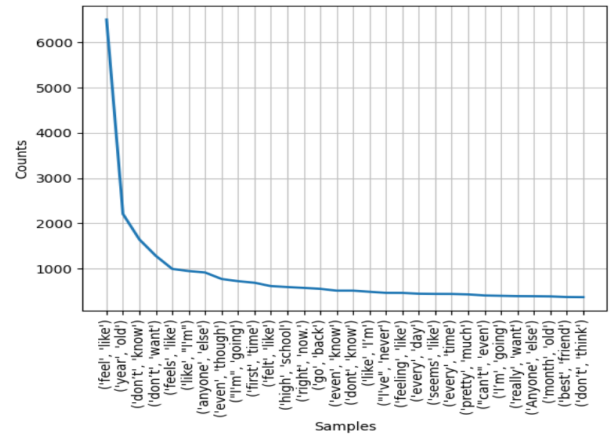


Figure 7. Tri-gram analysis

Apart from the above visualizations word clouds show that feel is the common frequent word across mental issue posts and in the nonmental disorder category kid is common in parenting and teacher and student are the frequent words. There are common explicit terms also in each mental category like depression, lonely, anxiety, and bipolar

C. Methods

In the proposed methodology n-gram analysis is performed and the LSTM model is built to classify the posts. In the section of N-gram analysis data is analysed in the context of bi-grams and trigrams. The figure 6 represents the bi-gram analysis and the figure 7 represents the tri-gram analysis. This is performed after removing the stop words from the data using NLTK stopwords.

To classify the text an LSTM model is built for two different contexts one is for without explicit words and the other one is for overall data. The LSTM model is built using Keras sequential layers this study used common architecture for the cases before choosing the word embedding length we analyzed the word frequency distribution separately for explicit words and without explicit words.

The figure shows 8 word frequency distribution for data without explicit words. This analysis helps in choosing the word embedding dimensions and tokenization process.

VII. RESULTS SUMMARY

Two LSTM models are built and trained. The models are built using keras. The embedding layers are selected as 100 from the frequency analysis we

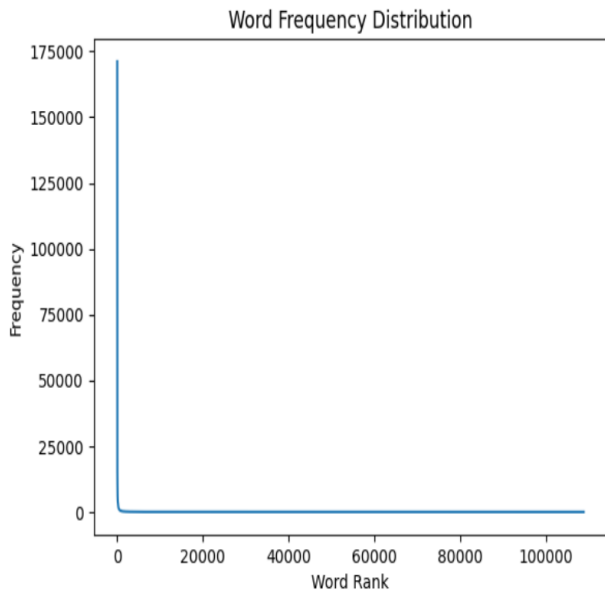


Figure 8. Word frequency analysis for without explicit words data

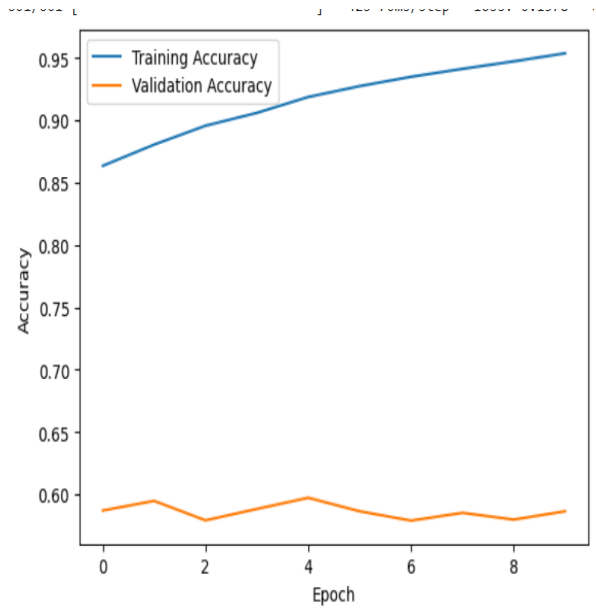


Figure 10. Accuracy for each epoch(Without explicit words)

