

Analyzing Social Media Posts for Mental Health Disorder Detection

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It is to be understood that by this approval, the undersigned does not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn thereof, but approves the report only for the purpose for which it has been submitted.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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Abstract

This project aims to analyze social media posts for early detection of mental health disorders. Specifically, it focuses on using machine learning and deep learning algorithms to classify social media text data based on potential mental health issues. The problem lies in efficiently detecting patterns that indicate mental health conditions within large, unstructured datasets. Using methods like Logistic Regression , XGboost the project seeks to enhance the accuracy of detecting mental health concern with a specific probability. Expected results include a robust classifier capable of distinguishing between different mental health concerns with high accuracy. This project could provide a valuable tool for mental health monitoring on social platforms.

1 Introduction

1.1 Project Overview

Mental health has become a critical global issue, with millions of people affected by various mental disorders, including depression, anxiety, and others. With the increasing use of social media, these platforms have emerged as spaces where people often express their emotions and struggles, sometimes unknowingly revealing signs of mental health challenges. This project focuses on analyzing social media posts to detect mental health disorders using advanced machine learning techniques. By examining language patterns and contextual usage in text data, this project aims to classify posts that potentially indicate mental health issues. Such detection can facilitate early intervention and help direct individuals to appropriate mental health services.

1.2 Project Purpose

The main goal of this project is to leverage machine learning and deep learning to identify the best model and create a web application capable of identifying signs of mental health disorders from text, images and social media posts by giving username as input. This aligns with a broader goal of using technology to address public health concerns by enabling early detection through data analysis. Specifically, we use classification models such as Logistic Regression and XGboost to predict mental health issues based on text patterns. The project also addresses the technical challenges of processing large datasets and optimizing algorithms for accurate classification.

1.3 Technical Domain Specifications

This project falls within the intersection of natural language processing (NLP) and machine learning (ML), leveraging techniques such as text vectorization, and classification algorithms. Here are the key technical domain specifications:

- **Hardware :** The project does not require specialized hardware beyond a standard machine with adequate processing power. However, for larger datasets or complex model training, a machine equipped with a GPU (Graphics Processing Unit) could significantly reduce processing time. The project can be run on any system with at least 8GB of RAM and a multi-core processor.
- **Operating System :** The project is cross-platform and can be developed and executed on any modern operating system, including:
 - Windows 10/11
 - macOS
 - Linux distributions (Ubuntu, Linux Mint, etc.) A Linux-based system is often preferred in machine learning projects due to its stability and support for tools like TensorFlow, PyTorch, and other libraries used for model training.
- **Software :**
 - **Programming Languages :** Python 3.x will be the primary programming language, given its extensive libraries for machine learning, data analysis, and NLP.
 - **Libraries / Frameworks :**
 - * **Scikit-learn :** Used for machine learning algorithms (k-NN, SVM) and model evaluation.
 - * **Pandas :** For data manipulation and preprocessing.
 - * **NumPy :** To handle large arrays and matrices, which are crucial for efficient numerical computations.
 - * **NLTK and spaCy :** For text preprocessing and natural language understanding.
 - * **Matplotlib and Seaborn :** For data visualization.
 - **Development Environment :**
 - * **Jupyter Notebook :** For interactive development, experimentation, and visualization.
 - * **Anaconda :** A distribution that simplifies package management and deployment.

- * **Google Colab** : For cloud-based execution when working with larger datasets or GPU-based model training.

1.4 Business Domain Specifications

From a business perspective, this project holds significant value across various sectors, particularly those that intersect with mental health monitoring, public health awareness, and social media governance. With the increasing prevalence of mental health issues globally, organizations within these industries are searching for innovative solutions to mitigate the growing mental health crisis. Leveraging machine learning for early detection of mental health disorders from social media data can revolutionize how mental health is addressed at both individual and societal levels. Below is a detailed exploration of how this project can impact different business domains:

- **Mental Health Services** : Mental health service providers—such as hospitals, therapy centers, and private practices—can greatly benefit from machine learning models capable of identifying early signs of mental health issues from social media data. In the traditional mental health setting, early detection of disorders like depression or anxiety often relies on self-reporting or clinical assessments, which may come too late in the progression of the disorder. By analyzing patterns in social media posts, these services can adopt a more proactive approach, reaching out to potential patients earlier in their mental health journey.
- **Social Media Platforms** : Social media platforms like Twitter, Facebook, Instagram, and others play an integral role in the public's expression of thoughts and feelings, including mental health struggles. These platforms face increasing pressure to safeguard the well-being of their users. This project's machine learning models can enable these companies to offer valuable services to users while adhering to ethical standards.
- **Public Health Organizations** : Public health organizations are tasked with monitoring and improving the mental well-being of the population on a large scale. For these organizations, access to real-time data from social media can provide a comprehensive view of the mental health landscape, identifying emerging trends and enabling data-driven interventions. Understanding how mental health is being discussed online can help public health organizations create more effective mental health awareness campaigns. Tailored messaging based on the language patterns identified by the model can lead to better engagement with individuals suffering from mental health issues.

1.5 Glossary / Keywords

Term	Definition
Machine Learning (ML)	A subset of artificial intelligence (AI) that enables computers to learn from data and make predictions or decisions without explicit programming.
Natural Language Processing (NLP)	A branch of artificial intelligence focused on the interaction between computers and humans through natural language, including tasks like text analysis.
Support Vector Machines (SVM)	A supervised learning algorithm used for classification or regression tasks, focusing on finding a hyperplane that best separates different classes.
Vectorization	The process of converting textual data into numerical form (such as a vector) so that it can be used as input for machine learning models.
Classifier	A machine learning model or algorithm that categorizes or labels data points into predefined classes.
Mental Health Disorder	A wide range of conditions that affect mood, thinking, and behavior, including depression, anxiety, schizophrenia, etc.
Data Preprocessing	The process of preparing raw data for analysis by cleaning, normalizing, and transforming it into a usable format for machine learning models.
Cross-validation	A model validation technique used to assess how well a model performs by dividing data into training and testing sets multiple times for better accuracy.
Precision	In the context of classification, precision refers to the accuracy of positive predictions, calculated as the ratio of true positives to the sum of true and false positives.
Recall	In classification, recall measures the ability of a model to identify all relevant instances within a dataset, calculated as the ratio of true positives to the sum of true positives and false negatives.
PRAW	PRAW (Python Reddit API Wrapper) is a Python library that provides a simple interface to interact with Reddit's API, allowing developers to easily access, retrieve, and analyze Reddit data, such as posts, comments, and user information.
TesseractOCR	TesseractOCR is an open-source Optical Character Recognition (OCR) engine that extracts text from images with high accuracy; it is widely used for various applications like scanning documents and digitalizing printed text.

Term	Definition
Depression	There is a difference between depression and mood swings or short-lived emotional reactions to daily experiments; A mental state causing painful symptoms adversely disrupts normal activities (e.g., sleeping).
Anxiety	Several behavioral disturbances are associated with anxiety disorders, including excessive fear and worry. Severe symptoms cause significant impairment in functioning cause considerable distress. Anxiety disorders come in many forms, such as social anxiety, generalized anxiety, panic, etc.
Bipolar Disorder	An alternating pattern of depression and manic symptoms is associated with bipolar disorder. An individual experiencing a depressive episode may feel sad, irritable, empty, or lose interest in daily activities. Emotions of euphoria or irritability, excessive energy, and increased talkativeness can all be signs of manic depression. Increased self-esteem, decreased sleep need, disorientation, and reckless behavior may also be signs of manic depression.
Post-Traumatic Stress Disorder (PTSD)	In PTSD, persistent mental and emotional stress can occur after an injury or severe psychological shock, characterized by sleep disturbances, constant vivid memories, and dulled response to others and the outside world. People who re-experience symptoms may have difficulties with their everyday routines and experience significant impairment in their performance.

2 Related Studies

The intersection of social media analytics and mental health research has received increasing attention in recent years, leading to several important studies that highlight the potential for early detection and intervention. This section reviews key findings from various studies, emphasizing the relevance and applicability of social media data for identifying mental health disorders.

One of the seminal works in this domain is by Choudhury et al. (2013), who explored the predictive capabilities of social media content in identifying depression. They analyzed Twitter data and discovered that specific linguistic patterns, such as the use of negative emotion words, correlated strongly with self-reported depressive symptoms. This study demonstrated that social media could serve as a valuable resource for predicting mental health conditions, offering a potential tool for clinicians and researchers alike [2].

Similarly, Guntuku et al. (2017) conducted an integrative review that focused on detecting mental illness through social media. Their work synthesized various approaches and method-

ologies used in the field, providing insights into the effectiveness of different machine learning algorithms and sentiment analysis techniques. They found that social media platforms are rich sources of data that can reveal critical information about users' mental health, advocating for the development of robust systems to analyze this data effectively [3].

A systematic review by Mathur et al. (2022) further emphasized the significance of mental health classification on social media. They examined various studies that utilized machine learning techniques for mental health detection, highlighting the success of these models in identifying depression and anxiety based on user-generated content. Their findings reinforced the notion that social media can be leveraged not only for individual assessments but also for broader epidemiological studies to understand population mental health trends [4].

In addition, Nadeem (2016) contributed to the discussion by investigating depression identification on Twitter. The study focused on developing algorithms that could discern emotional cues in tweets, indicating a user's mental state. The findings revealed that simple text analysis could lead to significant improvements in identifying at-risk individuals, further validating the potential of social media data in mental health monitoring [5].

Research by AlSagri and Ykhlef (2020) introduced a machine learning-based approach specifically for depression detection on Twitter. Their study incorporated both content and activity features, demonstrating that a combination of linguistic and behavioral analysis could enhance the accuracy of depression identification. This work illustrated the multifaceted nature of social media data and its ability to capture not just what users say but also how they interact online [1].

In a more recent study, Vaishnavi et al. (2022) investigated the application of various machine learning algorithms for predicting mental health illnesses. They found that certain algorithms outperformed others in classifying mental health conditions based on social media posts. This study provided a comparative analysis that could inform future research directions, emphasizing the importance of algorithm selection in the context of mental health detection [7].

Lastly, Safa et al. (2023) presented a roadmap for future development in predicting mental health using social media. Their work highlighted the ongoing challenges in the field, including ethical considerations and the need for improved data privacy measures. They emphasized that while social media offers rich data for mental health analysis, researchers must approach this opportunity with a strong ethical framework to ensure user safety and data security [6].

These studies collectively underscore the growing body of evidence supporting the integration of social media analytics and machine learning for mental health detection. They provide a solid foundation for the current project, which aims to enhance existing methodologies and develop a predictive model for identifying mental health disorders from social media posts.

3 Problem Definition and Preliminaries

3.1 Context and Background

Mental health disorders have become a significant public health concern worldwide. The World Health Organization (WHO) estimates that approximately 1 in 8 people globally experience mental health disorders, which encompass conditions such as depression, anxiety, bipolar disorder, and post-traumatic stress disorder (PTSD). The rise of social media platforms has changed how individuals express their mental health struggles, share experiences, and seek support. Posts on platforms like Reddit and Twitter provide a wealth of data reflecting real-time sentiments, issues, and conversations surrounding mental health. However, this vast amount of unstructured textual data presents challenges in effectively identifying and categorizing specific mental health disorders.

3.2 Objective

The primary objective of this project is to develop a robust system that can automatically analyze social media posts, specifically from Reddit and Twitter, to detect various mental health disorders. By leveraging Natural Language Processing (NLP) techniques and machine learning algorithms, this project aims to:

- **Classify Posts :** Accurately classify social media posts based on the type of mental health disorder mentioned, including but not limited to depression, anxiety, bipolar disorder, and PTSD.
- **Data Driven Insights :** Provide valuable insights into the prevalence and expression of mental health issues on social media, helping researchers, mental health professionals, and policymakers understand trends and patterns.

3.3 Challenges

- **Data Variability :** Social media posts can vary significantly in structure, style, and length. Users may employ slang, abbreviations, and informal language, making it difficult for algorithms to accurately interpret and classify posts.

- **Imbalanced Data :** Certain mental health issues may be underrepresented in social media discussions, leading to an imbalanced dataset. This imbalance can adversely affect model training and performance, making it harder to detect less frequent disorders.
- **Cultural and Contextual Nuances :** Mental health perceptions and discussions can vary across different cultures and contexts. The model needs to account for these nuances to avoid misclassification and provide accurate insights.
- **Privacy and Ethical Considerations :** Analyzing social media data raises ethical concerns regarding user privacy. It is crucial to handle sensitive information responsibly and comply with data protection regulations.

3.4 Scope

The scope of the project "Analyzing Social Media Posts for Mental Health Disorder Detection" delineates the specific aspects that will be covered, the methodologies employed, and the boundaries within which the research and analysis will occur. The project aims to harness the potential of machine learning and natural language processing (NLP) techniques to analyze social media sentiment and its correlation with mental health disorders, focusing specifically on a Reddit Dataset sourced using Python Reddit API Wrapper. This dataset contains user-generated content that reflects various emotional states, making it a valuable resource for this analysis.

- **Dataset Selection and Characteristics**

The primary data source for this project is the top textual posts from Reddit. This dataset includes posts that are labeled with mental health issues (Normal, Anxiety, Depression, Bipolar, PTSD). The selection of this dataset is pivotal, as it encapsulates a wide range of mental health-related discussions expressed by individuals on social media. Key characteristics of the dataset include:

- **User Anonymity :** To respect user privacy and adhere to ethical standards, the dataset does not contain personally identifiable information (PII) about the Twitter users. This ensures compliance with data protection regulations while allowing for robust analysis.

- **Analysis Objectives**

The project will focus on several key objectives:

- **Correlation with Mental Health Issues :** The analysis will explore the correlation between identified sentiments and specific mental health disorders, thereby contributing to the understanding of how social media discourse reflects mental health challenges.

- **Trend Analysis :** By analyzing sentiment trends over time, the project seeks to identify patterns in public discourse surrounding mental health, including any potential spikes in negative sentiments during particular events or crises.
- **Methodologies :** The project will employ various methodologies to achieve its objectives, including:
 - **Data Processing :** Cleaning and preparing the dataset to ensure that it is suitable for analysis. This includes tasks such as removing noise (e.g., URLs, hashtags), tokenization, and normalization of text.
 - **Feature Extraction :** Utilizing techniques like Term Frequency-Inverse Document Frequency (TF-IDF) to convert textual data into numerical representations suitable for machine learning algorithms.
 - **Machine Learning Techniques :** Implementing various machine learning algorithms, including Logistic Regression and XGboost to classify posts and evaluate their performance based on accuracy, precision, recall, and F1 score.
 - **Data Visualizations :** Employing visualization tools to present findings clearly, including heat maps for confusion matrices and ROC AUC Curve.

3.5 Exclusions

In delineating the boundaries of the project "Analyzing Social Media Posts for Mental Health Disorder Detection," it is crucial to specify what is excluded from the scope of this research to maintain a clear focus on the primary objectives. This project will not encompass the direct collection or real-time monitoring of Twitter data via the Twitter API, as it is solely reliant on the pre-existing Twitter sentiment dataset obtained from Kaggle. Therefore, any analysis involving the dynamic aspects of social media engagement, such as real-time sentiment shifts in response to current events or trending topics, will be outside the project's purview. Furthermore, the study will not address the technicalities of Reddit's platform-specific features, such as hashtags, user mentions, or reposts, subreddits in detail, as these elements are not central to the primary research focus on mental issue classification of individual users. While the project aims to analyze posts surrounding mental health, it will also include mapping the mental issue with mental wellbeing. Additionally, the research will not explore the ethical implications of data ownership or the responsibilities of social media platforms regarding user-generated content, as the focus will be primarily on data analysis techniques and outcomes rather than the broader ethical landscape.

3.6 Assumptions

In the context of the project "Analyzing Social Media Posts for Mental Health Disorder Detection," several key assumptions underpin the research framework and methodologies employed. Firstly, it is assumed that the Reddit dataset obtained using PRAW is representative of broader social media discourse regarding mental health issues, capturing a diverse range of sentiments expressed by users on the platform. This assumption is critical as it establishes the foundation for analyzing sentiment trends and their potential correlations with various mental health disorders. Secondly, it is presumed that the posts recorded in the dataset accurately reflect the users' true emotions and perspectives at the time of posting, thereby providing valid data for analysis. Furthermore, it is assumed that the textual data within the dataset can be effectively processed and interpreted through natural language processing (NLP) techniques, allowing for the accurate classification of sentiments and identification of patterns. Another assumption is that the selected machine learning algorithms, including Logistic Regression and XGboost, will perform optimally with the provided data, leading to reliable and interpretable results regarding sentiment analysis and mental health correlations. Additionally, it is assumed that the sentiments expressed in social media posts can serve as a valid proxy for understanding public perceptions of mental health, enabling insights into societal attitudes and the potential stigmatization associated with these disorders. The project also assumes that the cleaning and preprocessing steps applied to the data will sufficiently prepare the dataset for analysis, minimizing noise and irrelevant information that could skew the results. Lastly, it is presumed that the ethical considerations surrounding the use of publicly available social media data have been adequately addressed, ensuring that the research adheres to relevant ethical standards and does not compromise user privacy or data integrity. These assumptions serve as the bedrock for the project's analytical framework, guiding the research processes and interpretations that follow.

4 Proposed Solution

The proposed work centers around "Analyzing Social Media Posts for Mental Health Disorder Detection," leveraging advanced data analytics and machine learning techniques to provide insights into the sentiments expressed in social media discussions related to mental health issues. This research is significant due to the increasing prevalence of mental health disorders globally and the role social media plays in shaping public perception and discourse around these issues. The core objective of this project is to develop a systematic approach to classify sentiments in tweets, thereby enabling better understanding and awareness of mental health conditions through social media analysis. Below, I outline the specific contributions and reusable components deployed in this project.

4.1 Special Contributions

- **Dataset Acquisition and Preparation :** The initial step involved sourcing a high-quality dataset from Kaggle, specifically the Twitter sentiment dataset. This dataset comprises user-generated tweets containing sentiments related to various mental health issues, serving as the primary data source for analysis. The preparation phase included extensive data cleaning and preprocessing, wherein missing values were handled, duplicate entries removed, and text normalization performed. This crucial step ensured the dataset's integrity and suitability for subsequent analysis, allowing for a more accurate representation of sentiments.
- **Text Vectorization :** To enable machine learning models to interpret textual data, TF-IDF was implemented. This approach involved converting posts into a numerical format by creating a matrix representation of word frequencies across the dataset. The Scikit-learn library was instrumental in this process, offering functions for text vectorization and feature extraction. The reusable components for text preprocessing and vectorization were packaged into functions, allowing for easy application to future datasets or similar projects.
- **Implementation of Machine Learning Algorithms :** The project employed several machine learning algorithms, focusing primarily on Logistic Regression and XGboost for mental health classification. The Logistic Regression algorithm was chosen for its simplicity and effectiveness in classifying data points based on proximity in the feature space. In addition to Logistic Regression, XGboost was implemented due to its robustness in handling high-dimensional data and multi class classification tasks.
- **Model Evaluation :** Comprehensive evaluation metrics were employed to assess the performance of the machine learning models. Metrics such as accuracy, precision, recall, and F1-score were calculated to provide a holistic view of model effectiveness in classifying sentiments related to mental health. This evaluation process not only demonstrated the models' capabilities but also highlighted areas for improvement, providing a foundation for future iterations of the project. The evaluation framework, including metrics calculations and visualization, was designed as reusable components to streamline future model assessments.
- **Insights and Recommendations :** A critical aspect of this project is the generation of actionable insights based on the analysis of social media sentiments. The findings from the classification can inform mental health professionals, researchers, and policymakers about public sentiment trends, potential stigma associated with mental health issues, and

the effectiveness of awareness campaigns. Recommendations for mental health awareness strategies can be derived from understanding how sentiments vary across different demographics and regions. This interpretative analysis, combined with quantitative results, contributes valuable knowledge to the ongoing conversation about mental health in society.

- **Documentation and Reproducibility :** To enhance the usability and impact of the project, thorough documentation was maintained throughout the research process. This documentation includes detailed explanations of the methodologies employed, code snippets, and instructions for reproducing the results. The aim is to ensure that the components developed in this project can be easily utilized by other researchers and practitioners in the field. By documenting the code and methodologies, I am contributing to the open-source community, allowing for collaborative improvements and innovations in mental health sentiment analysis.

4.2 Reusable Components

- **Data Collection Functions :** Modular functions designed for data collection, which can be reused across different platforms.
- **Data preprocessing Module :** A component that does data cleaning to remove the duplicates and empty rows and add a separate column for cleaned texts. This formatted dataset is then used further with TF-IDF to create a numerical matrix to be fed to the machine learning algorithms.
- **Machine and Deep Learning Model Functions :** Functions for implementing Logistic Regression, Naive Bayes, Support Vector Machine, Random Forest, XGboost, Long Short Term Memory algorithm allowing for easy retraining on varying datasets. These also features various evaluation metrics, making it easy to assess different models' performances.
- **Deployment Function :** A separate function that has the main python file for creating web based application on Streamlit Cloud. This also includes the requirements and package dependencies for deploying the application.

5 Project Planning

5.1 Software Life Cycle Model

In developing the project, I adopted an iterative approach to the Waterfall model, enabling a structured yet flexible framework for managing the various phases of the project. The project

plan outlines specific tasks, dependencies, timelines, and milestones to ensure a systematic progression towards the final goal of analyzing social media posts for mental health disorder detection.

The Iterative Waterfall model was chosen for this project due to its structured approach while allowing for iterative revisions and refinements. Unlike the traditional Waterfall model, which emphasizes a linear progression through distinct phases, the iterative variant permits revisiting earlier stages based on findings and feedback. This flexibility is particularly beneficial in data-driven projects where insights gained during the analysis may necessitate adjustments to earlier stages, such as refining requirements or enhancing data preparation techniques.

In this project, the iterative nature of the Waterfall model facilitated ongoing improvement and adaptation throughout the development process. For example, initial results from the model evaluation phase may prompt a revisit to data preprocessing to enhance data quality or to explore alternative modeling techniques. This approach ultimately fosters a more robust final product, ensuring that the developed system meets the dynamic needs of mental health disorder detection in social media posts.

The key feature of the iterative approach is the feedback loop that exists between the phases. For instance, after completing the testing phase, if certain models do not meet performance expectations, the project can loop back to the implementation phase. This allows for modifications to the models, preprocessing techniques, or even revisiting the requirements to ensure alignment with the project's objectives.

The project is divided into distinct phases:

- **Requirement Gathering and Analysis :** This initial phase involved understanding the project's goals, objectives, and stakeholder expectations. It spanned approximately two weeks, culminating in a detailed requirements document that guided the subsequent stages.
- **Data Collection and Preparation :** Utilizing a Twitter sentiment dataset from Kaggle and Reddit API, the data collection phase was executed over a week. This included downloading the dataset, examining its structure, and performing data cleaning and prepossessing to ensure its suitability for analysis.
- **Model Development :** This phase, lasting about three weeks, included the creation of a Bag of Words model, splitting the dataset into training and test sets, and implementing various machine learning algorithms such as k-Nearest Neighbors (k-NN) and Support Vector Machines (SVM) for sentiment classification.

- **Model Evaluation** : Following model development, a week was allocated for rigorous testing and validation of the models, ensuring they met the required accuracy benchmarks. This phase involved using performance metrics such as accuracy, precision, recall, and F1-score to evaluate the models' effectiveness.
- **Final Deployment and Documentation** : The last phase, spanning two weeks, focused on deploying the best-performing model and creating comprehensive documentation. This included user manuals and technical documentation to facilitate future maintenance and enhancements.

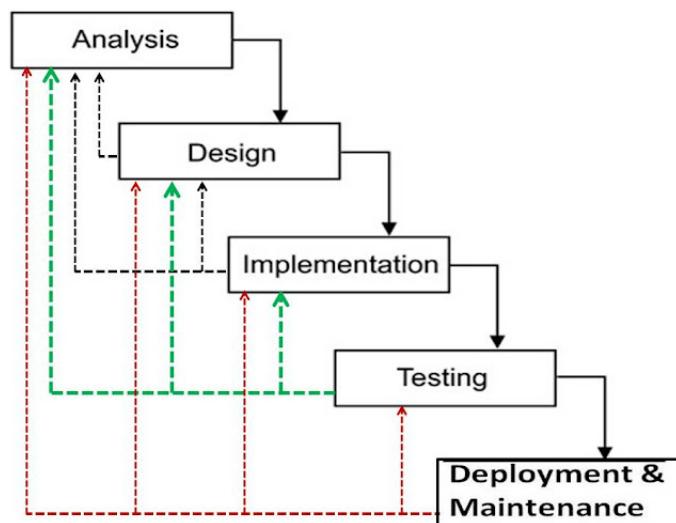


Figure 1: Iterative Waterfall Model

5.2 Dependencies and Milestones

Key dependencies were identified for successful project progression. For instance, completion of the data preparation phase was critical before proceeding to model development. Milestones were established at the end of each phase to ensure accountability and track progress. The successful completion of the requirement gathering phase marked the first milestone, followed by the data preparation phase, and so on.

5.3 Scheduling

Effective scheduling is crucial to the success of any project, as it establishes a clear timeline for tasks, milestones, and dependencies. In the context of our project on detecting mental health disorders through social media analysis, a detailed schedule has been developed to guide the project from inception to completion. This schedule includes specific tasks such as requirement gathering, data preprocessing, model implementation, testing, and deployment, each with

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clearly defined deadlines. The iterative nature of our chosen methodology allows for flexibility within the schedule, enabling adjustments based on testing outcomes and stakeholder feedback. Key milestones, such as the completion of data analysis, model validation, and user acceptance testing, have been identified to monitor progress and ensure timely delivery of the final product. By utilizing project management tools, such as Microsoft Project, we can visualize and track the progress of tasks, manage resources effectively, and maintain open communication among team members, ensuring that the project stays on schedule and meets its objectives. This proactive approach to scheduling enhances our ability to deliver a high-quality solution that aligns with our goals and stakeholder expectations.

Task Mode	Task Name	Duration	Start	Finish	Predecessors
➡	▫ Analyzing Social Media Posts for Mental Health Disorder Detection	109 days	Wed 03-07-24	Sat 30-11-24	
➡	Feasibility Study	6 days	Wed 03-07-24	Wed 10-07-24	
➡	▫ Requirements Analysis	15 days	Thu 11-07-24	Wed 31-07-24	
➡	Requirements Gathering	9 days	Thu 11-07-24	Tue 23-07-24	2
➡	Analysis Of Requirements	6 days	Wed 24-07-24	Wed 31-07-24	2
➡	▫ Design	15 days	Thu 01-08-24	Wed 21-08-24	
➡	High Level Design	8 days	Thu 01-08-24	Mon 12-08-24	5
➡	Low Level Design	7 days	Tue 13-08-24	Wed 21-08-24	7
➡	▫ Coding	30 days	Thu 22-08-24	Wed 02-10-24	
➡	Data Collection and Preprocessing	10 days	Thu 22-08-24	Wed 04-09-24	8
➡	Model Development	15 days	Thu 05-09-24	Wed 25-09-24	10
➡	Refining Models	1 day	Thu 26-09-24	Thu 26-09-24	11
➡	▫ Testing	25 days	Thu 03-10-24	Wed 06-11-24	
➡	Unit Testing	5 days	Thu 03-10-24	Wed 09-10-24	12
➡	Integration Testing	5 days	Thu 10-10-24	Wed 16-10-24	14
➡	System Testing	9 days	Thu 17-10-24	Tue 29-10-24	15
➡	Acceptance Testing	6 days	Thu 17-10-24	Thu 24-10-24	15
➡	▫ Deployment and Documentation	13 days	Thu 07-11-24	Mon 25-11-24	
➡	Deployment	8 days	Thu 07-11-24	Mon 18-11-24	17
➡	Documentation	5 days	Tue 19-11-24	Mon 25-11-24	19
➡	Delivery	1 day	Tue 26-11-24	Tue 26-11-24	20

Figure 2: Project Plan

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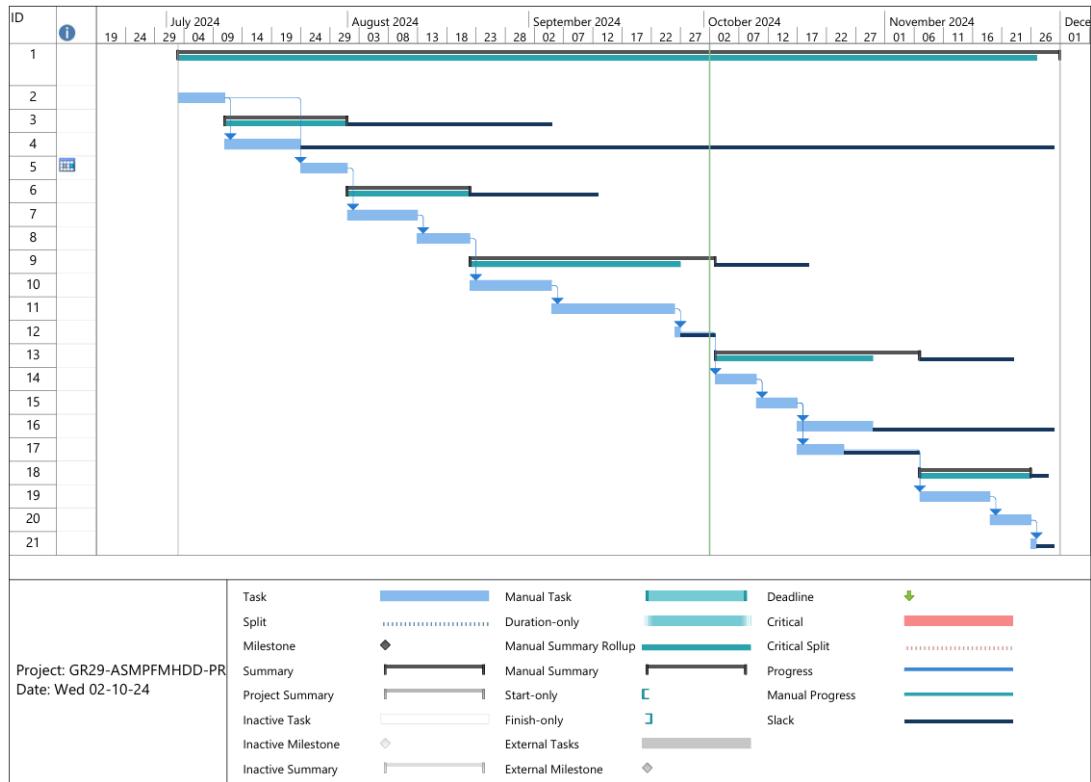


Figure 3: Gantt Chart

6 Requirement Analysis

6.1 Requirement Matrix

A	B	C	D	E	F	G	H	I
Requirement ID	Requirement Description	Priority	Category	Source	Status	Dependencies	Assigned To	Verification
FR-001	Collect and preprocess social media data from Kaggle and Reddit.	High	Functional	Stakeholder	Completed	RQ-002	Data Team	Data Analysis Review
FR-002	Implement data cleaning and feature extraction for NLP.	High	Functional	Project Docs	Completed	RQ-001	Development Team	Feature Verification
FR-003	Train machine learning and deep learning models (k-NN, SVM) for sentiment analysis.	High	Functional	Stakeholder	Completed	RQ-001, RQ-002	ML Team	Model Accuracy Testing
FR-004	Evaluate models using performance metrics (accuracy, recall, F1).	High	Functional	Stakeholder	Completed	RQ-003	ML Team	Performance Report
NFR-001	Document all technical and user aspects of the final solution.	Medium	Non Functional	Stakeholder	Completed	RQ-004	Documentation Team	Peer Review
NFR-002	Ensure model deployment is done on a scalable platform.	Medium	Non Functional	Project Docs	Completed	RQ-003, RQ-004	Development Team	System Testing

Figure 4: Requirement Matrix

The Requirement Matrix is a comprehensive tool used to track and manage the key requirements of a project. It systematically organizes each requirement with a unique identifier, description, priority, and category (such as functional or non-functional). The matrix also records the source of the requirement, its current status (e.g., in progress, completed), any dependencies on other

requirements, and the team or individual responsible for fulfilling it. Additionally, it includes a verification method to ensure the requirement is met, such as through testing or review. This structured format helps ensure that all requirements are clearly defined, prioritized, and tracked, enabling effective project management and ensuring alignment with stakeholder expectations.

6.2 Requirement Elaboration

6.2.1 Functional Requirements

Requirement ID: *FR-001*

Description: *Data Collection*

Priority: *High*

Category: *Functional*

The system requires an ability to collect and ingest a large dataset of Reddit posts using Python Reddit API Wrapper. The data should include text content from tweets, associated sentiment labels, and other metadata such as timestamp and user details. This will serve as the primary source of information for mental health disorder detection. The system must ensure that the dataset is loaded correctly into the machine learning environment, and any discrepancies in the structure should be handled with pre-processing steps like cleaning, normalization.

Requirement ID: *FR-002*

Description: *Data Cleaning and Preprocessing*

Priority: *High*

Category: *Functional*

The system must include modules to clean the raw data, such as removing irrelevant characters, handling missing data, and tokenizing text. For the social media posts, it is essential to remove URLs, stopwords, and unnecessary punctuation. The pre-processing pipeline should also convert the text into a suitable numerical format using Term Frequency-Inverse Document Frequency (TF-IDF) for further analysis. Proper pre-processing ensures that the data is in a form that can be efficiently used by machine learning models.

Requirement ID: *FR-003*

Description: *Sentiment and Disorder Detection Model*

Priority: *High*

Category: *Functional*

The system needs to implement machine learning algorithms such as Logistic Regression and XGBoost to classify social media posts based on text and detect potential signs of mental health disorders. The system must be able to train these models on historical data and then apply them

to predict the sentiment and detect mental health-related issues in new posts.

Requirement ID: FR-004

Description: Model Validation and Evaluation

Priority: High

Category: Functional

The system must evaluate the performance of the trained models by splitting the dataset into training and test sets. Various performance metrics like accuracy, precision, recall, and F1-score should be computed to assess the model's effectiveness in detecting mental health disorders. Based on the evaluation, the system should allow for model fine-tuning, such as adjusting hyperparameters, to improve the overall performance.

6.2.2 Non Functional Requirements

Requirement ID: NFR-001

Description: Documentation

Priority: Medium

Category: Non Functional

The addition of documentation and maintenance manuals as a non-functional requirement ensures that the system is not only usable in the short term but also maintainable and extensible over time. This guarantees that future updates and improvements to the system can be implemented without disrupting existing functionality or requiring a steep learning curve for new developers or users.

Requirement ID: NFR-002

Description: Scalability

Priority: Medium

Category: Non Functional

The system must be designed to efficiently process large volumes of data, considering the potential growth in the amount of social media posts that need to be analyzed. The data processing pipeline should be scalable to handle increasing data size without significant degradation in performance. This could involve implementing parallel processing techniques or leveraging cloud-based infrastructure to ensure that processing large datasets remains feasible even as the dataset scales.

7 Design

7.1 Technical Environment

The technical environment for the project "Analyzing Social Media Posts for Mental Health Disorder Detection" comprises a combination of hardware, software, and tools that enable smooth data analysis, machine learning model training, and deployment. Below is a detailed overview of the minimum hardware configuration, software tools, and package details necessary to carry out this project effectively.

Minimum Hardware Configuration

Given the nature of the project, which involves processing textual data and training machine learning models, the hardware requirements are modest but significant enough to ensure optimal performance. The minimum configuration needed is:

- **Processor :** Intel Core i5 (or equivalent) with a base clock speed of at least 2.5 GHz. A multi-core processor is preferred as it helps in parallel processing, which is essential during model training and data preprocessing steps.
- **RAM :** 8 GB of RAM is recommended to handle the operations of data loading, cleaning, and transformation. Large datasets, like those used in this project, may require more memory to prevent memory overflow errors and reduce delays during processing. For larger datasets, 16 GB of RAM would be ideal.
- **Storage :** At least 256 GB of SSD storage is recommended. Faster storage access significantly impacts loading time for datasets and dependencies. SSD is preferred over traditional HDD because of its faster read/write speeds, which benefit large datasets like the Reddit-based social media posts used in this project.
- **Graphics Processing Unit (GPU) :** For basic machine learning tasks like Logistic Regression or SVM, a dedicated GPU is not necessary. However, if deep learning models or more complex neural networks were introduced later, a GPU like NVIDIA GTX 1060 with 4 GB VRAM or higher would be advantageous.
- **Operating System :** Windows 10 (64-bit) or higher, macOS 10.13 (High Sierra) or higher, or any stable Linux distribution (e.g., Ubuntu 18.04 or higher). The operating system should support all necessary machine learning libraries and be compatible with the tools required for the project.

Software Tools and Packages

For the software stack, the project leverages a set of well-established tools, platforms, and programming libraries to ensure smooth execution from data preprocessing to model deployment:

- **Python** : The primary programming language used for data processing, model training, and evaluation. Python is chosen due to its rich ecosystem of libraries and frameworks tailored for machine learning and data science.
- **Pandas** : A powerful library for data manipulation and analysis, essential for data pre-processing tasks, such as handling missing values and restructuring datasets.
- **scikit-learn** : A comprehensive machine learning library in Python used for implementing and comparing algorithms in classification, regression, and clustering, along with various model evaluation tools.
- **Streamlit** : An open-source Python framework that facilitates the deployment of machine learning models and interactive web applications.
- **Pyngrok** : A Python wrapper for ngrok, used to create secure tunnels to locally deployed applications, which is particularly useful for sharing Streamlit applications over the web.
- **Google Colab** : A cloud-based platform used for writing, executing, and sharing Python code, with access to GPU and TPU resources, beneficial for model training. It integrates seamlessly with libraries like TensorFlow and PyTorch.
- **PRAW (Python Reddit API Wrapper)** : A Python library that allows for easy interaction with the Reddit API to access, retrieve, and analyze Reddit data, such as posts, comments, and user information.
- **pytesseract** : A Python wrapper for Tesseract OCR, used to extract text from images. It's essential for converting image-based text data into a format suitable for processing.
- **Pillow** : A Python Imaging Library that adds support for image processing, which aids in handling image files for text recognition tasks with pytesseract.
- **joblib** : A library for efficient serialization and deserialization of Python objects, especially useful for saving and loading machine learning models during deployment.
- **protobuf** : A protocol buffer library by Google used for serializing structured data, helpful in efficient data exchange between applications.
- **deep-translator** : A library that facilitates easy translation across different languages, enabling multilingual processing of text data.

- **Requests** : A user-friendly library for making HTTP requests, used to retrieve data from APIs or web resources as part of data collection.
- **google-generativeai** : A Python client library for Google's generative AI models, providing tools to integrate and utilize AI functionalities within the project.

7.2 Hierarchy of Modules

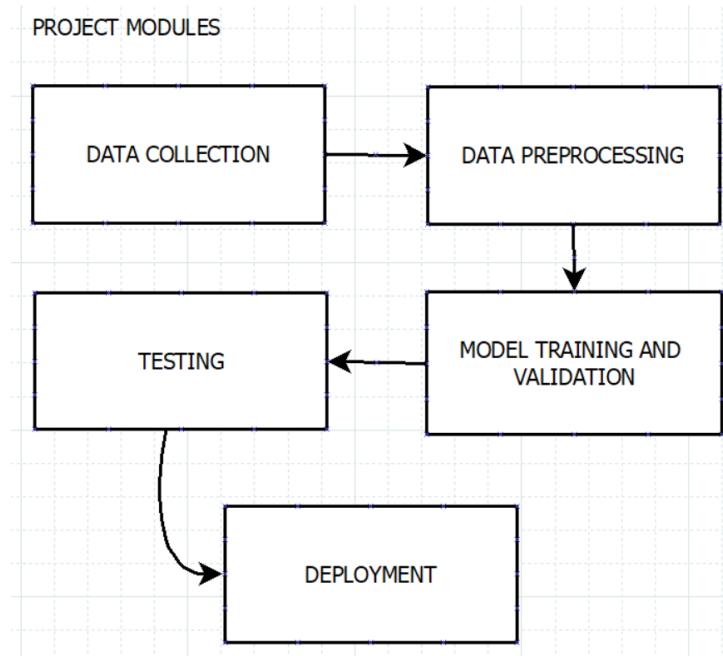


Figure 5: Project Modules

In this project, the system is structured into key modules to classify mental health issues based on text input effectively. The **Data Collection Module** gathers relevant text data, building a comprehensive dataset from sources like CSV files or platforms such as Reddit via PRAW. Next, the **Data Preprocessing Module** loads and cleans this data through tokenization, stop-word removal, and lemmatization, preparing it for analysis. Following this, the **Model Training and Validation Module** converts the text into numerical features using techniques like TF-IDF, splitting the data into training and validation sets to test various machine learning models, including Logistic Regression, Naive Bayes, SVM, Random Forest, XGboost and LSTM. Finally, the **Testing and Deployment Module** allows real-time predictions by deploying the model on platforms like Streamlit Cloud, providing an accessible solution for practical applications.

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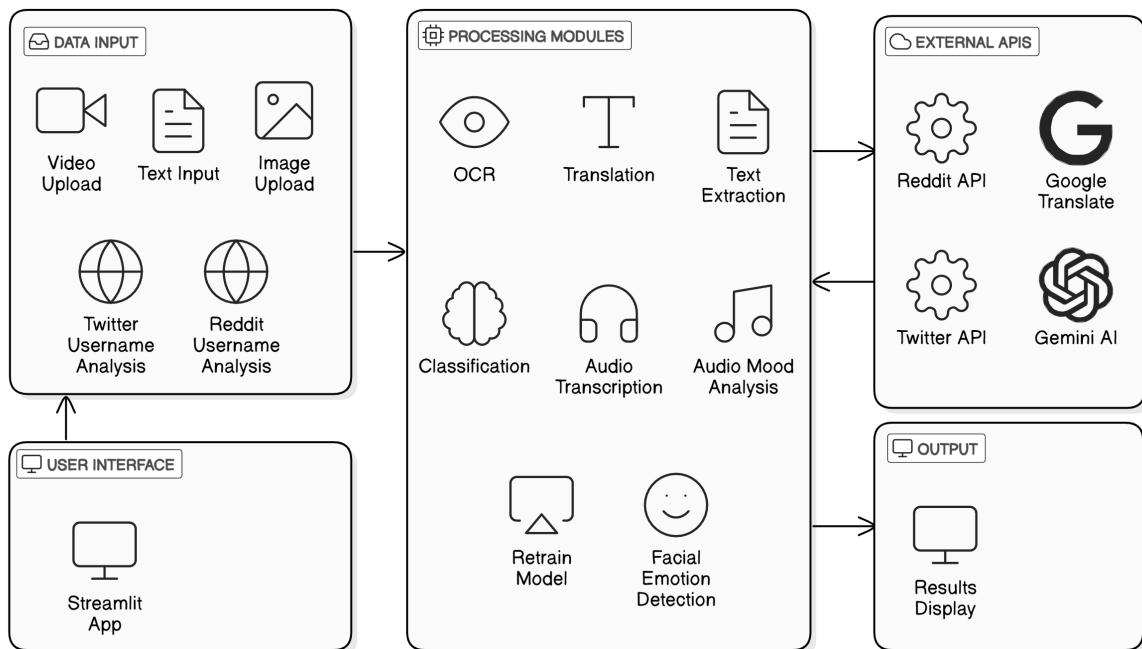


Figure 6: System Overview

ML Model Workflow

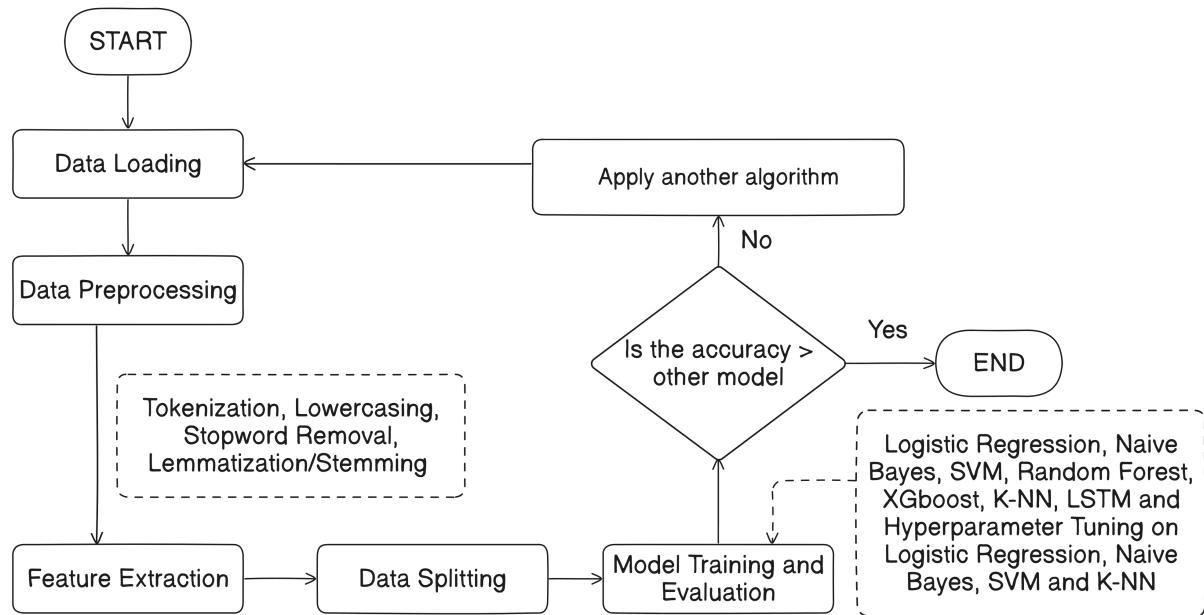


Figure 7: Model Workflow

7.3 Detailed Design

7.3.1 Data Loading and Preprocessing

The Data Loading and Preprocessing Module is the foundation of the system, responsible for ingesting and preparing the text data for analysis. This module begins by loading the dataset from the preprocessed_mental_health_text.csv file, which contains various mental health-related text entries. Once the data is loaded, a series of preprocessing steps are conducted to ensure the text is clean and ready for feature extraction. This includes tokenization, where the text is split into individual words or tokens, and lowercasing to maintain uniformity across the dataset. Additionally, stop-word removal is performed to eliminate common words that do not contribute to the meaning, such as "and," "the," and "is." Finally, lemmatization or stemming is applied to reduce words to their base or root forms. These preprocessing techniques are crucial as they help improve the quality of the input data, ultimately leading to better model performance.

7.3.2 Feature Extraction

In the Feature Extraction Module, the preprocessed text data is transformed into a numerical format that machine learning algorithms can process. This module allows for the selection between two primary feature extraction methods: Term Frequency-Inverse Document Frequency (TF-IDF). The TF-IDF approach evaluates the importance of words in the dataset by considering their frequency in individual documents relative to their overall occurrence across all documents. This helps in highlighting the most informative words. By converting text into numerical features, this module prepares the data for the subsequent training and validation stages, ensuring that the classification models can effectively interpret the input.

7.3.3 Model Training and Validation

The Model Training and Validation Module is critical to developing a robust classification system. In this module, the dataset is split into training and testing sets to evaluate the performance of the models accurately. Various classification algorithms are employed, including Logistic Regression, Naive Bayes, Support Vector Machines, Random Forest, XGboost, K-Nearest-Neighbours and LSTM. Each model is trained on the training set, which involves adjusting the model parameters based on the input features and their corresponding labels. Following training, the models undergo validation to assess their performance using various metrics such as accuracy, precision, recall, and F1-score. A decision point is included to determine if the achieved accuracy meets the project requirements. If the accuracy is deemed acceptable, the model is accepted.