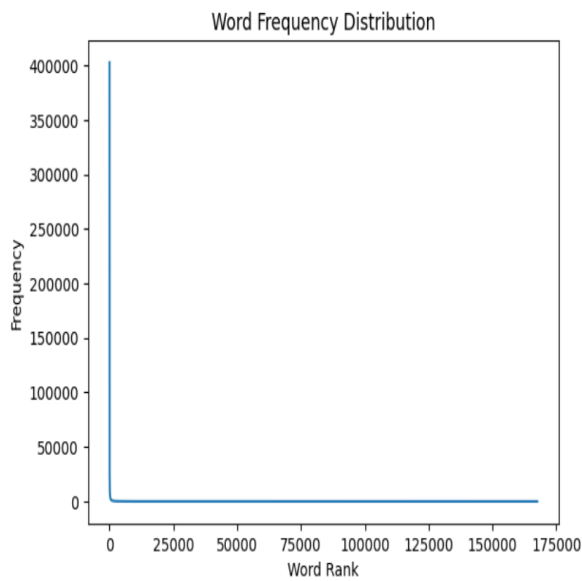


Figure 9. Word frequency analysis for without explicit words data

percent training accuracy and 60 percent validation accuracy.

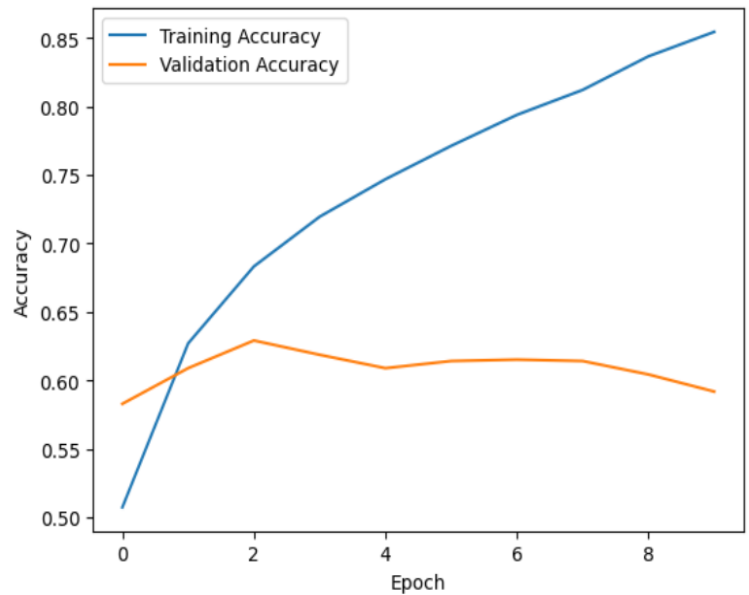


Figure 11. Accuracy for each epoch(With explicit words)

have selected the input dimension as 5000. The model is trained for 10 epochs. Figure 10 represents the accuracy of the without explicit words data. At the end of 10 epochs, the model achieved 95 percent training accuracy and 58 percent validation accuracy.

Figure 11 represents the accuracy of data with explicit words this model is also trained for 10 epochs. At the end of 10 epochs, the model achieved 85

For further analysis, we have plotted the confusion matrix for each case.

As per the figure 12 Upon detailed examination using the confusion matrix, it is evident that the model achieves remarkable accuracy in correctly classifying posts under the "Parenting" category,

which falls into the non-mental disorder category. However, challenges arise in accurately distinguishing between posts related to depression, a mental disorder category, and those categorized under "Suicide Watch." Notably, the model tends to misclassify posts, mistakenly categorizing some depression posts as belonging to "Suicide Watch" and vice versa. Additionally, there are instances where posts associated with anxiety are erroneously classified as depression.

In summary, the confusion matrix analysis reveals the model's strong performance in classifying non-mental disorder posts related to parenting. However, challenges persist in accurately categorizing posts related to depression, suicide watch, and anxiety, leading to misclassifications in these mental health categories.

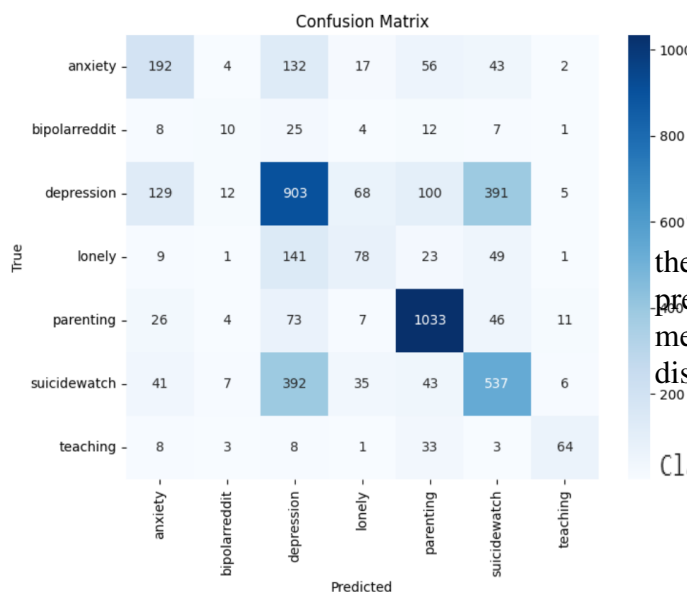


Figure 12. Confusion matrix(With explicit words)

As per the figure 13 The model demonstrates high accuracy in classifying posts related to "Parenting," achieving the most accurate predictions. However, it tends to struggle with distinguishing between posts in the "Depression" and "Suicide Watch" categories. Specifically, the model often misclassifies "Suicide Watch" posts as "Depression" and vice versa. Additionally, posts related to "Anxiety" are occasionally misclassified as "Depression."

In summary, the model excels in accurately identifying posts about parenting, but faces challenges

in distinguishing between posts related to depression and suicide watch, as well as occasionally misclassifying anxiety posts as depression.

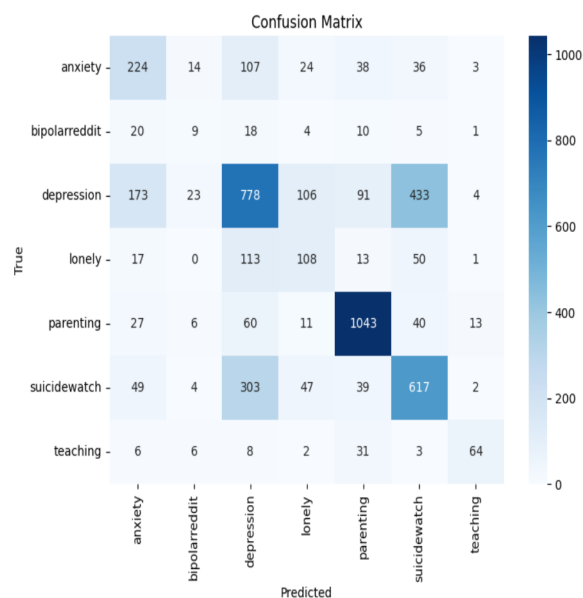


Figure 13. Confusion matrix for overall data

The classification report 14 of filtered data shows the same results as overall data. Highest scores of precision, recall, and F1 score for parenting non-mental health category and low scores for bipolar disease.

| Classification Report: | | | | |
|------------------------|-----------|--------|----------|---------|
| | precision | recall | f1-score | support |
| anxiety | 0.47 | 0.47 | 0.47 | 446 |
| bipolarreddit | 0.10 | 0.07 | 0.09 | 67 |
| depression | 0.55 | 0.58 | 0.56 | 1608 |
| lonely | 0.42 | 0.22 | 0.28 | 302 |
| parenting | 0.84 | 0.86 | 0.85 | 1200 |
| suicidewatch | 0.53 | 0.59 | 0.56 | 1061 |
| teaching | 0.82 | 0.58 | 0.68 | 120 |
| accuracy | | | 0.61 | 4804 |
| macro avg | 0.53 | 0.48 | 0.50 | 4804 |
| weighted avg | 0.61 | 0.61 | 0.60 | 4804 |

Figure 14. Classification report for filtered data

Figure 15 highlights significant variations in the model's performance across different categories. Notably:

The model excels in precision for the "Parenting" category, indicating a high proportion of correctly identified parenting posts among those predicted as such. Conversely, the precision for the "Bipolar" category is relatively lower, suggesting a higher likelihood of misclassifying posts as bipolar among those predicted.

The recall metric underscores the model's strong ability to capture a large proportion of actual parenting posts, as evidenced by the highest recall for this category. Conversely, the "Bipolar" category exhibits the lowest recall, indicating that the model may miss a significant number of actual bipolar posts.

The F1 score, which balances precision and recall, is highest for the "Parenting" category, reflecting a robust overall performance in this class. On the contrary, the "Bipolar" category demonstrates a lower F1 score, emphasizing challenges in achieving a balanced trade-off between precision and recall for bipolar posts.

Classification Report:

| | precision | recall | f1-score | support |
|---------------|-----------|--------|----------|---------|
| anxiety | 0.43 | 0.50 | 0.47 | 446 |
| bipolarreddit | 0.15 | 0.13 | 0.14 | 67 |
| depression | 0.56 | 0.48 | 0.52 | 1608 |
| lonely | 0.36 | 0.36 | 0.36 | 302 |
| parenting | 0.82 | 0.87 | 0.85 | 1200 |
| suicidewatch | 0.52 | 0.58 | 0.55 | 1061 |
| teaching | 0.73 | 0.53 | 0.62 | 120 |
| accuracy | | | 0.59 | 4804 |
| macro avg | 0.51 | 0.49 | 0.50 | 4804 |
| weighted avg | 0.59 | 0.59 | 0.59 | 4804 |

Figure 15. Classification report for overall data

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