7.3.4 Prediction

The Prediction Module is designed to provide real-time classification of new input text related to mental health issues. Upon receiving user input, this module initiates a preprocessing workflow that mirrors the steps applied during the training phase, including tokenization, lowercasing, stop-word removal, and lemmatization or stemming. Once the input text is preprocessed, it is fed into the trained classification models to generate predictions. Each model may provide a classification result, allowing for a comprehensive analysis of the input. This module not only delivers the predicted mental health issue but also ensures that users receive an informative output that reflects the confidence level of each prediction, enabling them to understand the model's reasoning.

7.3.5 Testing and Deployment

The module focuses on making the trained models accessible for real-time predictions. Once the models have been validated and selected based on their performance, this module prepares them for deployment on suitable platforms like Streamlit Cloud. This involves packaging the models and creating a user interface where users can input text and receive predictions. The deployment process also includes considerations for scaling, ensuring that the system can handle multiple requests simultaneously while maintaining responsiveness. By providing a free and efficient deployment solution, this module enables users to access the mental health classification service easily. The deployment of the models ensures that the insights generated from the analysis can be utilized effectively in real-world applications.

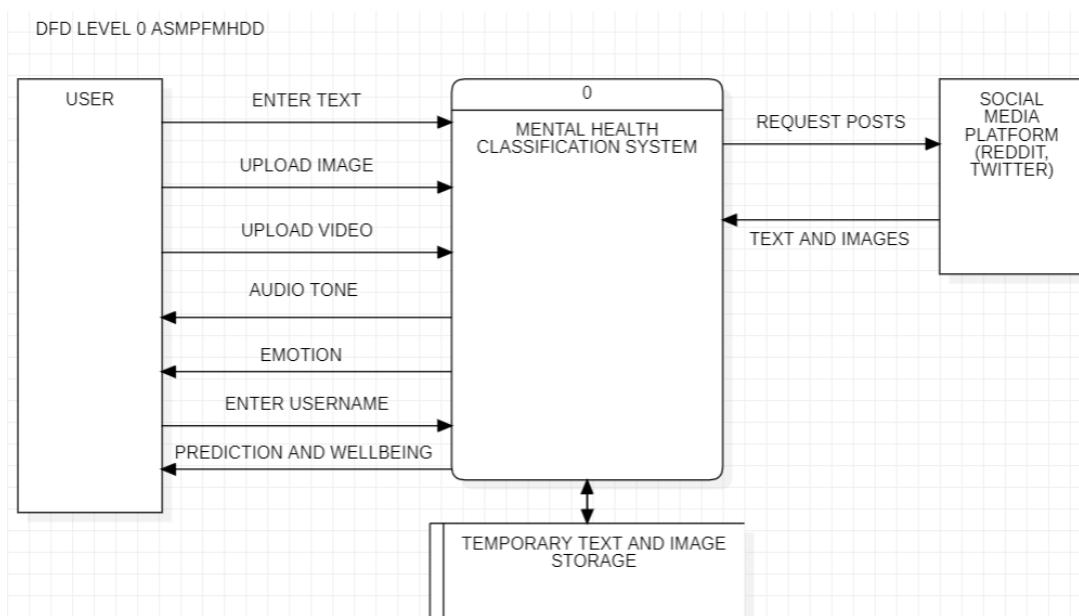


Figure 8: DFD Level 0 of the System

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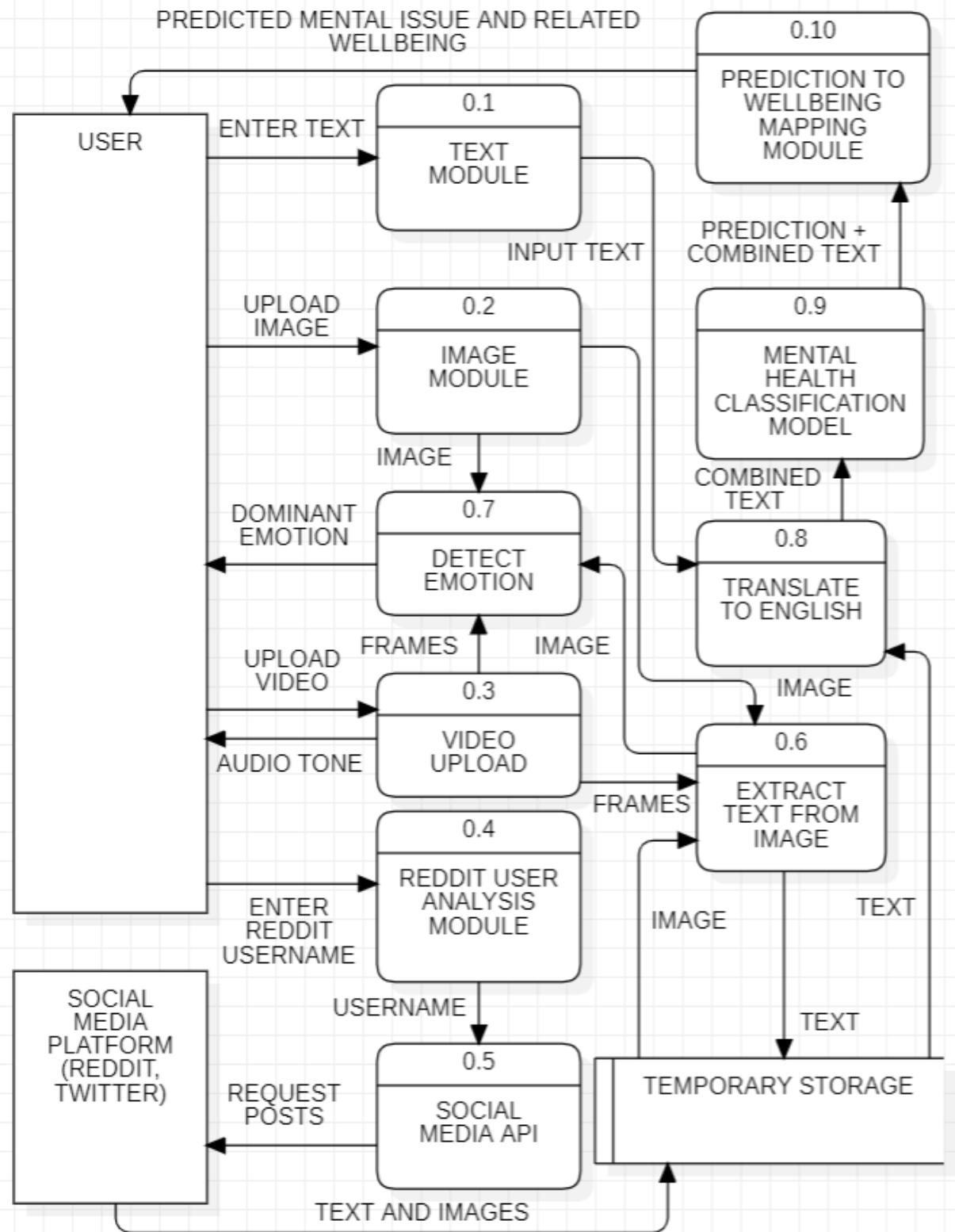


Figure 9: DFD Level 1 of the System

8 Implementation

8.1 Features From RM

For the initial prototype development, a subset of the requirements from the Requirement Matrix (RM) was carefully selected to focus on implementing core functionalities and demonstrating proof of concept. The selection was based on a combination of high-priority functional requirements that form the backbone of the system, ensuring that critical features are built and validated before expanding the scope.

The requirements chosen for the prototype primarily involve data preprocessing, model training, and evaluation processes. These requirements were selected because they are fundamental to the project's success, ensuring that the data pipeline and model implementation work seamlessly together. This subset of features lays the groundwork for later integration with additional components and more complex functionality.

The filtered part of the RM focuses on the following high-priority requirements: data cleaning and feature extraction, training of machine learning models, and evaluation of model performance using standard metrics. These requirements were identified as crucial because they directly impact the system's ability to handle data, learn patterns, and provide meaningful outputs. Without successfully implementing these core features, the overall effectiveness of the solution would be significantly reduced.

Furthermore, these selected features align with the project's goals and provide a clear pathway for incremental development. By narrowing down the requirements to these foundational aspects, the development team can ensure that the prototype is not only functional but also extensible, providing a robust framework for future enhancements.

	A Requirement ID	B Requirement Description	C Priority	D Category
1				
2	FR-001	Collect and preprocess social media data from Kaggle and Reddit.	High	Functional
3	FR-002	Implement data cleaning and feature extraction for NLP.	High	Functional
4	FR-003	Train machine learning and deep learning models (k-NN, SVM) for sentiment analysis.	High	Functional
5	FR-004	Evaluate models using performance metrics (accuracy, recall, F1).	High	Functional

Figure 10: Features from Requirement Matrix

8.2 Code Details and Output

8.2.1 Data Collection

Collecting Reddit Posts

```

import praw
import pandas as pd
import time
# Initialize Reddit API
reddit = praw.Reddit(client_id='YOUR_CLIENT_ID',
                      client_secret='YOUR_CLIENT_SECRET',
                      user_agent='Mental_Health_Classifier')
# Define subreddits and post types
subreddits = {'normal': ['news', 'AskReddit'],
              'depression': ['depression'],
              'ptsd': ['PTSD'],
              'anxiety': ['Anxiety'],
              'bipolar': ['BipolarReddit']}
post_types = ['hot', 'new', 'top']
posts_per_type = 100
# Collect and save posts
data = []
for label, subs in subreddits.items():
    for sub in subs:
        for post_type in post_types:
            posts = getattr(reddit.subreddit(sub), post_type)(
                limit=posts_per_type)
            for post in posts:
                data.append([post.title + "\n" + post.selftext,
                            label])
                time.sleep(1)
df = pd.DataFrame(data, columns=['text', 'label'])
df.to_csv(f'{label}_dataset.csv', index=False)

```

		text	mental_health_issue
0	2024 Election Due to the 2024 US Presidential ...		bipolar
1	Our most-broken and least-understood rules is ...		depression
2	Rules **UPDATED** 1. If you're here you must p...		normal
3	Happy Cakeday, r/Normal! Today you're 11 Let's...		normal
4	Happy Cakeday, r/Normal! Today you're 10 Let's...		normal
5	I am also a person I am very normal. Today I t...		normal
6	Happy Cakeday, r/Normal! Today you're 9 Let's ...		normal
7	I am a person I am a person		normal
8	Elections and Politics Hello friends!\n\nIt's ...		anxiety
9	You are more than just one emotion		ptsd

Figure 11: Obtained Dataset

Combining Collected Datasets

```

import pandas as pd
from sklearn.utils import shuffle

# Load datasets
bipolar_df = pd.read_csv("bipolar_dataset.csv")
depression_df = pd.read_csv("depression_dataset.csv")
normal_df = pd.read_csv("normal_dataset.csv")
anxiety_df = pd.read_csv("anxiety_dataset.csv")
ptsd_df = pd.read_csv("ptsd_dataset.csv")

# Minimum length for balanced classes
min_length = min(len(bipolar_df), len(depression_df), len(
    normal_df) // 6, len(anxiety_df), len(ptsdf))

# Create balanced pattern
pattern_data = []
for i in range(min_length):
    pattern_data.extend([bipolar_df.iloc[i], depression_df.
        iloc[i]] +
        normal_df.iloc[i*6:(i+1)*6].to_dict(
            'records') +
        [anxiety_df.iloc[i], ptsd_df.iloc[i
            ]])

pattern_df = pd.DataFrame(pattern_data)
remaining_data = shuffle(pd.concat([bipolar_df[min_length:],

depression_df[min_length:],

normal_df[min_length
*6:], anxiety_df[
min_length:], ptsd_df
[min_length:]]))

final_df = pd.concat([pattern_df, remaining_data]).reset_index(drop=True)
final_df.to_csv("mental_health_combined.csv", index=False)

```

The first code snippet collects Reddit posts by connecting to specific subreddits associated with various mental health topics. Using the Reddit API, posts are retrieved from ‘hot’, ‘new’, and ‘top’ categories for each mental health type, including general subreddits (for the “normal” category). Each post’s title and content are combined, labeled, and saved into separate CSV files. The second code snippet merges these CSV files to form a combined dataset. It creates a balanced sample by selecting the minimum number of rows across each category and organizes the data in a structured pattern. Remaining rows are shuffled and appended, producing a final dataset suitable for machine learning applications in mental health classification.

8.2.2 Data Preprocessing

Text Preprocessing

```

import pandas as pd
import re
from sklearn.feature_extraction.text import
    TfidfVectorizer
from nltk.corpus import stopwords
from nltk.tokenize import word_tokenize
import nltk

# Download stopwords (if you haven't already)
nltk.download('stopwords')
nltk.download('punkt')

# Load the dataset
df = pd.read_csv('mental_health.csv')

# 1. Handling Missing Values
df.dropna(subset=['text'], inplace=True)

# 2. Removing duplicates (if any)
df.drop_duplicates(subset=['text'], inplace=True)

# 3. Text Preprocessing
negative_words = {"not", "no", "nor", "never", "nothing",
                  "nowhere", "neither", "cannot", "n't", "without", "barely",
                  "hardly", "scarcely"}

def clean_text(text):
    text = re.sub(r'http\S+', '', text) # Remove URLs
    text = re.sub(r@\w+, '', text) # Remove mentions
        (@username)
    text = re.sub(r'[^a-zA-Z\s]', '', text) # Remove
        special characters, numbers, and punctuations
    text = text.lower() # Convert text to lowercase
    tokens = word_tokenize(text) # Tokenize the text
    tokens = [word for word in tokens if word not in
              stopwords.words('english') or word in
              negative_words] # Remove stopwords, but keep
              negative words
    clean_text = '_'.join(tokens) # Join the tokens
        back into a single string
    return clean_text

df['cleaned_text'] = df['text'].apply(clean_text) #
    Apply the cleaning function to the 'text' column

```

Text Preprocessing

```

# 4. Feature Extraction using TF-IDF Vectorization
vectorizer = TfidfVectorizer(max_features=10000) #
    Adjust the max_features
X = vectorizer.fit_transform(df['cleaned_text']) # Fit
    and transform the cleaned text data
X_df = pd.DataFrame(X.toarray(), columns=vectorizer.
    get_feature_names_out()) # Convert the result to a
    DataFrame for easier understanding

# Save the preprocessed dataset (optional)
df.to_csv('preprocessed_mental_health.csv', index=False)

```

The code snippet above demonstrates the preprocessing steps for a mental health dataset. It handles missing values and duplicates in the text data, performs text cleaning by removing URLs, mentions, and special characters, and applies tokenization. The cleaned text is then vectorized using TF-IDF to convert the textual data into a format suitable for machine learning models. Finally, the preprocessed dataset is saved as a new CSV file for future use in classification tasks.

```

[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data] Package stopwords is already up-to-date!
[nltk_data] Downloading package punkt to /root/nltk_data...
[nltk_data] Package punkt is already up-to-date!
    aaaaaaaaaaaaaaaaaaaaaaaaaa ab abandon abandoned \
0 0.0                      0.0 0.0      0.0      0.0
1 0.0                      0.0 0.0      0.0      0.0
2 0.0                      0.0 0.0      0.0      0.0
3 0.0                      0.0 0.0      0.0      0.0
4 0.0                      0.0 0.0      0.0      0.0

    abandoning abandonment abc abilities ability ... zemeckis zemlja \
0      0.0        0.0 0.0      0.0 0.00000 ...      0.0      0.0
1      0.0        0.0 0.0      0.0 0.03726 ...      0.0      0.0
2      0.0        0.0 0.0      0.0 0.00000 ...      0.0      0.0
3      0.0        0.0 0.0      0.0 0.00000 ...      0.0      0.0
4      0.0        0.0 0.0      0.0 0.00000 ...      0.0      0.0

    zero zoloft zombie zombieland zombies zone zoom zuckerberg
0  0.0   0.0   0.0     0.0     0.0   0.0   0.0   0.0
1  0.0   0.0   0.0     0.0     0.0   0.0   0.0   0.0
2  0.0   0.0   0.0     0.0     0.0   0.0   0.0   0.0
3  0.0   0.0   0.0     0.0     0.0   0.0   0.0   0.0
4  0.0   0.0   0.0     0.0     0.0   0.0   0.0   0.0

[5 rows x 10000 columns]

```

Figure 12: Data Collection and Preprocessing

8.2.3 Logistic Regression Model for Classification

Logistic Regression for Mental Health Classification

```

import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score,
    classification_report, confusion_matrix

# Load the preprocessed dataset
dataset = pd.read_csv('preprocessed_mental_health.csv')

# Check if 'cleaned_text' and 'mental_health_issue' columns
# exist
if 'cleaned_text' not in dataset.columns or \
    'mental_health_issue' not in dataset.columns:
    raise ValueError("The dataset must have 'cleaned_text' and 'mental_health_issue' columns.")

# Remove rows with missing values in 'cleaned_text' column
dataset.dropna(subset=['cleaned_text'], inplace=True)

# Initialize the CountVectorizer and fit/transform the
# cleaned text
LRvectorizer = CountVectorizer()
X = LRvectorizer.fit_transform(dataset['cleaned_text'])

# Prepare the target variable
y = dataset['mental_health_issue']

# Split the dataset into Training and Test Sets
X_train, X_test, y_train, y_test = train_test_split(X, y,
    test_size=0.2, random_state=42)

# Initialize the Logistic Regression model
LRmodel = LogisticRegression(multi_class='ovr', max_iter
    =10000)

# Train the model
LRmodel.fit(X_train, y_train)

# Make predictions on the test set
y_pred = LRmodel.predict(X_test)

```

Logistic Regression for Mental Health Classification

```

# Evaluate the model
accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy:{accuracy*100:.2f}%')

# Print classification report
print("Classification_Report:\n", classification_report(
    y_test, y_pred))

# Print confusion matrix
print("Confusion_Matrix:\n", confusion_matrix(y_test, y_pred))

```

The provided code demonstrates how to apply Logistic Regression for mental health classification using a preprocessed dataset. First, the dataset is loaded, and a check is performed to ensure that it contains the necessary columns, specifically `cleaned_text` and `mental_health_issue`. If these columns are missing, an error is raised. The dataset is then cleaned by removing rows that have missing values in the `cleaned_text` column using the `dropna()` function. Next, the `CountVectorizer` is initialized and applied to the `cleaned_text` column to convert the text data into a numerical format suitable for machine learning. This is accomplished by transforming the text into a document-term matrix where each row represents a document (post) and each column represents a unique term (word). The target variable, `mental_health_issue`, is also extracted from the dataset. The dataset is then split into training and testing sets using `train_test_split()`, where 80% of the data is used for training, and 20% is reserved for testing. The `random_state` is set to ensure reproducibility of the results. A Logistic Regression model is initialized with a multi-class strategy (`multi_class='ovr'`) and a high number of iterations (`max_iter=10000`) to allow the model to converge. The model is then trained on the training data using the `fit()` method. After training, predictions are made on the test set using the `predict()` method. The model's performance is evaluated by calculating the accuracy score, which is printed as a percentage. Additionally, a detailed classification report is generated, which includes metrics such as precision, recall, and F1-score for each class. Lastly, a confusion matrix is printed to visualize the model's classification performance and to understand how well the model distinguishes between different mental health issues. This end-to-end pipeline is crucial for applying Logistic Regression to textual data, allowing for effective classification of mental health issues based on Reddit posts.

8.2.4 Naive Bayes for Classification

Naive Bayes for Mental Health Classification

```

import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import
    CountVectorizer
from sklearn.naive_bayes import MultinomialNB
from sklearn.metrics import accuracy_score,
    classification_report, confusion_matrix

# Load the preprocessed dataset
dataset = pd.read_csv('preprocessed_mental_health.csv')

# Check if 'cleaned_text' and 'mental_health_issue'
# columns exist
if 'cleaned_text' not in dataset.columns or 'mental_health_issue' not in dataset.columns:
    raise ValueError("The dataset must have 'cleaned_text' and 'mental_health_issue' columns.")

# Remove rows with missing values in 'cleaned_text' column
dataset.dropna(subset=['cleaned_text'], inplace=True)

# Initialize the CountVectorizer and fit/transform the cleaned text
NBvectorizer = CountVectorizer()
X = NBvectorizer.fit_transform(dataset['cleaned_text'])

# Prepare the target variable
y = dataset['mental_health_issue']

# Split the dataset into Training and Test Sets
X_train, X_test, y_train, y_test = train_test_split(X, y,
    test_size=0.2, random_state=42)

# Initialize the Naive Bayes classifier
NBmodel = MultinomialNB()

# Fit the model
NBmodel.fit(X_train, y_train)

```

Naive Bayes for Mental Health Classification

```

# Make predictions
y_pred = NBmodel.predict(X_test)

# Evaluate the model
accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy: {accuracy * 100:.2f}%')

# Print classification report
print("Classification_Report:\n", classification_report(
    y_test, y_pred))

# Print confusion matrix
print("Confusion_Matrix:\n", confusion_matrix(y_test,
    y_pred))

```

The provided code demonstrates how to apply the Naive Bayes classifier (MultinomialNB) for mental health classification using a preprocessed dataset. First, the dataset is loaded, and a check is performed to ensure that it contains the necessary columns, specifically `cleaned_text` and `mental_health_issue`. If these columns are missing, an error is raised. The dataset is then cleaned by removing rows that have missing values in the `cleaned_text` column using the `dropna()` function. Next, the `CountVectorizer` is initialized and applied to the `cleaned_text` column to convert the text data into a numerical format suitable for machine learning. This is accomplished by transforming the text into a document-term matrix where each row represents a document (post) and each column represents a unique term (word). The target variable, `mental_health_issue`, is also extracted from the dataset. The dataset is then split into training and testing sets using `train_test_split()`, where 80% of the data is used for training, and 20% is reserved for testing. The `random_state` is set to ensure reproducibility of the results. A Naive Bayes model (`MultinomialNB`) is initialized and trained on the training data using the `fit()` method. After training, predictions are made on the test set using the `predict()` method. The model's performance is evaluated by calculating the accuracy score, which is printed as a percentage. Additionally, a detailed classification report is generated, which includes metrics such as precision, recall, and F1-score for each class. Lastly, a confusion matrix is printed to visualize the model's classification performance and to understand how well the model distinguishes between different mental health issues. This end-to-end pipeline is crucial for applying the Naive Bayes algorithm to textual data, allowing for effective classification of mental health issues based on Reddit posts.

8.2.5 Support Vector Machine for Classification

Support Vector Classifier Implementation

```

import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.svm import SVC
from sklearn.metrics import accuracy_score,
    classification_report, confusion_matrix

# Load the preprocessed dataset
dataset = pd.read_csv('preprocessed_mental_health.csv')

# Check if 'cleaned_text' and 'mental_health_issue' columns
# exist
if 'cleaned_text' not in dataset.columns or \
    'mental_health_issue' not in dataset.columns:
    raise ValueError("The dataset must have 'cleaned_text' and 'mental_health_issue' columns.")

# Remove rows with missing values in 'cleaned_text' column
dataset.dropna(subset=['cleaned_text'], inplace=True)

# Initialize the CountVectorizer and fit/transform the
# cleaned text
SVMvectorizer = CountVectorizer()
X = SVMvectorizer.fit_transform(dataset['cleaned_text'])

# Prepare the target variable
y = dataset['mental_health_issue']

# Split the dataset into Training and Test Sets
X_train, X_test, y_train, y_test = train_test_split(X, y,
    test_size=0.2, random_state=42)

# Initialize the Support Vector Classifier
SVMmodel = SVC(kernel='linear', C=1, random_state=42,
    probability=True) # You can adjust parameters as needed

# Train the model
SVMmodel.fit(X_train, y_train)

# Make predictions on the test set
y_pred = SVMmodel.predict(X_test)

```

Support Vector Classifier Implementation

```

# Evaluate the model
accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy:{accuracy*100:.2f}%')

# Print classification report
print("Classification_Report:\n", classification_report(
    y_test, y_pred))

# Print confusion matrix
print("Confusion_Matrix:\n", confusion_matrix(y_test, y_pred))

```

The provided code demonstrates how to apply the Support Vector Classifier (SVC) for mental health classification using a preprocessed dataset. First, the dataset is loaded, and a check is performed to ensure that it contains the necessary columns, specifically `cleaned_text` and `mental_health_issue`. If these columns are missing, an error is raised. The dataset is then cleaned by removing rows that have missing values in the `cleaned_text` column using the `dropna()` function. Next, the `CountVectorizer` is initialized and applied to the `cleaned_text` column to convert the text data into a numerical format suitable for machine learning. This is accomplished by transforming the text into a document-term matrix where each row represents a document (post) and each column represents a unique term (word). The target variable, `mental_health_issue`, is also extracted from the dataset. The dataset is then split into training and testing sets using `train_test_split()`, where 80% of the data is used for training, and 20% is reserved for testing. The `random_state` is set to ensure reproducibility of the results. A Support Vector Classifier model (SVC) is initialized with a linear kernel (`kernel='linear'`), regularization parameter `C=1`, and the probability flag set to `True` to enable probability estimates. The model is then trained on the training data using the `fit()` method. After training, predictions are made on the test set using the `predict()` method. The model's performance is evaluated by calculating the accuracy score, which is printed as a percentage. Additionally, a detailed classification report is generated, which includes metrics such as precision, recall, and F1-score for each class. Lastly, a confusion matrix is printed to visualize the model's classification performance and to understand how well the model distinguishes between different mental health issues. This end-to-end pipeline is crucial for applying the Support Vector Machine (SVM) algorithm to textual data, allowing for effective classification of mental health issues based on Reddit posts.

8.2.6 Random Forest for Classification

Random Forest Classifier Implementation

```

import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score,
    classification_report, confusion_matrix

# Load the preprocessed dataset
dataset = pd.read_csv('preprocessed_mental_health.csv')

# Check if 'cleaned_text' and 'mental_health_issue' columns
# exist
if 'cleaned_text' not in dataset.columns or \
    'mental_health_issue' not in dataset.columns:
    raise ValueError("The dataset must have 'cleaned_text' and 'mental_health_issue' columns.")

# Remove rows with missing values in 'cleaned_text' column
dataset.dropna(subset=['cleaned_text'], inplace=True)

# Initialize the CountVectorizer and fit/transform the
# cleaned text
RFvectorizer = CountVectorizer()
X = RFvectorizer.fit_transform(dataset['cleaned_text'])

# Prepare the target variable
y = dataset['mental_health_issue']

# Split the dataset into Training and Test Sets
X_train, X_test, y_train, y_test = train_test_split(X, y,
    test_size=0.2, random_state=42)

# Initialize the Random Forest Classifier with added
# parameters
RFmodel = RandomForestClassifier(
    n_estimators=3000,           # Number of trees
    max_depth=None,             # Maximum depth of each tree
    min_samples_split=20,        # Minimum number of samples
    to split a node

```

Random Forest Classifier Implementation

```

        min_samples_leaf=1,           # Minimum number of samples
        in a leaf node
        max_features='sqrt',         # Number of features to
        consider at each split
        bootstrap=False,             # Whether to use
        bootstrapping

        random_state=42             # For reproducibility
    )

# Train the model
RFmodel.fit(X_train, y_train)

# Make predictions on the test set
y_pred = RFmodel.predict(X_test)

# Evaluate the model
accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy: {accuracy * 100:.2f}%')

# Print classification report
print("Classification_Report:\n", classification_report(
    y_test, y_pred))

# Print confusion matrix
print("Confusion_Matrix:\n", confusion_matrix(y_test, y_pred))

```

The provided code demonstrates how to apply the Random Forest Classifier for mental health classification using a preprocessed dataset. First, the dataset is loaded, and a check is performed to ensure that it contains the necessary columns, specifically `cleaned_text` and `mental_health_issue`. If these columns are missing, an error is raised. The dataset is then cleaned by removing rows that have missing values in the `cleaned_text` column using the `dropna()` function. Next, the `CountVectorizer` is initialized and applied to the `cleaned_text` column to convert the text data into a numerical format suitable for machine learning. This is accomplished by transforming the text into a document-term matrix where each row represents a document (post) and each column represents a unique term (word). The target variable, `mental_health_issue`, is also extracted from the dataset. The dataset is then split into training and testing sets using `train_test_split()`, where 80% of the data is used for training, and 20% is reserved for testing. The `random_state` is set to ensure reproducibility of the results. A Random Forest Classifier model is initialized with several hyperparameters. Specifically, `n_estimators=3000` defines the number of decision trees in the forest. The

`max_depth=None` means the trees are allowed to grow until all leaves are pure or contain fewer than the minimum samples required to split a node. The `min_samples_split=20` and `min_samples_leaf=1` specify the minimum number of samples required to split an internal node and the minimum number of samples required to be at a leaf node, respectively. The `max_features='sqrt'` sets the maximum number of features to consider for the best split at each node to be the square root of the total number of features. `bootstrap=False` disables bootstrapping, meaning the entire dataset is used to build each tree. After initialization, the model is trained using the `fit()` method on the training data. After training, predictions are made on the test set using the `predict()` method. The model's performance is evaluated by calculating the accuracy score, which is printed as a percentage. Additionally, a detailed classification report is generated, which includes metrics such as precision, recall, and F1-score for each class. Lastly, a confusion matrix is printed to visualize the model's classification performance and to understand how well the model distinguishes between different mental health issues. This end-to-end pipeline is essential for applying the Random Forest algorithm to textual data, allowing for effective classification of mental health issues based on Reddit posts.

8.2.7 XGBoost for Classification

XGBoost Classifier Implementation

```

import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from sklearn.metrics import accuracy_score,
    classification_report, confusion_matrix
import xgboost as xgb

# Load the dataset
data = pd.read_csv('preprocessed_mental_health.csv')

# Separate features and target
X = data['text']
y = data['mental_health_issue']

# Encode target labels
label_encoder = LabelEncoder()
y = label_encoder.fit_transform(y)

# Split dataset into training and test sets
X_train, X_test, y_train, y_test = train_test_split(X, y,
    test_size=0.2, random_state=42)

```

XGBoost Classifier Implementation

```

# Convert text data to numerical data using TF-IDF
Vectorizer
from sklearn.feature_extraction.text import TfidfVectorizer
tfidf = TfidfVectorizer(max_features=5000)
X_train = tfidf.fit_transform(X_train)
X_test = tfidf.transform(X_test)

# Define the XGBoost classifier
xgb_clf = xgb.XGBClassifier(objective='multi:softmax',
    num_class=5, eval_metric='mlogloss', use_label_encoder=
    False)

# Train the model
xgb_clf.fit(X_train, y_train)

# Predict on the test set
y_pred = xgb_clf.predict(X_test)

# Evaluate the model
accuracy = accuracy_score(y_test, y_pred)
report = classification_report(y_test, y_pred, target_names=
    label_encoder.classes_)

print(f"Accuracy:{accuracy*100:.2f}%")
print("Classification_Report:\n", report)

# Print confusion matrix
print("Confusion_Matrix:\n", confusion_matrix(y_test, y_pred
    ))

```

The provided code demonstrates how to apply XGBoost for mental health classification using a preprocessed dataset. First, the dataset is loaded, and the target variable (`mental_health_issue`) is separated from the feature variable (`text`). The target variable is then encoded using `LabelEncoder()` to convert the categorical labels into numerical values, which are required for machine learning algorithms. Next, the dataset is split into training and testing sets using `train_test_split()`, where 80% of the data is used for training, and 20% is reserved for testing. The `random_state` is set to ensure reproducibility of the results. The text data is then transformed into numerical features using the `TfidfVectorizer()`. This vectorizer converts the raw text into a matrix of TF-IDF (Term Frequency-Inverse Document Frequency) features, which are more suitable for training a machine learning model. The `max_features=5000` parameter limits the number of features to the 5000 most frequent terms in the dataset. The XGBoost classifier is then initialized with several hyperparameters.

The `objective='multi:softmax'` indicates that the task is a multi-class classification problem. The `num_class=5` parameter specifies the number of classes for the classification task, and `eval_metric='mlogloss'` is set to use the log loss metric for evaluation. `use_label_encoder=False` disables the automatic label encoding of target labels, as we have already manually encoded the labels. After initialization, the model is trained on the training data using the `fit()` method. After training, predictions are made on the test set using the `predict()` method. The model's performance is evaluated by calculating the accuracy score, which is printed as a percentage. Additionally, a detailed classification report is generated, which includes metrics such as precision, recall, and F1-score for each class. Lastly, a confusion matrix is printed to visualize the model's classification performance and to understand how well the model distinguishes between different mental health issues. This pipeline demonstrates the use of XGBoost in combination with TF-IDF vectorization for text classification, enabling effective classification of mental health issues based on Reddit posts.

8.2.8 K Nearest Neighbours for Classification

```
k-NN Classifier Implementation for Mental Health Classification

import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import accuracy_score,
                         classification_report, confusion_matrix

# Load the preprocessed dataset
dataset = pd.read_csv('preprocessed_mental_health.csv')

# Check if 'cleaned_text' and 'mental_health_issue' columns
# exist
if 'cleaned_text' not in dataset.columns or 'mental_health_issue'
    not in dataset.columns:
    raise ValueError("The dataset must have 'cleaned_text' and 'mental_health_issue' columns.")

# Remove rows with missing values in 'cleaned_text' column
dataset.dropna(subset=['cleaned_text'], inplace=True)

# Initialize the CountVectorizer and fit/transform the cleaned
# text
KNNvectorizer = CountVectorizer()
X = KNNvectorizer.fit_transform(dataset['cleaned_text'])
```

k-NN Classifier Implementation for Mental Health Classification

```

# Prepare the target variable
y = dataset['mental_health_issue']

# Split the dataset into Training and Test Sets
X_train, X_test, y_train, y_test = train_test_split(X, y,
    test_size=0.2, random_state=42)

# Initialize the k-NN classifier
KNNmodel = KNeighborsClassifier(n_neighbors=5)    # You can adjust
    the number of neighbors

# Fit the model
KNNmodel.fit(X_train, y_train)

# Make predictions
y_pred = KNNmodel.predict(X_test)

# Evaluate the model
accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy: {accuracy * 100:.2f}%')

# Print classification report
print("Classification_Report:\n", classification_report(y_test,
    y_pred))

# Print confusion matrix
print("Confusion_Matrix:\n", confusion_matrix(y_test, y_pred))

```

The code provided demonstrates how to implement a k-Nearest Neighbors (k-NN) classifier for mental health issue classification based on text data. Initially, the dataset is loaded from a CSV file, and a check is performed to ensure the presence of the necessary columns, namely `cleaned_text` and `mental_health_issue`. If any of these columns are missing, the program raises an error. The next step involves removing rows with missing text data from the `cleaned_text` column using `dropna()`. The `CountVectorizer` from `sklearn` is used to transform the textual data into a matrix of token counts, which is suitable for machine learning. This transformation converts each post (document) into a vector of word occurrences, with each unique word in the dataset being represented by a column. The target variable, `mental_health_issue`, is extracted, and the dataset is split into training and test sets using `train_test_split()`. The training set consists of 80% of the data, and the remaining 20% is used for testing. A k-NN classifier is initialized with 5 neighbors (`n_neighbors=5`), though this number can be adjusted for tuning the model. The classifier is trained on the training data using the `fit()` method. Once the model is trained, it is used to predict mental health

issues for the test set, and the accuracy of the predictions is calculated and printed. In addition to the accuracy score, a detailed classification report is generated, which includes metrics like precision, recall, and F1-score for each class. Finally, a confusion matrix is printed to help visualize the model's performance in terms of how well it classifies different mental health issues. This end-to-end pipeline demonstrates how to apply a k-NN classifier to a text classification task, specifically identifying mental health issues based on user-generated content such as social media posts.

8.2.9 Long Short Term Memory based Classification

LSTM Model Implementation

```

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.metrics import confusion_matrix,
    classification_report
from sklearn.preprocessing import LabelEncoder
from tensorflow.keras.preprocessing.text import Tokenizer
from tensorflow.keras.preprocessing.sequence import
    pad_sequences
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Embedding, LSTM, Dense,
    Dropout
from tensorflow.keras.utils import to_categorical
from sklearn.model_selection import train_test_split

# Load the dataset
data = pd.read_csv('preprocessed_mental_health.csv')

# Separate features and target
X = data['text']
y = data['mental_health_issue']

# Encode target labels
label_encoder = LabelEncoder()
y = label_encoder.fit_transform(y)
y = to_categorical(y) # Convert labels to one-hot encoded
# format for multi-class classification

# Split dataset into training and test sets
X_train, X_test, y_train, y_test = train_test_split(X, y,
    test_size=0.2, random_state=42)

```

LSTM Model Implementation

```

# Tokenize and pad the text sequences
vocab_size = 10000 # Set a vocabulary size
max_length = 100 # Set a max length for padding

tokenizer = Tokenizer(num_words=vocab_size, oov_token=<OOV>
    ")
tokenizer.fit_on_texts(X_train)

X_train_seq = tokenizer.texts_to_sequences(X_train)
X_test_seq = tokenizer.texts_to_sequences(X_test)

X_train_padded = pad_sequences(X_train_seq, maxlen=
    max_length, padding='post', truncating='post')
X_test_padded = pad_sequences(X_test_seq, maxlen=max_length,
    padding='post', truncating='post')

# Build the LSTM model
model = Sequential([
    Embedding(vocab_size, 128, input_length=max_length),
    LSTM(128, return_sequences=True),
    Dropout(0.2),
    LSTM(64),
    Dropout(0.2),
    Dense(64, activation='relu'),
    Dense(y.shape[1], activation='softmax') # Output layer
        with softmax for multi-class classification
])

model.compile(optimizer='adam', loss='
    categorical_crossentropy', metrics=['accuracy'])

# Train the model
history = model.fit(X_train_padded, y_train, epochs=10,
    batch_size=32, validation_data=(X_test_padded, y_test))

# Plot training history
plt.figure(figsize=(12, 4))
plt.subplot(1, 2, 1)
plt.plot(history.history['accuracy'], label='Training_
    Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation_
    Accuracy')
plt.title('Model_Accuracy')
plt.xlabel('Epochs')
plt.ylabel('Accuracy')
plt.legend()

```

LSTM Model Implementation

```

plt.subplot(1, 2, 2)
plt.plot(history.history['loss'], label='Training_Loss')
plt.plot(history.history['val_loss'], label='Validation_Loss')
plt.title('Model_Loss')
plt.xlabel('Epochs')
plt.ylabel('Loss')
plt.legend()
plt.show()

# Evaluate the model on test data
test_loss, test_accuracy = model.evaluate(X_test_padded,
                                         y_test)
print(f"Test_Accuracy:{test_accuracy*100:.2f}%")

# Generate predictions and convert back from one-hot
encoding
y_pred = model.predict(X_test_padded)
y_pred_classes = np.argmax(y_pred, axis=1)
y_test_classes = np.argmax(y_test, axis=1)

# Output classification report
print("Classification_Report:\n", classification_report(
    y_test_classes, y_pred_classes, target_names=
    label_encoder.classes_))

# Plot Confusion Matrix
cm = confusion_matrix(y_test_classes, y_pred_classes)
plt.figure(figsize=(8, 6))
sns.heatmap(cm, annot=True, fmt='d', cmap='Blues',
            xticklabels=label_encoder.classes_, yticklabels=
            label_encoder.classes_)

plt.xlabel('Predicted_Labels')
plt.ylabel('True_Labels')
plt.title('Confusion_Matrix')
plt.show()

```

This code demonstrates how to apply a Long Short-Term Memory (LSTM) neural network for text classification, specifically for predicting mental health issues based on preprocessed Reddit data. The dataset is loaded and the target variable (`mental_health_issue`) is encoded into a one-hot format for multi-class classification. The dataset is split into training and testing sets. Text data is tokenized and padded to ensure uniform input lengths for the LSTM model. The model consists of embedding layers, LSTM layers with dropout for regularization, and dense

layers for classification. The model is trained on the training data, and performance is monitored using validation data. The training and validation accuracy and loss are plotted. The model is evaluated on the test data, and performance metrics such as accuracy and classification report are displayed. A confusion matrix is plotted to visualize model performance.

```

Epoch 1/10
/usr/local/lib/python3.10/dist-packages/keras/src/layers/core/embedding.py:90: UserWarning: Argument `input_length` is deprecated. Just remove it.
    warnings.warn(
465/465 ━━━━━━━━ 135s 280ms/step - accuracy: 0.6046 - loss: 1.1142 - val_accuracy: 0.6841 - val_loss: 0.7390
Epoch 2/10
465/465 ━━━━━━━━ 131s 281ms/step - accuracy: 0.6681 - loss: 0.7686 - val_accuracy: 0.6634 - val_loss: 0.8092
Epoch 3/10
465/465 ━━━━━━━━ 144s 286ms/step - accuracy: 0.6499 - loss: 0.8130 - val_accuracy: 0.6680 - val_loss: 0.7538
Epoch 4/10
465/465 ━━━━━━━━ 139s 280ms/step - accuracy: 0.6368 - loss: 0.8657 - val_accuracy: 0.6605 - val_loss: 0.7481
Epoch 5/10
465/465 ━━━━━━━━ 130s 280ms/step - accuracy: 0.6949 - loss: 0.6574 - val_accuracy: 0.6922 - val_loss: 0.6711
Epoch 6/10
465/465 ━━━━━━━━ 141s 278ms/step - accuracy: 0.7132 - loss: 0.6056 - val_accuracy: 0.6933 - val_loss: 0.6697
Epoch 7/10
465/465 ━━━━━━━━ 147s 289ms/step - accuracy: 0.7304 - loss: 0.5676 - val_accuracy: 0.7081 - val_loss: 0.6606
Epoch 8/10
465/465 ━━━━━━━━ 131s 282ms/step - accuracy: 0.7483 - loss: 0.5433 - val_accuracy: 0.7516 - val_loss: 0.6319
Epoch 9/10
465/465 ━━━━━━━━ 142s 282ms/step - accuracy: 0.8079 - loss: 0.4523 - val_accuracy: 0.7484 - val_loss: 0.6037
Epoch 10/10
465/465 ━━━━━━━━ 142s 282ms/step - accuracy: 0.8564 - loss: 0.3823 - val_accuracy: 0.8355 - val_loss: 0.5368

```

Figure 13: Output for LSTM Epochs

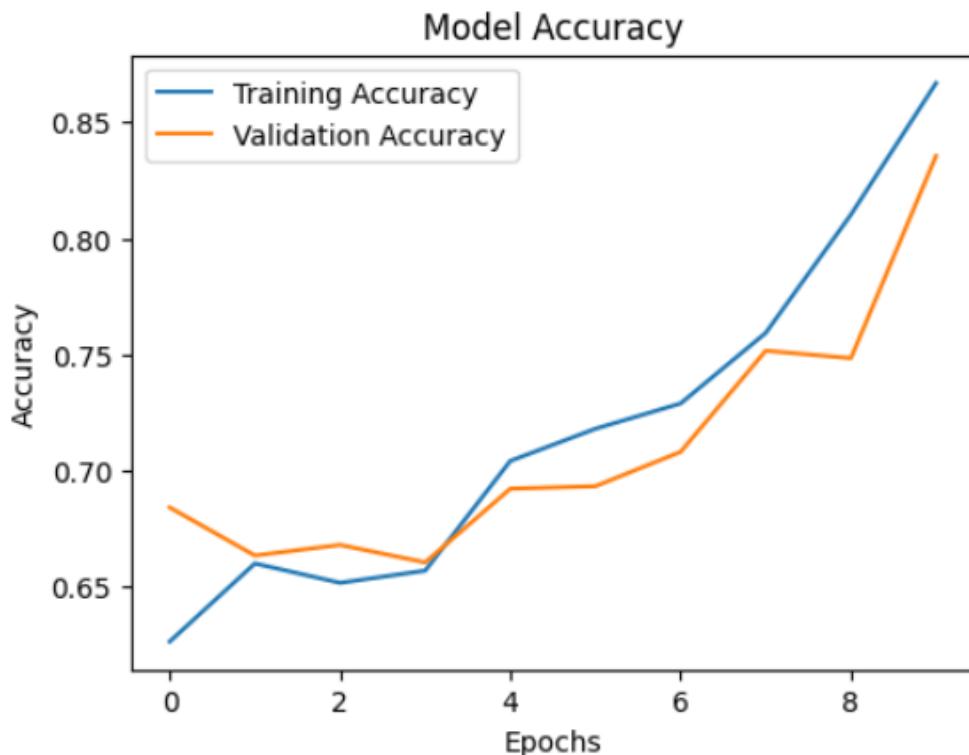


Figure 14: Accuracy v/s Epoch

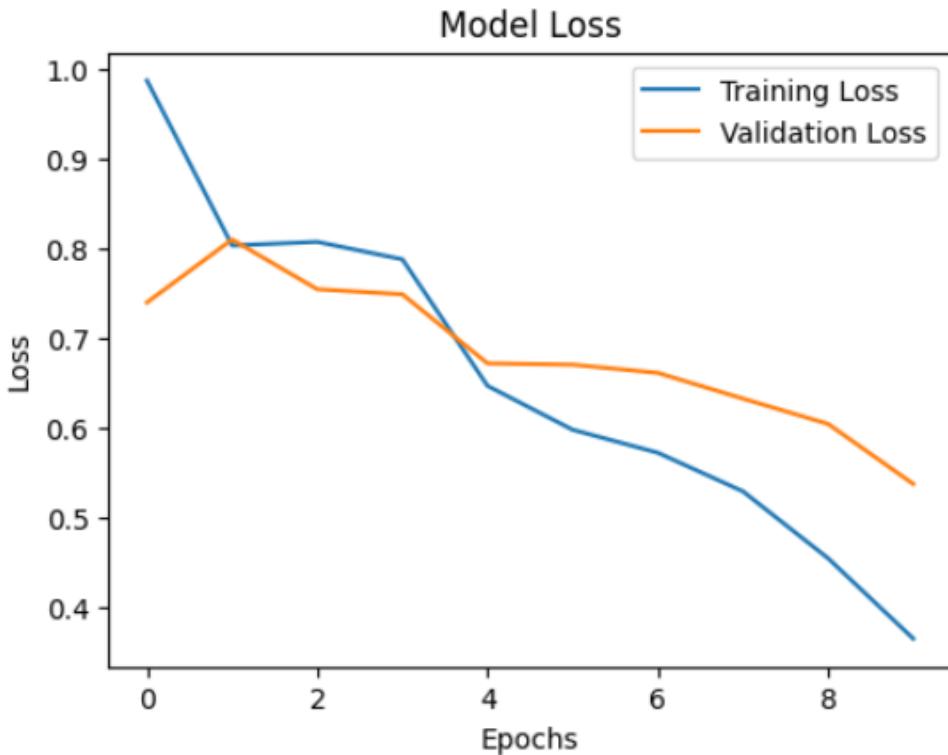


Figure 15: Loss v/s Epoch

8.2.10 Hyperparameter Tuning Using RandomizedSearchCV

Logistic Regression

```

import pandas as pd
from sklearn.model_selection import train_test_split,
    RandomizedSearchCV
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score,
    classification_report

# Load the preprocessed dataset
dataset = pd.read_csv('preprocessed_mental_health.csv')

# Check if 'cleaned_text' and 'mental_health_issue' columns
# exist
if 'cleaned_text' not in dataset.columns or 'mental_health_issue'
    not in dataset.columns:
    raise ValueError("The dataset must have 'cleaned_text' and 'mental_health_issue' columns.")

```

Logistic Regression

```

# Remove rows with missing values in 'cleaned_text' column
dataset.dropna(subset=['cleaned_text'], inplace=True)

# Initialize the CountVectorizer and fit/transform the cleaned
text
HPLRvectorizer = CountVectorizer()
X = HPLRvectorizer.fit_transform(dataset['cleaned_text'])

# Prepare the target variable
y = dataset['mental_health_issue']

# Split the dataset into Training and Test Sets
X_train, X_test, y_train, y_test = train_test_split(X, y,
    test_size=0.2, random_state=42)

# Initialize the Logistic Regression model
HPLRmodel = LogisticRegression(max_iter=200)

# Define the hyperparameter grid for Randomized Search
param_distributions = {
    'C': [0.001, 0.01, 0.1, 1, 10, 100],           # Inverse of
    regularization strength
    'penalty': ['l1', 'l2', 'elasticnet', 'none'],   #
    Regularization types
    'solver': ['liblinear', 'saga']                  # Solvers that
    support l1, elasticnet
}

# Initialize RandomizedSearchCV
random_search = RandomizedSearchCV(estimator=HPLRmodel,
    param_distributions=param_distributions,
    n_iter=10, scoring='accuracy',
    cv=5, n_jobs=-1,
    random_state=42)

# Fit RandomizedSearchCV
random_search.fit(X_train, y_train)

# Best hyperparameters from Random Search
print("Best_Hyperparameters:", random_search.best_params_)

# Best model from Random Search
best_modellR = random_search.best_estimator_

# Make predictions using the best model
y_pred = best_modellR.predict(X_test)

```

Logistic Regression

```
# Evaluate the model
accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy: {accuracy * 100:.2f}%')

# Print classification report
print("Classification_Report:\n", classification_report(y_test,
y_pred))
```

The above code demonstrates a machine learning workflow for classifying mental health issues using LogisticRegression with hyperparameter tuning. The dataset is loaded using pandas, and a check ensures the presence of 'cleaned_text' and 'mental_health_issue' columns. Missing values in 'cleaned_text' are dropped to prevent processing errors. The textual data is transformed into a numerical format using CountVectorizer, which converts text into a bag-of-words representation. The dataset is then split into training and testing sets using train_test_split. A logistic regression model is initialized, and the hyperparameter grid is defined, including parameters like C (inverse of regularization strength), penalty, and solver. Hyperparameter tuning is performed using RandomizedSearchCV, which searches for the best model configuration by sampling parameter combinations. The best model is used to make predictions on the test set, and evaluation metrics such as accuracy and a classification report are printed. This approach ensures optimal model performance and generalization to new data.

K Nearest Neighbours

```
import pandas as pd
from sklearn.model_selection import train_test_split,
RandomizedSearchCV
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import accuracy_score,
classification_report, confusion_matrix

# Load the preprocessed dataset
dataset = pd.read_csv('preprocessed_mental_health.csv')
# Check if 'cleaned_text' and 'mental_health_issue' columns
# exist
if 'cleaned_text' not in dataset.columns or 'mental_health_issue'
    not in dataset.columns:
    raise ValueError("The dataset must have 'cleaned_text' and "
'mental_health_issue' columns.)
```

K Nearest Neighbours

```

# Remove rows with missing values in 'cleaned_text' column
dataset.dropna(subset=['cleaned_text'], inplace=True)

# Initialize the CountVectorizer and fit/transform the cleaned
text
HPTKNNvectorizer = CountVectorizer()
X = HPTKNNvectorizer.fit_transform(dataset['cleaned_text'])

# Prepare the target variable
y = dataset['mental_health_issue']

# Split the dataset into Training and Test Sets
X_train, X_test, y_train, y_test = train_test_split(X, y,
    test_size=0.2, random_state=42)

# Initialize the k-NN classifier
knn = KNeighborsClassifier()

# Define the hyperparameter grid for Randomized Search
param_distributions = {
    'n_neighbors': [3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 14,
        15, 16, 17, 18, 19, 20],
        # Different values for number of neighbors
    'metric': ['euclidean', 'manhattan', 'chebyshev', 'minkowski
        '], # Different distance metrics
    'weights': ['uniform', 'distance'] # Weighing options for
        neighbors
}

# Initialize RandomizedSearchCV
random_search = RandomizedSearchCV(estimator=knn,
    param_distributions=param_distributions,
        n_iter=10, scoring='accuracy
            ', cv=5, n_jobs=-1,
            random_state=42)

# Fit RandomizedSearchCV
random_search.fit(X_train, y_train)

# Best hyperparameters from Random Search
print("Best_Hyperparameters:", random_search.best_params_)

# Best model from Random Search
best_knn = random_search.best_estimator_

# Make predictions using the best model
y_pred = best_knn.predict(X_test)

```

K Nearest Neighbours

```
# Evaluate the model
accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy: {accuracy * 100:.2f}%')

# Print classification report
print("Classification_Report:\n", classification_report(y_test,
y_pred))

# Print confusion matrix
print("Confusion_Matrix:\n", confusion_matrix(y_test, y_pred))
```

This code implements a k-Nearest Neighbors (k-NN) classifier for classifying mental health issues from text data using hyperparameter tuning via RandomizedSearchCV. First, it loads a preprocessed dataset, ensuring the existence of critical columns, `cleaned_text` (features) and `mental_health_issue` (target). Rows with missing values in the `cleaned_text` column are removed to maintain data integrity. The text is vectorized into numerical format using CountVectorizer, converting text into a bag-of-words model. The features (X) and target (y) are split into training (80%) and test (20%) datasets to ensure proper model evaluation. The k-NN model is initialized without predefined parameters, and a hyperparameter grid is defined for tuning. This grid explores various values for the number of neighbors (`n_neighbors`), distance metrics (`metric`), and neighbor weighting options (`weights`). RandomizedSearchCV is then used to optimize these parameters by training multiple k-NN models with combinations from the grid, evaluating them with 5-fold cross-validation, and scoring based on accuracy. The best combination of hyperparameters is identified and used to configure the final k-NN model. The model is then tested on unseen data (test set), and its performance is evaluated by calculating the accuracy, a classification report detailing precision, recall, F1-score for each class, and a confusion matrix showing true vs. predicted classifications. This approach balances computational efficiency with robustness, enabling the selection of an optimized k-NN model for mental health classification.

Support Vector Machine

```
import pandas as pd
from sklearn.model_selection import train_test_split,
RandomizedSearchCV
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.svm import SVC
from sklearn.metrics import accuracy_score,
classification_report
```

Support Vector Machine

```

# Load the preprocessed dataset
dataset = pd.read_csv('preprocessed_mental_health.csv')

# Check if 'cleaned_text' and 'mental_health_issue' columns
# exist
if 'cleaned_text' not in dataset.columns or 'mental_health_issue'
    not in dataset.columns:
    raise ValueError("The dataset must have 'cleaned_text' and 'mental_health_issue' columns.")

# Remove rows with missing values in 'cleaned_text' column
dataset.dropna(subset=['cleaned_text'], inplace=True)

# Initialize the CountVectorizer and fit/transform the cleaned
# text
vectorizer = CountVectorizer()
X = vectorizer.fit_transform(dataset['cleaned_text'])

# Prepare the target variable
y = dataset['mental_health_issue']

# Split the dataset into Training and Test Sets
X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.2, random_state=42)

# Initialize the SVC model
model = SVC()

# Define the hyperparameter grid for Randomized Search
param_distributions = {
    'C': [0.1, 1, 10, 100],                      # Regularization
    'kernel': ['linear', 'rbf', 'poly'],           # Kernel types
    'gamma': ['scale', 'auto', 0.1, 1],            # Kernel coefficient
    'for rbf', 'poly', and 'sigmoid'
}

# Initialize RandomizedSearchCV
random_search = RandomizedSearchCV(estimator=model,
    param_distributions=param_distributions,
    n_iter=10, scoring='accuracy',
    cv=5, n_jobs=-1,
    random_state=42)

# Fit RandomizedSearchCV
random_search.fit(X_train, y_train)

```

Support Vector Machine

```

# Best hyperparameters from Random Search
print("Best_Hyperparameters:", random_search.best_params_)

# Best model from Random Search
best_model = random_search.best_estimator_

# Make predictions using the best model
y_pred = best_model.predict(X_test)

# Evaluate the model
accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy:{accuracy*100:.2f}%')

# Print classification report
print("Classification_Report:\n", classification_report(y_test,
    y_pred))

```

This code implements a Support Vector Classifier (SVC) for classifying mental health issues from text data using hyperparameter tuning via RandomizedSearchCV. It begins by loading a preprocessed dataset and ensuring that essential columns, `cleaned_text` (features) and `mental_health_issue` (target), are present. Any rows with missing values in the `cleaned_text` column are removed to ensure clean data. The text is then vectorized into a numerical format using CountVectorizer, transforming it into a bag-of-words representation. The features (X) and target (y) are split into training (80%) and test (20%) sets for model validation. The SVC model is initialized without predefined hyperparameters, and a hyperparameter grid is defined for tuning. This grid includes different values for the regularization parameter (C), kernel types (`kernel`), and the kernel coefficient (`gamma`). RandomizedSearchCV is employed to find the best combination of these parameters by evaluating multiple models with various hyperparameter combinations through 5-fold cross-validation, using accuracy as the scoring metric. The best set of hyperparameters is selected to configure the final SVC model. The model is then evaluated on the test set by making predictions, and its performance is measured by calculating the accuracy, as well as generating a classification report that includes precision, recall, and F1-score for each class. This approach ensures the selection of the most optimized SVC model for the classification of mental health issues from text data.

Naive Bayes

```

import pandas as pd
from sklearn.model_selection import train_test_split,
    RandomizedSearchCV
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.naive_bayes import MultinomialNB
from sklearn.metrics import accuracy_score,
    classification_report, confusion_matrix
from scipy.stats import uniform

# Load the preprocessed dataset
dataset = pd.read_csv('preprocessed_mental_health.csv')

# Check if 'cleaned_text' and 'mental_health_issue' columns
# exist
if 'cleaned_text' not in dataset.columns or 'mental_health_issue'
    not in dataset.columns:
    raise ValueError("The dataset must have 'cleaned_text' and 'mental_health_issue' columns.")

# Remove rows with missing values in 'cleaned_text' column
dataset.dropna(subset=['cleaned_text'], inplace=True)

# Initialize the CountVectorizer and fit/transform the cleaned
# text
vectorizer = CountVectorizer()
X = vectorizer.fit_transform(dataset['cleaned_text'])

# Prepare the target variable
y = dataset['mental_health_issue']

# Split the dataset into Training and Test Sets
X_train, X_test, y_train, y_test = train_test_split(X, y,
    test_size=0.2, random_state=42)

# Initialize the Naive Bayes model
naive_bayes_model = MultinomialNB()

# Define the parameter distribution for Randomized Search
param_distributions = {
    'alpha': uniform(0.001, 5.0) # Sampling alpha from a
        uniform distribution
}

```

Naive Bayes

```

# Initialize RandomizedSearchCV
random_search = RandomizedSearchCV(estimator=naive_bayes_model,
    param_distributions=param_distributions,
        n_iter=10, scoring='accuracy',
        cv=5, n_jobs=-1,
        random_state=42)

# Fit RandomizedSearchCV
random_search.fit(X_train, y_train)

# Best hyperparameters from Random Search
print("Best_Hyperparameters:", random_search.best_params_)

# Best model from Random Search
best_model = random_search.best_estimator_

# Make predictions using the best model
y_pred = best_model.predict(X_test)

# Evaluate the model
accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy: {accuracy * 100:.2f}%')

# Print classification report
print("Classification_Report:\n", classification_report(y_test,
    y_pred))

# Print confusion matrix
print("Confusion_Matrix:\n", confusion_matrix(y_test, y_pred))

```

This code implements a Naive Bayes classifier using the MultinomialNB algorithm to classify mental health issues from text data, with hyperparameter tuning via RandomizedSearchCV. The dataset is first loaded, ensuring the required columns, `cleaned_text` (features) and `mental_health_issue` (target), exist. Rows with missing values in the `cleaned_text` column are removed to maintain data quality. The text is vectorized using CountVectorizer, converting it into a bag-of-words representation. The features (X) and target (y) are then split into training (80%) and test (20%) sets to facilitate proper evaluation. The Naive Bayes model is initialized, and a parameter distribution for `alpha` is defined using a uniform distribution, sampling values between 0.001 and 5.0. RandomizedSearchCV is utilized to explore different values for `alpha` over 10 iterations, using 5-fold cross-validation and accuracy as the scoring metric. The best hyperparameters are identified and used to configure the final Naive Bayes model. The model is then tested on the unseen data (test set).

9 Results and Analysis

The metrics used for evaluating the performance of the classification models include Precision, Recall, F1-Score, and Support, along with the Confusion Matrix. These metrics are crucial for assessing how well the models are able to differentiate between various classes, providing insight into their accuracy, ability to capture relevant instances, and the overall balance between precision and recall. By analyzing these metrics, a comprehensive understanding of the model's performance can be obtained, enabling informed decisions for further optimization and tuning.

9.1 Classification Metrics and Confusion Matrix

- **Precision:** Precision is the ratio of correctly predicted positive observations to the total predicted positives. It can be calculated as:

$$\text{Precision} = \frac{TP}{TP + FP}$$

where TP represents True Positives, and FP represents False Positives.

- **Recall:** Recall is the ratio of correctly predicted positive observations to all observations in the actual class:

$$\text{Recall} = \frac{TP}{TP + FN}$$

where TP is True Positives, and FN is False Negatives.

- **F1-Score:** F1-Score is the harmonic mean of Precision and Recall, calculated as:

$$\text{F1-Score} = 2 \times \frac{\text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}}$$

- **Support:** Support refers to the number of actual occurrences of each class in the dataset:

$$\text{Support} = \text{Number of samples in the true class}$$

- **Confusion Matrix:** A confusion matrix is used to evaluate the performance of a classification model. It is structured as follows:

$$\begin{bmatrix} TP & FP \\ FN & TN \end{bmatrix}$$

where:

- TP = True Positives
- FP = False Positives
- FN = False Negatives
- TN = True Negatives

9.2 Results of Logistic Regression

Logistic Regression Classification Report

Class	Precision	Recall	F1-Score	Support
Anxiety	0.83	0.77	0.80	379
Bipolar	0.74	0.55	0.63	384
Depression	0.76	0.76	0.76	373
Normal	0.92	0.99	0.95	2183
PTSD	0.87	0.77	0.82	394
Accuracy	87.66%			
Macro Avg	0.82	0.77	0.79	3713
Weighted Avg	0.87	0.88	0.87	3713

Confusion Matrix for Logistic Regression Model

	Anxiety	Bipolar	Depression	Normal	PTSD
Anxiety	291	18	27	24	19
Bipolar	7	213	29	125	10
Depression	26	31	283	18	15
Normal	3	10	4	2165	1
PTSD	24	16	29	22	303

ROC Curve Areas for Each Class

Class	ROC AUC
Anxiety	0.95
Bipolar	0.92
Depression	0.96
Normal	0.99
PTSD	0.95

The Logistic Regression model performed well with an overall accuracy of 87.66%, indicating that the model correctly classified the majority of the instances. The classification report shows high precision, recall, and F1-scores for the 'Normal' class, which was expected due to its large number of instances. However, the 'Bipolar' and 'Anxiety' classes have lower recall and F1-scores, suggesting that the model struggles more with these classes. The confusion matrix highlights the misclassifications. For example, 'Anxiety' is often confused with 'Depression' and 'PTSD,' while the 'Normal' class is well-separated from the other classes. The large number of instances in the 'Normal' class could have contributed to the high accuracy but also to the imbalance in performance across other classes. The ROC curve AUC scores indicate that the model performs well in distinguishing between the classes. The 'Normal' class has the highest AUC (0.99), which is expected due to the large proportion of 'Normal' instances. Other classes, like 'Anxiety' and 'Depression,' also have high AUC scores (0.95 and 0.96, respectively), indicating that the model is capable of distinguishing them effectively.

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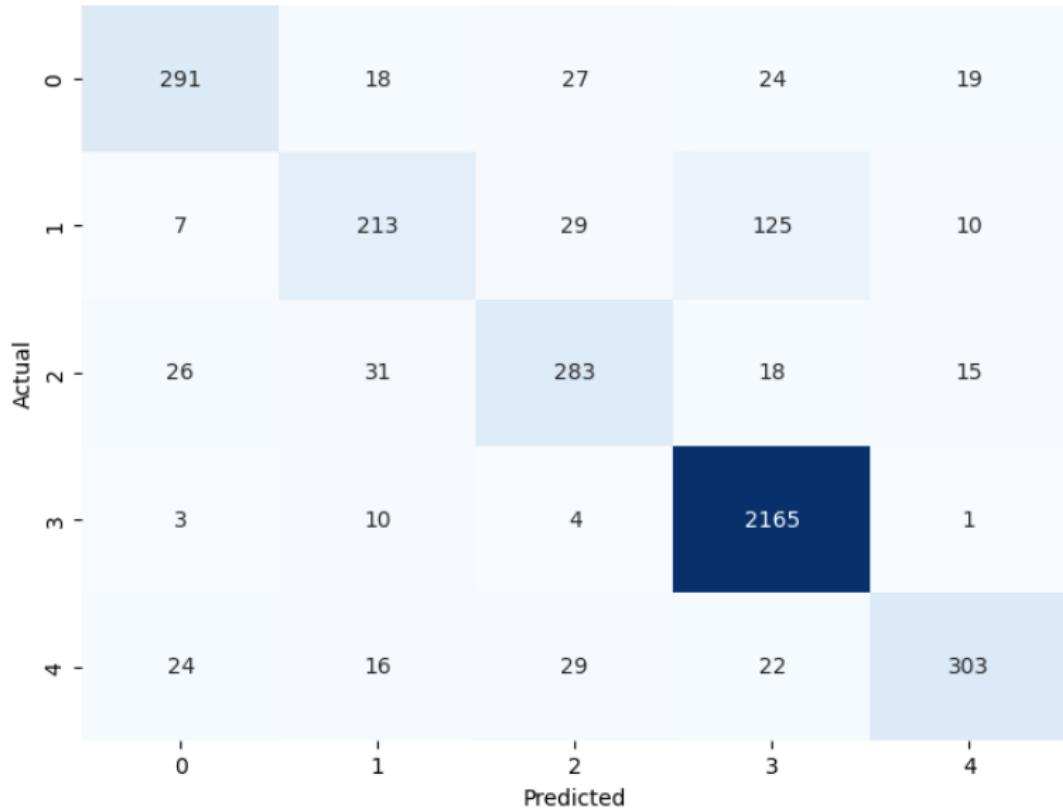


Figure 16: Confusion Matrix (Logistic Regression)

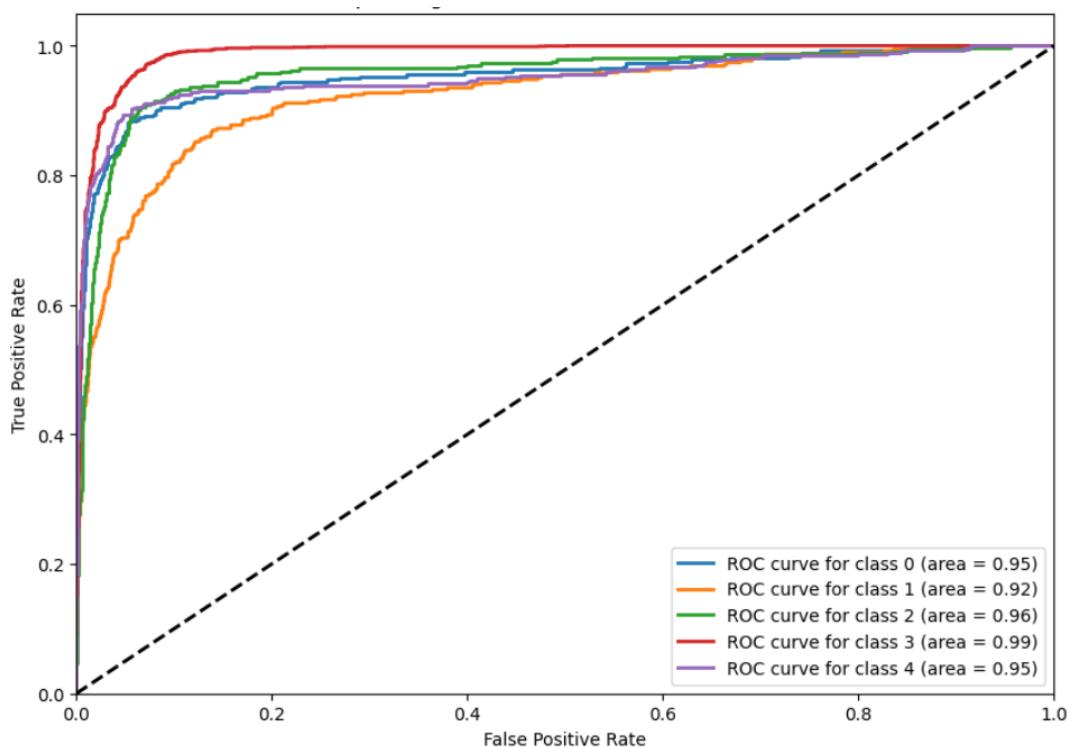


Figure 17: ROC AUC (Logistic Regression)

9.3 Results of Naive Bayes

Naive Bayes Classification Report

Class	Precision	Recall	F1-Score	Support
Anxiety	0.70	0.73	0.72	379
Bipolar	0.83	0.45	0.58	384
Depression	0.59	0.87	0.70	373
Normal	0.96	0.92	0.94	2183
PTSD	0.71	0.83	0.76	394
Accuracy	83.63%			
Macro Avg	0.76	0.76	0.74	3713
Weighted Avg	0.85	0.84	0.84	3713

Confusion Matrix for Naive Bayes Model

	Anxiety	Bipolar	Depression	Normal	PTSD
Anxiety	278	4	63	3	31
Bipolar	30	171	62	86	35
Depression	26	6	323	0	18
Normal	38	21	68	2006	50
PTSD	24	5	34	4	327

ROC Curve Areas for Each Class

Class	ROC AUC
Anxiety	0.92
Bipolar	0.89
Depression	0.94
Normal	0.99
PTSD	0.94

The Naive Bayes model achieved an overall accuracy of 83.63%, indicating a reasonable performance. The classification report shows strong results for the Normal class, with a precision of 0.96 and a recall of 0.92, resulting in an F1-score of 0.94. However, the Bipolar class exhibits much lower recall (0.45) and F1-score (0.58), suggesting that the model struggles to accurately identify Bipolar instances. Misclassifications are more frequent for Bipolar, often being confused with Depression and PTSD. The Anxiety class, although having decent precision (0.70), shows a lower recall (0.73), indicating that it also faces challenges in classification. The Confusion Matrix highlights that the model has difficulty distinguishing Bipolar and Depression from each other, with a large number of misclassifications across these classes. On the other hand, the Normal class is well-separated and correctly classified, with 2006 true positives, which likely contributes to the high overall accuracy. PTSD also shows relatively good classification results, with misclassifications being less frequent. The ROC AUC Curve Areas show that the model

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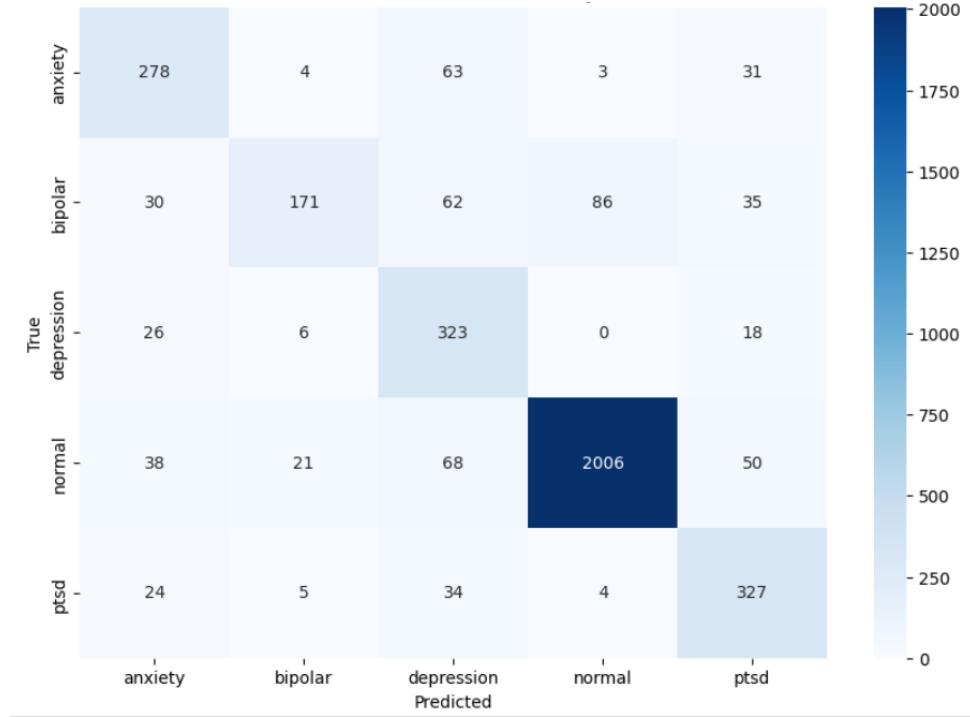


Figure 18: Confusion Matrix (Naive Bayes)

performs well for most classes, with the Normal class having the highest AUC score (0.99), followed by Depression and PTSD with AUCs of 0.94. While the model performs well for distinguishing between classes like Normal and Depression, the lower AUC for Bipolar (0.89) indicates that there may still be room for improvement in distinguishing this class from others.

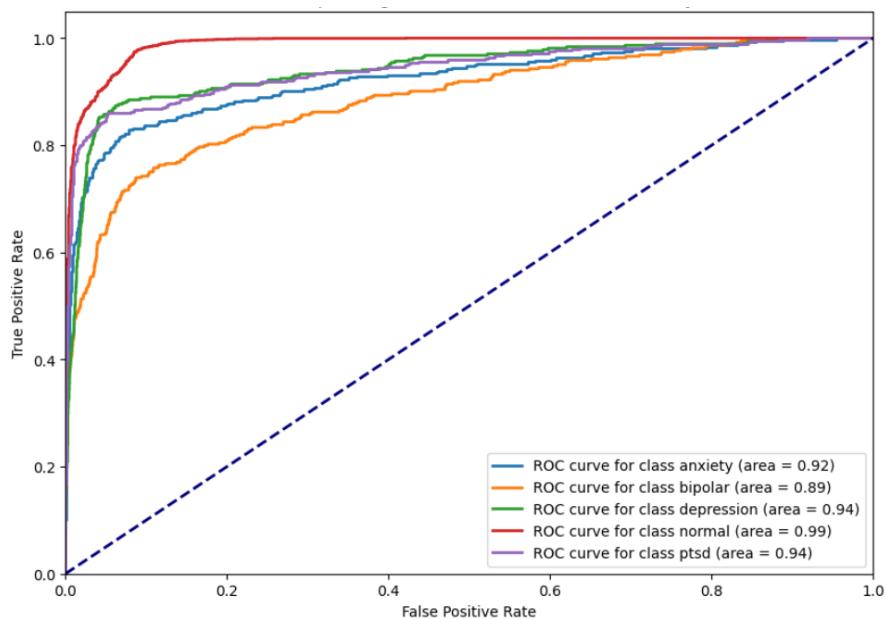


Figure 19: ROC AUC (Naive Bayes)

9.4 Results of Support Vector Machine

SVM Classification Report

Class	Precision	Recall	F1-Score	Support
Anxiety	0.72	0.76	0.74	379
Bipolar	0.62	0.61	0.61	384
Depression	0.74	0.71	0.72	373
Normal	0.94	0.95	0.95	2183
PTSD	0.78	0.74	0.76	394
Accuracy	85.13%			
Macro Avg	0.76	0.75	0.76	3713
Weighted Avg	0.85	0.85	0.85	3713

Confusion Matrix for SVM Model

	Anxiety	Bipolar	Depression	Normal	PTSD
Anxiety	287	22	29	13	28
Bipolar	20	233	29	88	14
Depression	37	31	265	11	29
Normal	20	62	8	2084	9
PTSD	34	26	29	13	292

ROC Curve Areas for Each Class

Class	ROC AUC
Anxiety	0.96
Bipolar	0.90
Depression	0.96
Normal	0.98
PTSD	0.96

The Support Vector Machine (SVM) model achieved an accuracy of 85.13%, demonstrating strong performance in classifying the various mental health conditions. The classification report indicates that the Normal class has the highest precision (0.94) and recall (0.95), resulting in an F1-score of 0.95, showing that the model is particularly good at identifying instances of normal behavior. However, the Bipolar class shows lower performance, with a precision of 0.62 and recall of 0.61, suggesting that the model struggles more with identifying bipolar disorder instances. The recall for the Anxiety class is relatively high (0.76), though precision is somewhat lower (0.72), indicating a balanced classification performance for this condition. The confusion matrix reveals that the model is generally accurate, with the Normal class being correctly classified most of the time (2084 true positives). However, some misclassifications occur for classes like Bipolar, Depression, and PTSD, with notable misclassifications of Bipolar as Depression and Normal. These misclassifications are likely affecting the overall recall for certain

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Figure 20: Confusion Matrix (SVM)

classes. The ROC AUC curve areas demonstrate that the model has excellent performance in distinguishing between most classes. The Normal class has the highest AUC of 0.98, followed by Anxiety, Depression, and PTSD with AUCs of 0.96. Bipolar, although still high at 0.90, lags behind the other classes, reflecting the model's challenge in distinguishing Bipolar from other conditions.

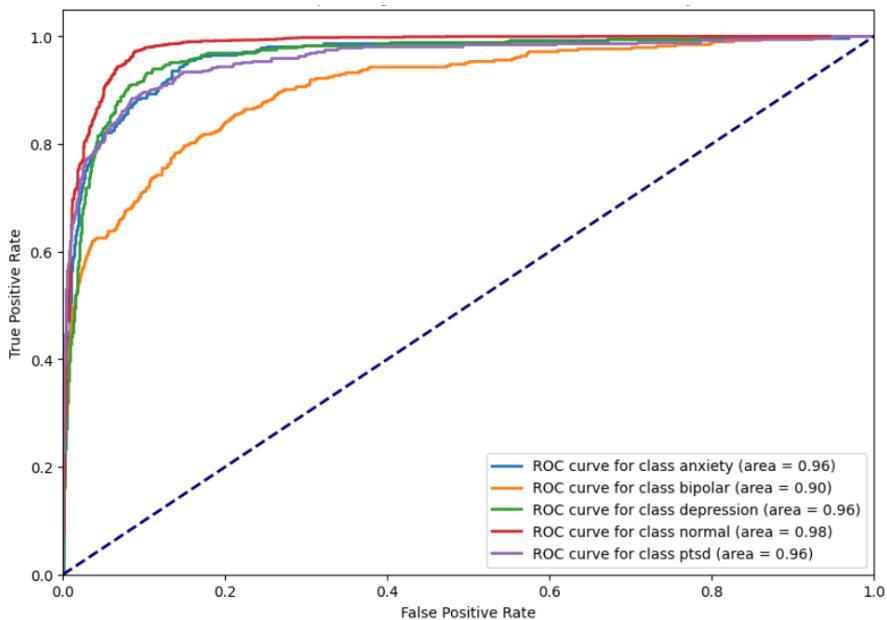


Figure 21: ROC AUC (SVM)

9.5 Results of Random Forest

Random Forest Classification Report

Class	Precision	Recall	F1-Score	Support
Anxiety	0.81	0.70	0.75	379
Bipolar	0.93	0.47	0.62	384
Depression	0.72	0.77	0.74	373
Normal	0.88	1.00	0.93	2183
PTSD	0.92	0.74	0.82	394
Accuracy	86.00%			
Macro Avg	0.85	0.73	0.77	3713
Weighted Avg	0.86	0.86	0.85	3713

Confusion Matrix for Random Forest Model

	Anxiety	Bipolar	Depression	Normal	PTSD
Anxiety	264	3	34	68	10
Bipolar	12	180	46	141	5
Depression	26	3	286	48	10
Normal	3	6	1	2173	0
PTSD	19	2	30	53	290

ROC Curve Areas for Each Class

Class	ROC AUC
Anxiety	0.96
Bipolar	0.89
Depression	0.97
Normal	0.97
PTSD	0.97

The Random Forest model achieved an accuracy of 86.00%, indicating a strong performance in classifying the mental health conditions. The classification report shows that the Normal class achieved the highest recall (1.00) and a precision of 0.88, resulting in a high F1-score of 0.93. This reflects the model's ability to correctly classify the majority of the Normal instances. The Bipolar class, however, shows a much lower recall (0.47), which indicates that the model has difficulty identifying instances of Bipolar disorder, as reflected by its F1-score of 0.62. The Anxiety and PTSD classes have relatively balanced performance, with moderate precision and recall values. The confusion matrix illustrates the distribution of misclassifications. The Normal class is correctly classified almost entirely (2173 true positives), while other classes like Bipolar and PTSD exhibit significant misclassifications, particularly Bipolar, which is often misclassified as Depression and Normal. The ROC AUC scores for all classes are quite high, indicating

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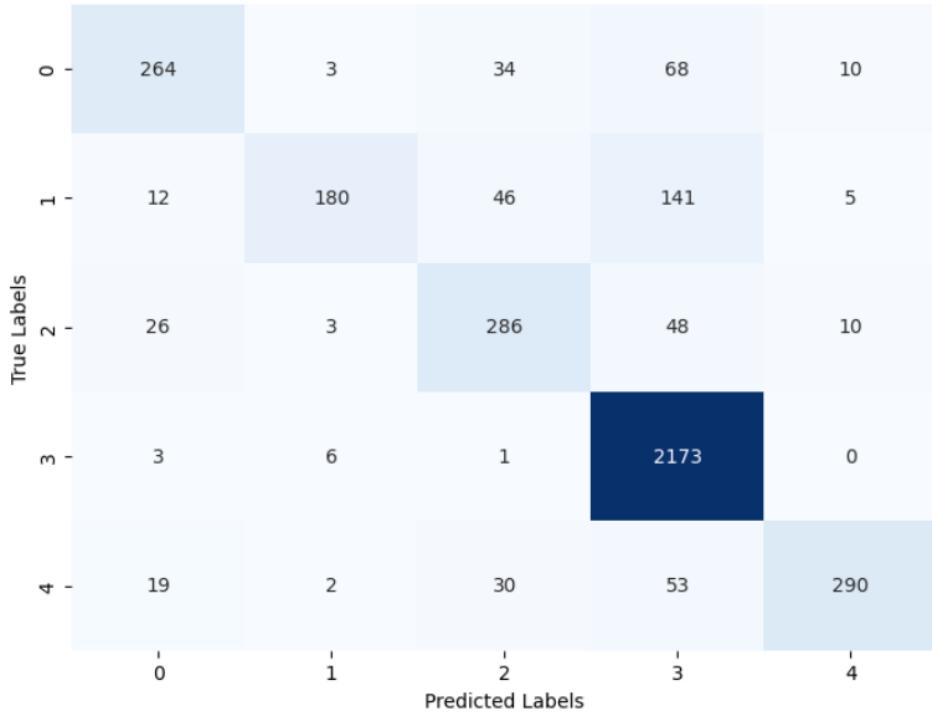


Figure 22: Confusion Matrix (Random Forest)

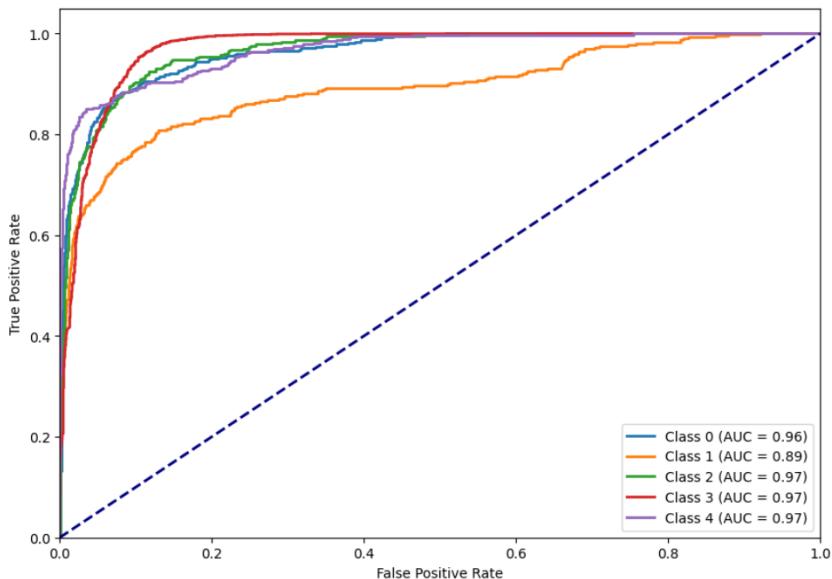


Figure 23: ROC AUC (Random Forest)

that the model is effective at distinguishing between the classes. The Anxiety, Depression, Normal, and PTSD classes each have AUC values above 0.96, with the Normal and Depression classes achieving 0.97. Bipolar has the lowest AUC at 0.89, which corresponds to its lower classification performance. These AUC values suggest that the Random Forest model is proficient in distinguishing between most of the classes, though it faces challenges in identifying Bipolar disorder.

9.6 Results of XGBoost

XGBoost Classification Report

Class	Precision	Recall	F1-Score	Support
Anxiety	0.81	0.74	0.77	403
Bipolar	0.77	0.62	0.69	397
Depression	0.72	0.81	0.76	387
Normal	0.93	0.98	0.95	2137
PTSD	0.86	0.75	0.80	396
Accuracy	87.39%			
Macro Avg	0.82	0.78	0.80	3720
Weighted Avg	0.87	0.87	0.87	3720

Confusion Matrix for XGBoost Model

	Anxiety	Bipolar	Depression	Normal	PTSD
Anxiety	297	20	39	24	23
Bipolar	13	248	36	92	8
Depression	30	13	313	17	14
Normal	3	28	8	2096	2
PTSD	22	12	36	29	297

ROC Curve Areas for Each Class

Class	ROC AUC
Anxiety	0.97
Bipolar	0.95
Depression	0.97
Normal	0.99
PTSD	0.97

The XGBoost model achieved an accuracy of 87.39%, demonstrating strong overall performance. The classification report indicates high precision and recall for the 'Normal' class, which is likely due to its substantial representation in the dataset. The 'Anxiety' and 'PTSD' classes also showed reasonable results, with the 'Anxiety' class achieving a precision of 0.81 and a recall of 0.74. However, the 'Bipolar' class exhibited a lower recall (0.62), suggesting that the model struggles more with this class. The confusion matrix highlights a well-separated 'Normal' class, while the 'Bipolar' and 'PTSD' classes experience more confusion with other categories. The ROC AUC scores further emphasize the model's good discriminatory capability, with AUC values of 0.97 for 'Anxiety,' 'Depression,' and 'PTSD,' and 0.99 for 'Normal.' These scores indicate that the model is proficient at distinguishing between different mental health conditions in the dataset.

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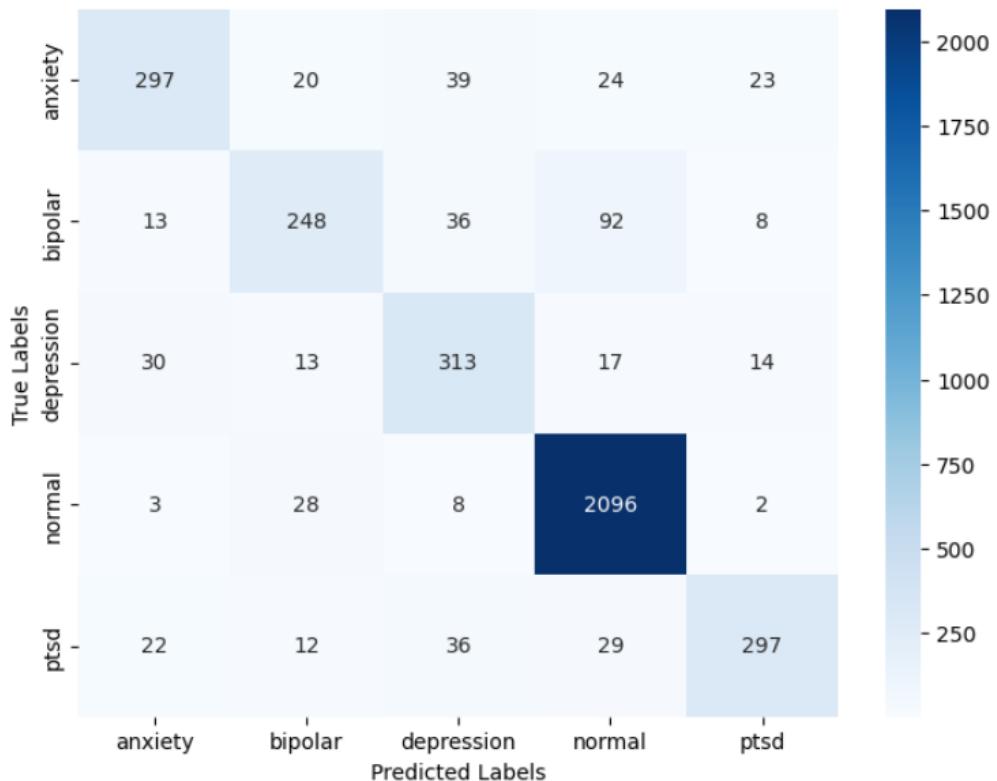


Figure 24: Confusion Matrix (XGBoost)

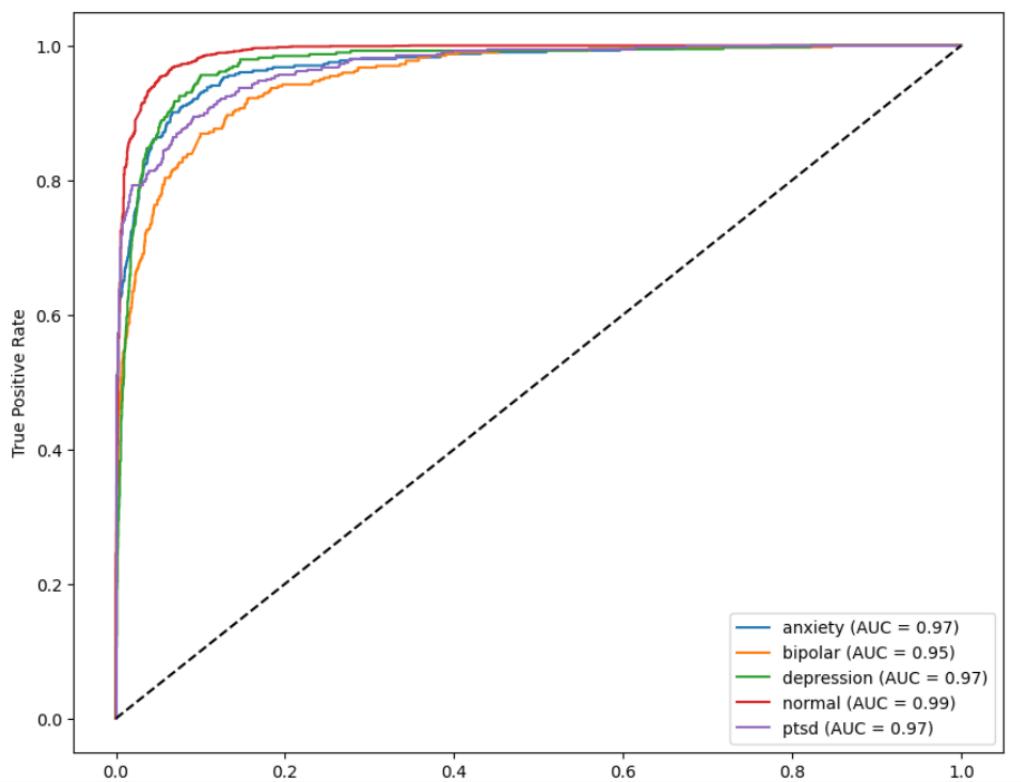


Figure 25: ROC AUC (XGBoost)

9.7 Results of KNN

KNN Classification Report

Class	Precision	Recall	F1-Score	Support
Anxiety	0.58	0.31	0.40	379
Bipolar	0.18	0.59	0.28	384
Depression	0.47	0.39	0.43	373
Normal	0.79	0.69	0.73	2183
PTSD	0.80	0.09	0.16	394
Accuracy	54.46%			
Macro Avg	0.56	0.41	0.40	3713
Weighted Avg	0.67	0.54	0.56	3713

Confusion Matrix for KNN Model

	Anxiety	Bipolar	Depression	Normal	PTSD
Anxiety	117	122	35	101	4
Bipolar	7	226	40	108	3
Depression	24	129	145	74	1
Normal	11	657	15	1499	1
PTSD	41	120	74	124	35

ROC Curve Areas for Each Class

Class	ROC AUC
Anxiety	0.73
Bipolar	0.67
Depression	0.77
Normal	0.80
PTSD	0.67

The KNN model achieved an accuracy of 54.46%, which is considerably lower than the XGBoost model. The classification report reveals a significant imbalance in performance across classes. The 'Normal' class achieved relatively high precision (0.79) and recall (0.69), reflecting the model's tendency to perform well with dominant classes. However, the 'Anxiety' and 'PTSD' classes performed poorly, especially with PTSD having a very low recall of 0.09, indicating substantial misclassification. The confusion matrix suggests that the model struggles with distinguishing between some classes, especially 'Anxiety' and 'Bipolar,' where confusion with other categories is high. The ROC AUC scores are relatively lower compared to the XGBoost model, with 'Normal' having the highest AUC of 0.80. These results indicate that while the KNN model offers a lower overall performance, it still provides a reasonable level of discrimination for the 'Normal' class.

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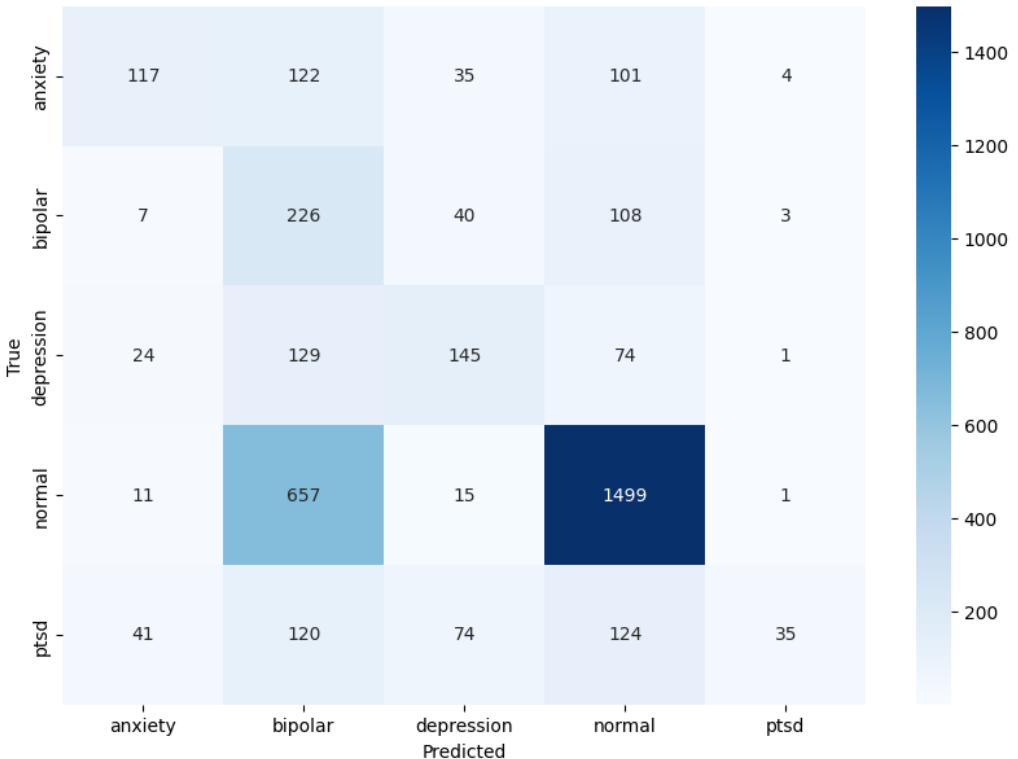


Figure 26: Confusion Matrix (KNN)

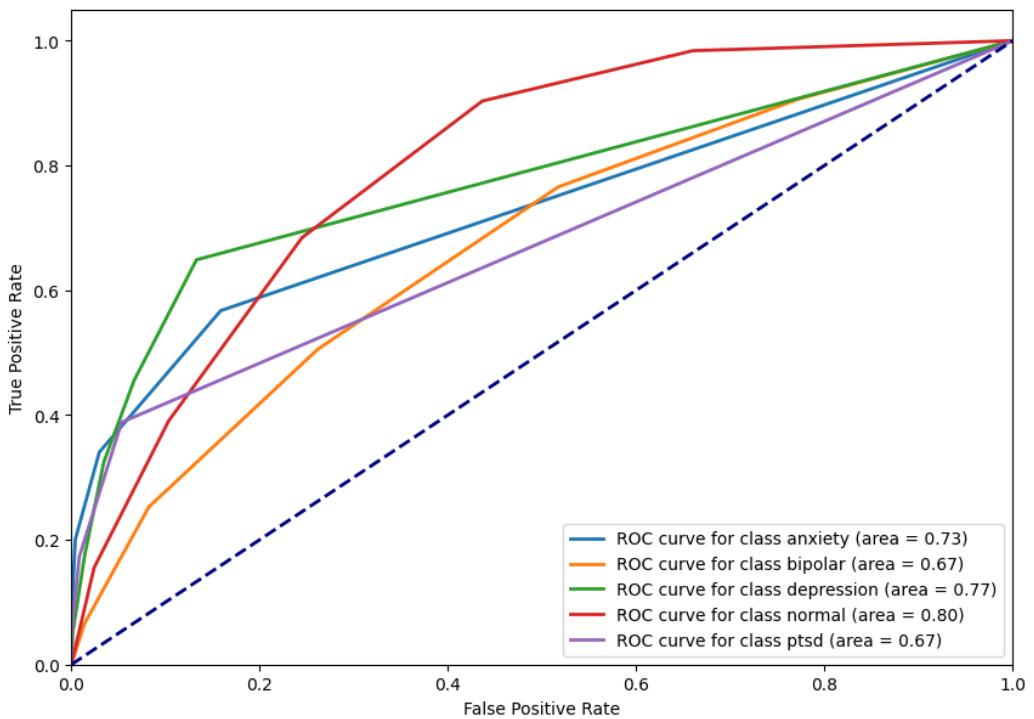


Figure 27: ROC AUC (KNN)

9.8 Results of LSTM

LSTM Classification Report

Class	Precision	Recall	F1-Score	Support
Anxiety	0.81	0.68	0.74	403
Bipolar	0.60	0.59	0.60	397
Depression	0.56	0.77	0.65	387
Normal	0.96	0.96	0.96	2137
PTSD	0.76	0.61	0.68	396
Accuracy	83.55%			
Macro Avg	0.74	0.72	0.73	3720
Weighted Avg	0.84	0.84	0.84	3720

Confusion Matrix for LSTM Model

	Anxiety	Bipolar	Depression	Normal	PTSD
Anxiety	274	36	32	28	33
Bipolar	26	233	42	85	11
Depression	25	31	299	19	13
Normal	6	18	11	2043	9
PTSD	31	33	33	35	264

ROC Curve Areas for Each Class

Class	ROC AUC
Anxiety	0.95
Bipolar	0.92
Depression	0.94
Normal	0.99
PTSD	0.95

The LSTM model achieved an accuracy of 83.55%, indicating strong performance, although it lags slightly behind other models such as XGBoost and SVM. The classification report shows high precision, recall, and F1-scores for the 'Normal' class, which dominates the dataset. The 'Anxiety' class has reasonable performance, with a precision of 0.81 and recall of 0.68, but the 'Bipolar' and 'PTSD' classes have lower precision and recall, especially for 'Bipolar' (0.60 in both precision and recall). The confusion matrix reflects this, with 'Bipolar' and 'PTSD' misclassified with other classes, while 'Normal' is well-separated. The ROC AUC scores highlight the model's ability to distinguish between classes effectively, with 'Normal' scoring the highest AUC of 0.99, followed by other classes such as 'Anxiety' and 'Depression,' both with AUCs above 0.90.

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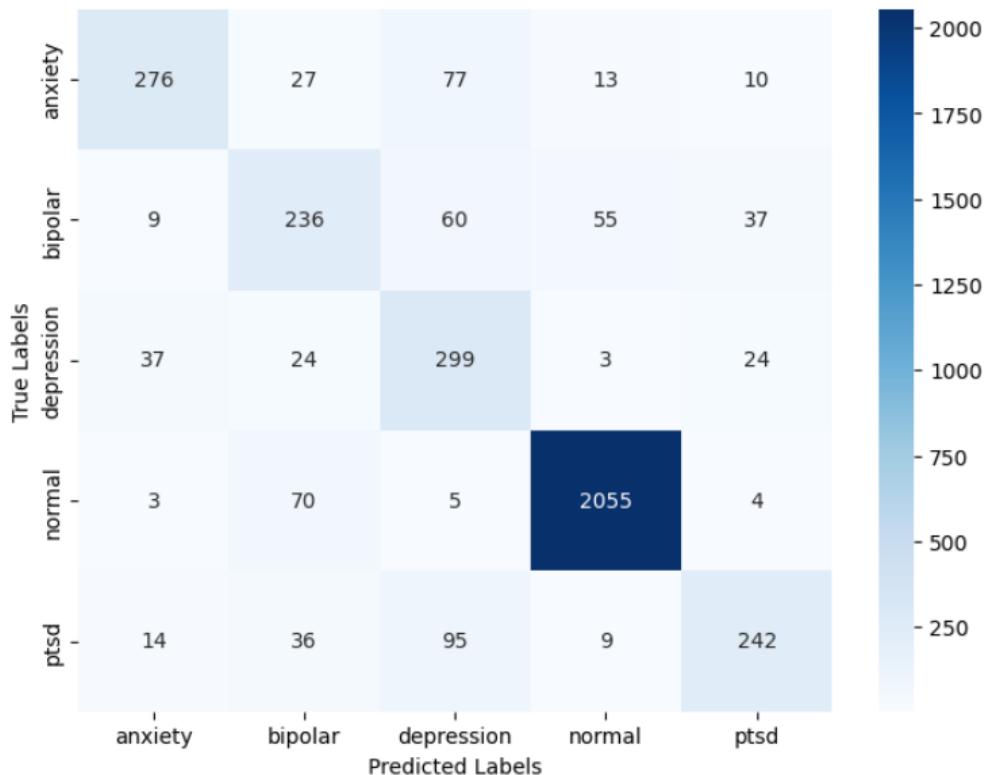


Figure 28: Confusion Matrix (LSTM)

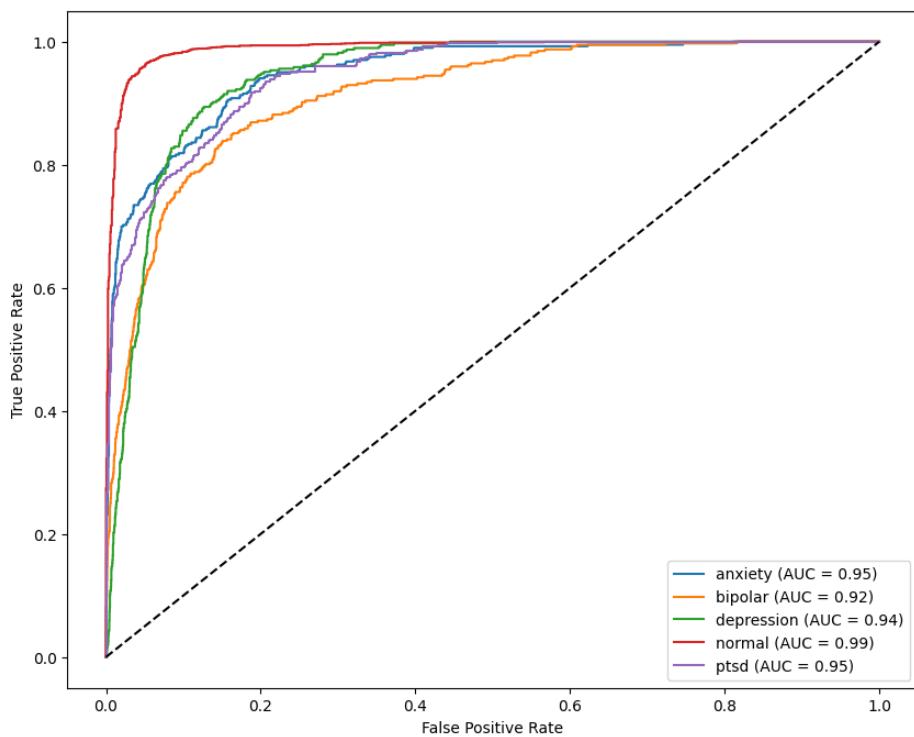


Figure 29: ROC AUC (LSTM)

Among the various machine learning algorithms tested, Logistic Regression emerged as the best performing model. With an accuracy of 87.66%, it outperformed the other models in terms of overall accuracy, precision, recall, and F1-score. The classification report for Logistic Regression shows strong performance across all classes, especially the 'Normal' class, which had high precision (0.92) and recall (0.99). Although the model faced challenges with the 'Bipolar' class, which had lower recall and F1-score, its overall ability to differentiate between other mental health conditions was impressive. The confusion matrix and ROC AUC scores further highlight the model's robustness, with an AUC of 0.99 for the 'Normal' class and strong values for other classes as well. This indicates that Logistic Regression not only achieves high accuracy but also performs well in distinguishing between different mental health categories, making it the most reliable choice for this classification task.

9.9 Results of Hyperparameter Tuning

Hyperparameter Tuning on Logistic Regression

Best Hyperparameters	Value
Solver	liblinear
Penalty	l2
C	1

Classification Report

Class	Precision	Recall	F1-Score	Support
Anxiety	0.83	0.77	0.80	379
Bipolar	0.74	0.55	0.64	384
Depression	0.76	0.76	0.76	373
Normal	0.92	0.99	0.95	2183
PTSD	0.87	0.77	0.82	394
Accuracy	0.88			3713
Macro avg	0.83	0.77	0.79	3713
Weighted avg	0.87	0.88	0.87	3713

ROC Curve Areas for Each Class

Class	ROC AUC
Anxiety	0.95
Bipolar	0.92
Depression	0.96
Normal	0.99
PTSD	0.95

The results of hyperparameter tuning on the Logistic Regression model show that the best hyperparameters were a solver of `liblinear`, a penalty of `l2`, and a regularization parameter (`C`) of 1. The model achieved an overall accuracy of 87.72%, with high performance across

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most classes. The classification report reveals that the model performs well on normal class with an accuracy of 92% in predicting this class, whereas performance on bipolar is slightly lower 64% $F1 - score$. The ROC AUC scores indicate that the model is highly effective in distinguishing between different classes, with normal achieving a near-perfect AUC of 0.99, followed closely by depression at 0.96. These results suggest that the model is well-tuned, particularly for classes like normal and anxiety.

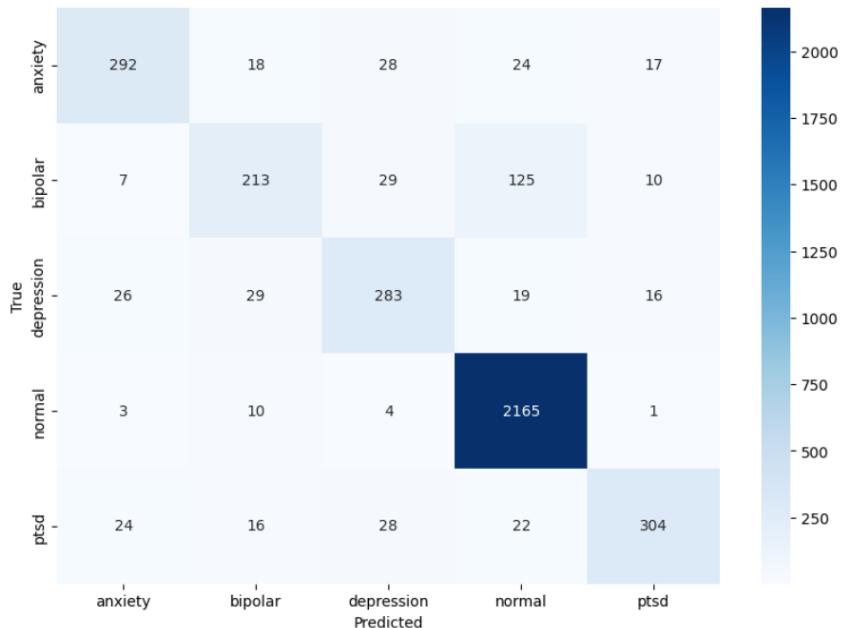


Figure 30: Classification Matrix after Hyperparameter Tuning (Logistic Regression)

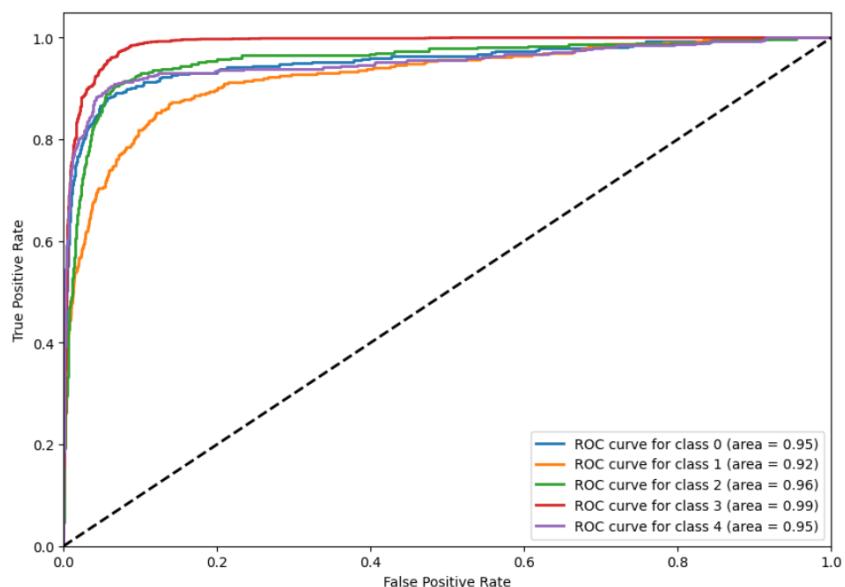


Figure 31: ROC AUC after Hyperparameter Tuning (Logistic Regression)

Hyperparameter Tuning on k-NN

Best Hyperparameters	Value
Weights	distance
n_neighbors	10
Metric	euclidean

Classification Report

Class	Precision	Recall	F1-Score	Support
Anxiety	0.73	0.23	0.35	379
Bipolar	0.18	0.60	0.27	384
Depression	0.47	0.40	0.43	373
Normal	0.74	0.65	0.69	2183
PTSD	0.83	0.10	0.18	394
Accuracy	0.52			3713
Macro avg	0.59	0.40	0.39	3713
Weighted avg	0.66	0.52	0.53	3713

ROC Curve Areas for Each Class

Class	ROC AUC
Anxiety	0.77
Bipolar	0.67
Depression	0.79
Normal	0.79
PTSD	0.71

The results of hyperparameter tuning on the k-Nearest Neighbors (k-NN) model show that the best hyperparameters were weights set to distance, n_neighbors set to 10, and metric set to euclidean. Despite these optimizations, the model achieved an overall accuracy of 52.03%, which is relatively low. The classification report indicates that the model struggled to effectively predict the anxiety and PTSD classes, with particularly low recall values (0.23 and 0.10, respectively). However, it performed reasonably well on the normal class with an F1-score of 0.69. The ROC AUC scores reflect this by showing relatively poor performance for bipolar (0.67) and PTSD (0.71), while normal and depression had slightly better values at 0.79 each. These results suggest that k-NN is not the best model for this dataset, as it fails to consistently classify the minority classes effectively.

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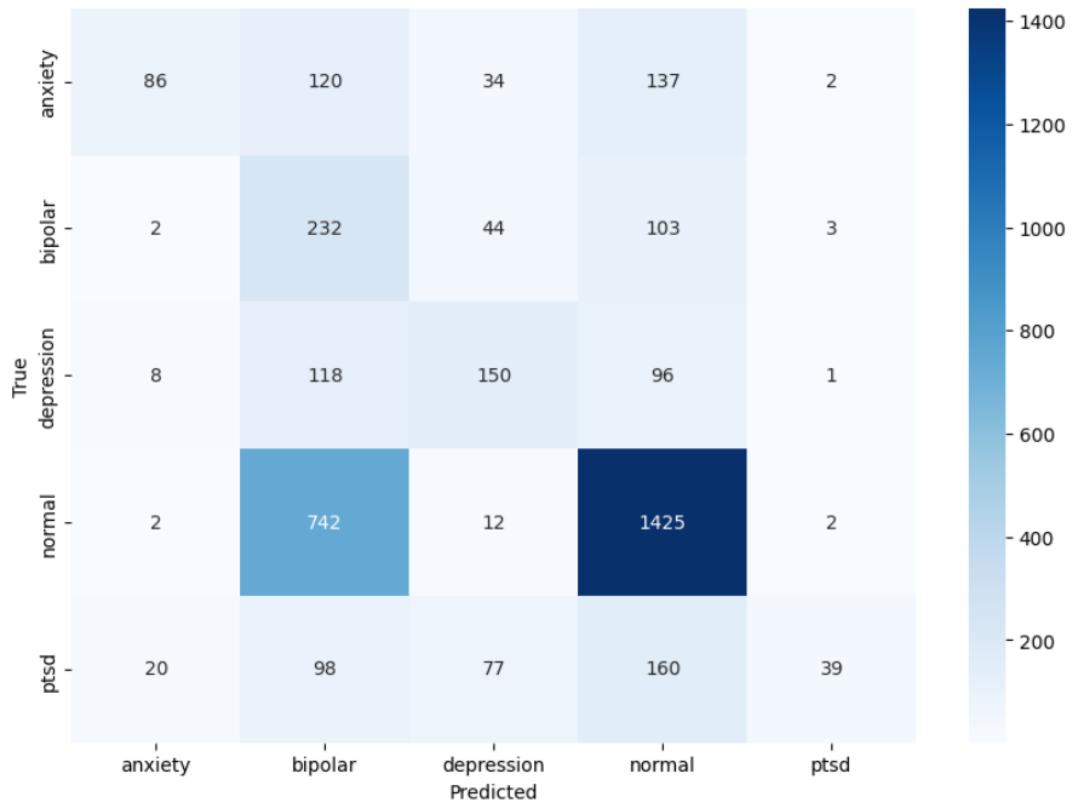


Figure 32: Classification Matrix after Hyperparameter Tuning (KNN)

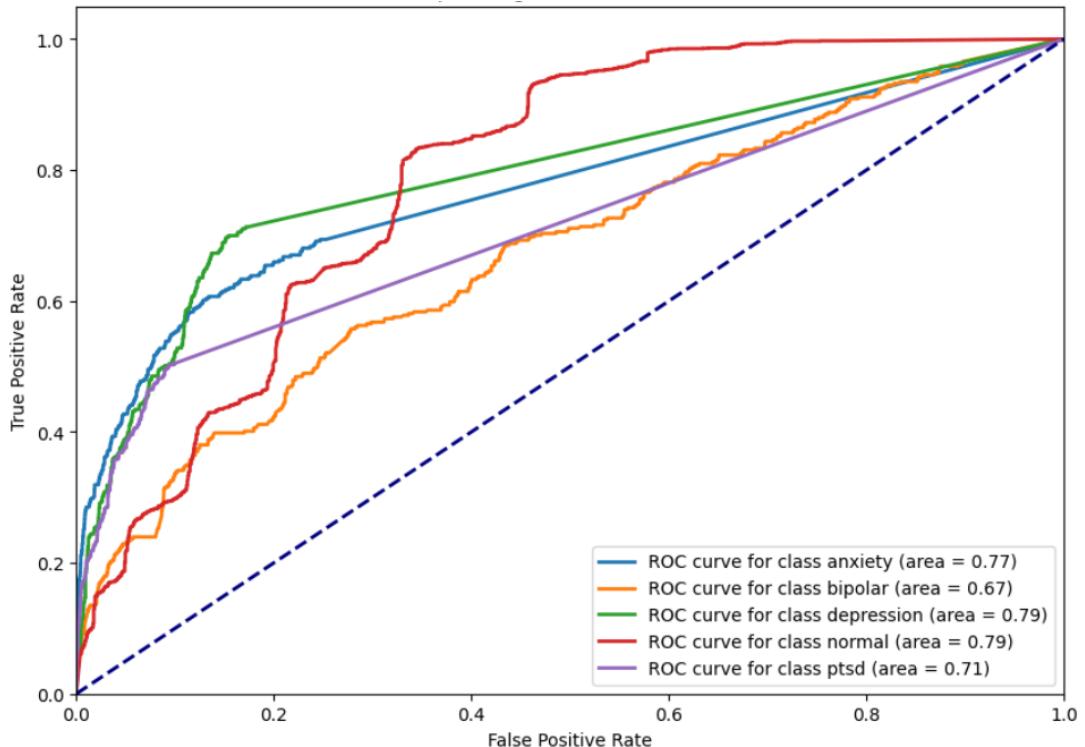


Figure 33: ROC AUC after Hyperparameter Tuning (KNN)

Hyperparameter Tuning on SVM

Best Hyperparameters	Value
Kernel	linear
Gamma	scale
C	1

Classification Report

Class	Precision	Recall	F1-Score	Support
Anxiety	0.72	0.76	0.74	379
Bipolar	0.62	0.61	0.61	384
Depression	0.74	0.71	0.72	373
Normal	0.94	0.95	0.95	2183
PTSD	0.78	0.74	0.76	394
Accuracy	0.85			3713
Macro avg	0.76	0.75	0.76	3713
Weighted avg	0.85	0.85	0.85	3713

ROC Curve Areas for Each Class

Class	ROC AUC
Anxiety	0.92
Bipolar	0.88
Depression	0.95
Normal	0.98
PTSD	0.94

The results of hyperparameter tuning on the Support Vector Machine (SVM) model reveal that the best hyperparameters were kernel set to linear, gamma set to scale, and C set to 1. With these settings, the model achieved an overall accuracy of 85.13%. The classification report indicates solid performance across most classes, with normal achieving the highest F1-score of 0.95, followed by depression at 0.72 and anxiety at 0.74. The bipolar class had a slightly lower F1-score of 0.61, indicating that the model was less effective in distinguishing this class. The ROC AUC values were strong for most classes, with normal reaching 0.98 and depression, PTSD, and anxiety all scoring above 0.90, showing that the SVM model effectively discriminates between the classes. Overall, the SVM model performed well on this dataset, particularly for the normal and anxiety classes, making it a strong contender for mental health issue classification.

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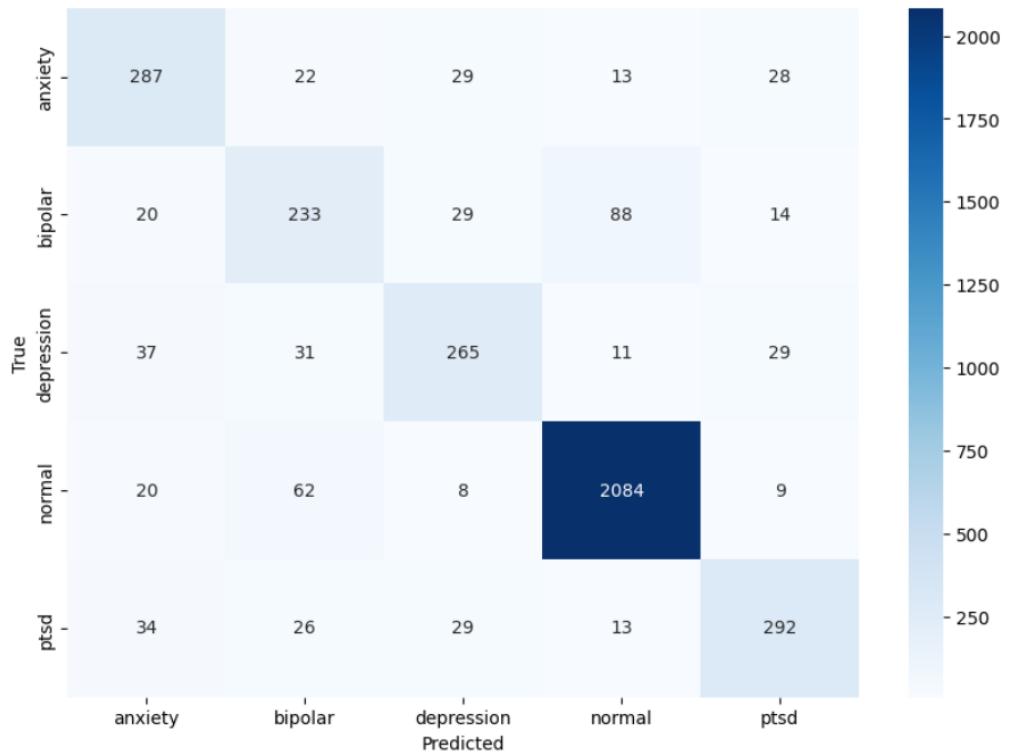


Figure 34: Classification Matrix after Hyperparameter Tuning (SVM)

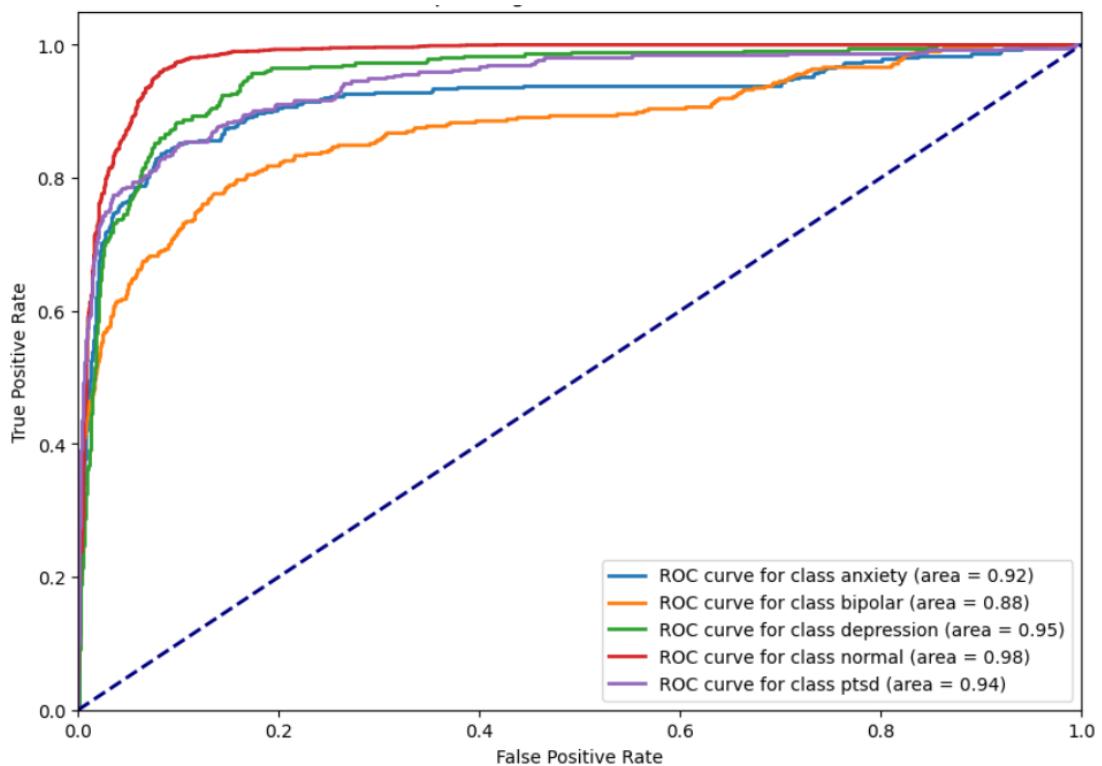


Figure 35: ROC AUC after Hyperparameter Tuning (SVM)

Hyperparameter Tuning on Naive Bayes

Best Hyperparameters	Value
Alpha	0.2914180608409973

Classification Report

Class	Precision	Recall	F1-Score	Support
Anxiety	0.69	0.76	0.72	379
Bipolar	0.75	0.55	0.64	384
Depression	0.60	0.83	0.70	373
Normal	0.96	0.91	0.94	2183
PTSD	0.73	0.79	0.76	394
Accuracy	0.84			3713
Macro avg	0.75	0.77	0.75	3713
Weighted avg	0.85	0.84	0.84	3713

ROC Curve Areas for Each Class

Class	ROC AUC
Anxiety	0.93
Bipolar	0.93
Depression	0.93
Normal	0.99
PTSD	0.94

The results of hyperparameter tuning on the Naive Bayes model show that the best hyperparameter was alpha set to 0.2914. With this optimal value, the model achieved an accuracy of 83.95%. The classification report reveals that the normal class performed the best, with a high F1-score of 0.94, followed by PTSD at 0.76. The anxiety class achieved a solid F1-score of 0.72, while bipolar and depression had lower scores. The ROC AUC curve areas demonstrate strong performance across all classes, with normal reaching a perfect 0.99 and the other classes scoring above 0.90. Overall, the Naive Bayes model performed well, especially in identifying normal and PTSD, making it a good candidate for mental health issue classification.

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Figure 36: Classification Matrix after Hyperparameter Tuning (Naive Bayes)

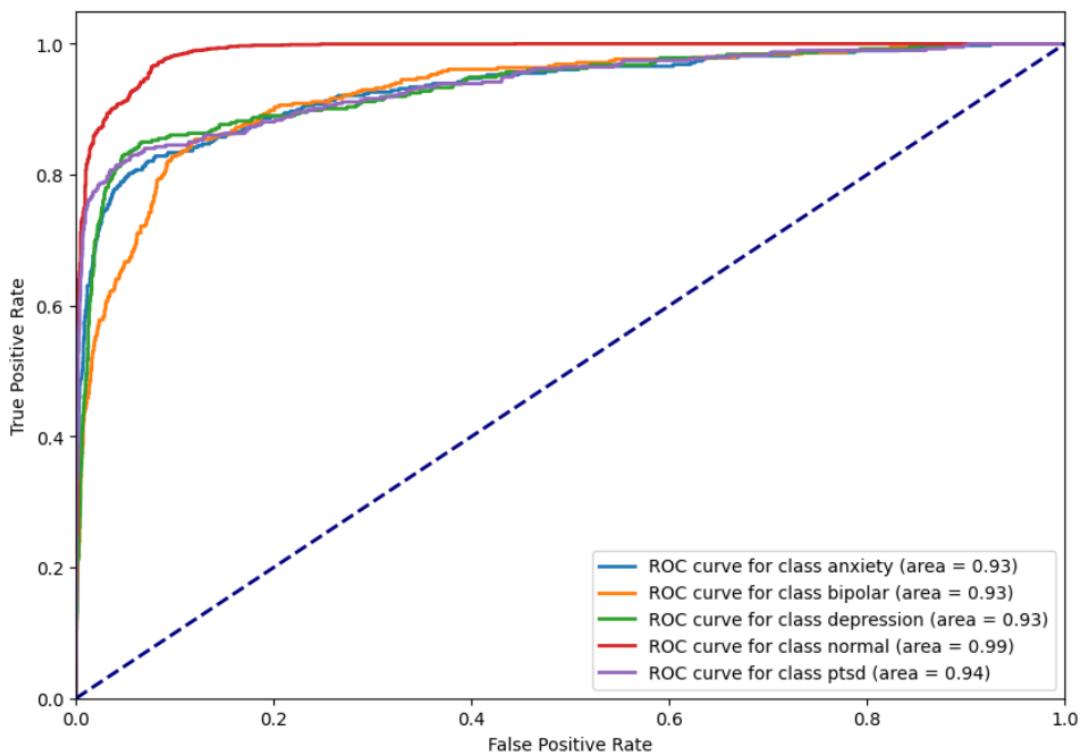


Figure 37: ROC AUC after Hyperparameter Tuning (Naive Bayes)

After performing hyperparameter tuning using RandomizedSearchCV, Logistic Regression emerged as the best-performing model for mental health classification. The model achieved an accuracy of 87.72%, demonstrating its strong ability to correctly classify mental health issues based on text data. The best hyperparameters found during tuning were 'solver': 'liblinear', 'penalty': 'l2', 'C': 1, which contributed to the model's robustness and efficiency. In terms of classification performance, Logistic Regression showed a high recall and precision, especially for classes like *normal*, with a recall of 0.99, indicating its proficiency in identifying the most prevalent class in the dataset. Furthermore, the ROC AUC scores for each class were impressive, with values close to or exceeding 0.90, which suggests excellent model discrimination between classes. Overall, Logistic Regression's combination of high accuracy, solid precision-recall balance, and optimal hyperparameters makes it the most suitable model for this task.

10 Conclusion

10.1 Project Benefits

The project on detecting mental health disorders through social media analysis offers a wide array of significant benefits, both immediate and long-term, across multiple dimensions. First and foremost, it addresses a critical issue in mental health care—early detection and intervention. Social media has become a ubiquitous platform where people express their thoughts, feelings, and emotional states, often unconsciously. By leveraging the vast amounts of data available on social media platforms, our project seeks to tap into this resource to identify early signs of mental health disorders such as anxiety, depression, and more severe conditions like bipolar disorder or schizophrenia. The ability to detect mental health issues through real-time social media data is a game-changer for public health systems, mental health practitioners, and even individuals who may not realize they are at risk. Early detection enables timely intervention, reducing the overall burden of mental health disorders on society by preventing escalation into more severe conditions that often lead to hospitalization, self-harm, or even suicide. In this sense, the project aligns with global health initiatives that emphasize early diagnosis and preventive care.

Moreover, this project holds significant potential for improving the accuracy and efficiency of mental health diagnostics. Traditional diagnostic methods are often time-consuming, subjective, and reliant on self-reporting, which can lead to underdiagnosis or misdiagnosis. By utilizing machine learning algorithms and natural language processing techniques, our project automates the process of sentiment and behavioral analysis on social media platforms, offering a more objective and data-driven approach. This automated system can process large volumes of data much faster than human professionals, providing insights that would be impossible to

glean from manual analysis. The algorithms developed as part of this project can be easily scaled to analyze millions of social media posts, enabling a broader reach in monitoring public mental health trends. Additionally, the project offers practical benefits for mental health professionals, allowing them to focus on treatment and intervention rather than diagnosis. It provides a tool that can be integrated into telehealth systems, offering mental health screening at scale, which is particularly valuable in underserved or rural areas where access to mental health professionals is limited.

From a technological standpoint, the project offers a host of reusable components and methodologies. The machine learning models developed, the sentiment analysis tools, and the overall data pipeline are designed to be scalable and modular. These components can be adapted and extended to other domains beyond mental health, such as market sentiment analysis, public opinion monitoring, or even detecting harmful behavior like cyberbullying and harassment online. By advancing the state of the art in social media analytics, this project contributes to the growing field of AI-driven health care solutions. Furthermore, it provides a blueprint for future interdisciplinary work that integrates data science, psychology, and public health.

10.2 Future Scope for Improvements

While this project offers numerous immediate benefits, there is substantial room for future enhancements that can broaden its applicability, accuracy, and effectiveness. Currently, the project focuses on analyzing Reddit data using PRAW, which is limited to a specific social media platform and dataset. In the future, incorporating data from other platforms like Facebook, Instagram, Twitter, and even niche forums could provide a more comprehensive understanding of an individual's mental health status. Different platforms cater to different demographics and social behaviors, and expanding the dataset will allow for a more holistic analysis of mental health indicators across various user bases. Additionally, expanding the dataset to include multilingual posts or integrating language translation capabilities could make the system applicable to a global audience, helping to identify mental health issues in non-English speaking populations.

Moreover, future improvements could focus on integrating real-time data analysis capabilities. Currently, our project is based on batch processing of historical data. However, in future iterations, the system could be developed to perform real-time monitoring, offering immediate feedback and potentially alerting health professionals or loved ones when someone shows signs of mental distress. This real-time capability would be invaluable in emergency situations, allowing for immediate intervention. Developing a mobile application or a web-based interface where users can voluntarily connect their social media accounts to monitor their mental health status could also increase user engagement and provide individuals with direct feedback on their

well-being.

Another significant future enhancement could involve incorporating ethical considerations and improving user privacy. As mental health is a sensitive subject, ensuring that the system is designed with robust privacy protections is critical. Future work could focus on using differential privacy or other anonymization techniques to ensure that user data remains confidential while still allowing for effective analysis. Moreover, collaborating with psychologists, ethicists, and legal experts could help refine the system to ensure it adheres to ethical guidelines and avoids potential harm, such as misdiagnosis or privacy violations.

Lastly, the future scope of this project could include expanding its use in clinical settings. While the current system is primarily designed as a research tool, future iterations could be developed in collaboration with mental health professionals to ensure that it meets clinical standards.

11 References

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APPENDIX A - Prototype

System Dependencies Installation

```
! apt-get install -y ffmpeg libsm6 libxext6
! apt-get install -y tesseract-ocr
! apt-get install -y portaudio19-dev
```

This code installs essential system-level dependencies required for multimedia processing, Optical Character Recognition (OCR), and audio manipulation tasks. The ffmpeg library provides robust capabilities for processing video and audio data, supporting operations like format conversion, compression, and extraction. The libsm6 and libxext6 libraries are X Window System components needed for graphical processing and enabling compatibility with multimedia frameworks like OpenCV. The tesseract-ocr package installs Tesseract, a powerful OCR engine used for extracting text from images and documents. Lastly, portaudio19-dev is a development package for the PortAudio library, which enables cross-platform audio processing and is often required for speech recognition and audio streaming applications. These installations ensure that the environment is properly configured to handle complex data processing workflows.

Import Libraries

```
import streamlit as st
import joblib
import pandas as pd
import praw
from PIL import Image
from deep_translator import GoogleTranslator
import requests
from io import BytesIO
from collections import Counter
import google.generativeai as genai
import cv2
import numpy as np
import whisper
import tempfile
import os
from pydub import AudioSegment
import subprocess
import re
import librosa
import librosa.display
import tensorflow as tf
import pytesseract
```

This code snippet includes various library imports essential for building a multi-functional application that processes and analyzes multimedia data, text, and machine learning tasks. Streamlit is used for building interactive web apps. Joblib assists with object serialization, and pandas handles structured data manipulation. PRAW enables interaction with Reddit's API, while Pillow facilitates image processing. GoogleTranslator supports text translation, and requests fetches data from web sources. BytesIO handles in-memory byte streams, and collections.Counter aids in counting elements in datasets. Google Generative AI tools are also incorporated for advanced AI tasks. For media processing, OpenCV and NumPy handle image and video manipulations. Whisper is an ASR (Automatic Speech Recognition) tool, and tempfile manages temporary files. Pydub processes audio, and subprocess executes shell commands. Re provides regular expressions for text parsing, Librosa supports audio feature extraction and visualization, and TensorFlow enables building machine learning models. Lastly, pytesseract extracts text from images using OCR (Optical Character Recognition), completing a robust toolset for diverse computational tasks.

Configuration and Model Initialization

```

# Configure Tesseract and FFMPEG
pytesseract.pytesseract.tesseract_cmd = '/usr/bin/tesseract'
os.environ["FFMPEG_BINARY"] = "/usr/bin/ffmpeg"
# Load Whisper model for audio transcription
whisper_model = whisper.load_model("base")
# Load the saved logistic regression model and vectorizer
model = joblib.load('LRmodel.pkl')
vectorizer = joblib.load('LRvectorizer.pkl')
# Initialize Reddit API
reddit = praw.Reddit(client_id='<CLIENT_ID>',
client_secret='<CLIENT_SECRET_KEY>', user_agent='Mental_Health')
# Configure Gemini API for wellbeing insights
genai.configure(api_key="<GEMINI_API_KEY>")
generation_config = {
    "temperature": 1, "top_p": 0.95, "top_k": 40,           "
    "max_output_tokens": 8192, "response_mime_type": "text
    /plain",
}
gemini_model = genai.GenerativeModel(
    model_name="gemini-1.5-flash",           generation_config=
    generation_config,
)

```

This code initializes and configures various tools and models for a complex data-processing pipeline. The Tesseract OCR engine is configured by specifying its executable path to enable text extraction from images. The FFMPEG binary is similarly set to facilitate multimedia

processing tasks. The Whisper model, a speech-to-text solution, is loaded with its base configuration for audio transcription. Saved machine learning artifacts, a logistic regression model, and a vectorizer are loaded using joblib, providing a pre-trained setup for text classification tasks. The Reddit API is initialized using PRAW, with credentials to interact with Reddit's platform for data retrieval. For generative AI tasks, the Gemini API is configured with an API key and generation parameters such as temperature, top-p sampling, and maximum output token limit. A generative model is instantiated using these configurations, designed to provide wellbeing insights. This setup creates a cohesive framework for multimedia processing, natural language processing, and machine learning applications.

Fetching Reddit User Text Posts

```
# Function to fetch text-based posts from Reddit
def fetch_user_text_posts(username):
    try:
        user = reddit.redditor(username)
        posts = [post.title + "\n" + post.selftext for post
                 in user.submissions.new(limit=20)]
        return posts
    except Exception as e:
        st.write(f"Error fetching text posts: {e}")
        return []
```

This function, `fetch_user_text_posts`, is designed to fetch text-based posts from a specified Reddit user. The function takes a `username` as an input and attempts to retrieve the most recent 20 text-based posts from that user's Reddit submissions. Using the PRAW library, the `reddit.redditor(username)` method is called to access the user's posts, and the function iterates over these posts, concatenating the title and the content (`selftext`) of each post into a single string. These concatenated post details are then stored in a list. If an error occurs during this process (such as network issues or invalid user input), the function catches the exception and displays an error message using Streamlit's `st.write()`. If an exception is caught, an empty list is returned. This function is useful for collecting Reddit text data for further analysis or processing.

Fetching Image-Based Posts from Reddit and Performing OCR

```

# Function to fetch image-based posts from Reddit and
perform OCR
def fetch_user_images_and_extract_text(username):
    try:
        user = reddit.redditor(username)
        images = [post.url for post in user.submissions.new(
            limit=20) if post.url.endswith('.jpg', '.jpeg',
            '.png', '.webp', '.bmp', '.tiff'))]

        extracted_texts = []
        for image_url in images:
            try:
                response = requests.get(image_url)
                image = Image.open(BytesIO(response.content))
                st.image(image, caption="Fetched_Image",
                         use_column_width=True)

                extracted_text = extract_text_from_image(
                    image)
                if extracted_text.strip():
                    translated_text = GoogleTranslator(
                        source='auto', target='en').translate(
                        extracted_text)
                    extracted_texts.append(translated_text)
                    st.write("Extracted_and_Translated_Text_
                             from_Image:")
                    st.text(translated_text)
            except Exception as e:
                st.write(f"Error_processing_image_{image_url}
                         :_{e}")

        return extracted_texts
    except Exception as e:
        st.write(f"Error_fetching_images:_{e}")
        return []

```

This function, `fetch_user_images_and_extract_text`, is designed to fetch image-based posts from a specified Reddit user and perform Optical Character Recognition (OCR) to extract text from the images. The function first attempts to retrieve the most recent 20 submissions from the specified Reddit user using the PRAW library. It filters the posts to include only those with image URLs that match common image file formats (e.g., .jpg, .jpeg, .png, etc.). For each valid image URL, the function fetches the image using the `requests` library and then processes it by opening the image with Pillow's `Image.open()` method. The image is dis-

played on the Streamlit app using `st.image()` with the option to show it in the appropriate column width. After displaying the image, the function calls `extract_text_from_image`, which performs OCR using Tesseract (assumed to be defined elsewhere in the code). If any text is successfully extracted, it is translated into English using the `GoogleTranslator` from the `deep_translator` library, and the translated text is displayed on the app using `st.write()` and `st.text()`. In case of errors (e.g., issues fetching the image or processing the OCR), exceptions are caught and an error message is displayed via Streamlit's `st.write()`. The function returns a list of extracted and translated texts from the images, or an empty list if any errors occur during the process. This function is helpful for gathering, processing, and translating text from image posts on Reddit.

Classifying Text and Displaying Results

```
# Function to classify text and display result
def classify_text(text):
    input_vectorized = vectorizer.transform([text])
    prediction_proba = model.predict_proba(input_vectorized)

    issue_labels = model.classes_
    proba_df = pd.DataFrame(prediction_proba, columns=
        issue_labels).T
    proba_df.columns = ['Probability']

    top_issue = proba_df['Probability'].idxmax()
    top_probability = proba_df['Probability'].max()

    st.write(f"The most likely mental health concern is:{top_issue} with a probability of {top_probability:.2%}")

get_wellbeing_insight(text, top_issue)
```

This function, `classify_text`, is used to classify a given text and display the most likely mental health concern along with its probability. The function first vectorizes the input `text` using the `vectorizer.transform()` method, which converts the text into a format suitable for the machine learning model. The `model.predict_proba()` method is then called to get the probabilities for each possible class label, which represents different mental health issues. The class labels (issues) are retrieved using `model.classes_`, and a Pandas DataFrame (`proba_df`) is created to display the predicted probabilities for each issue. The DataFrame is transposed and renamed to give a clearer view, with a column for the probability values. The function then identifies the issue with the highest probability using `idxmax()` and retrieves the maximum probability value using `max()`. Finally, the most likely issue and its associated

probability are displayed on the Streamlit app using `st.write()`. Additionally, the function calls `get_wellbeing_insight`, passing the text and the top issue, likely to generate further insights into the mental health concern identified. This function is integral to classifying text data for mental health analysis and providing actionable insights based on the results.

Getting Wellbeing Insights from Gemini Model

```
# Function to get wellbeing insights from Gemini model
def get_wellbeing_insight(text, top_issue):
    try:
        chat_session = gemini_model.start_chat(history[])
        prompt = f"<Prompt_to_get_the_well_being_based_on_Ryff_Scale_Six_Factor_Model>"

        response = chat_session.send_message(prompt)

        st.write("###_Wellbeing_Insight:")
        st.write(response.text)
    except Exception as e:
        st.write(f"Error_retrieving_wellbeing_insights:{e}")
    )
```

The function `get_wellbeing_insight` interacts with the Gemini AI model to generate insights related to a mental health issue based on the Ryff Scale of Psychological Well-Being. The function starts by initializing a chat session with the Gemini model using `gemini_model.start_chat()`. It then constructs a detailed prompt that outlines the six factors of well-being: autonomy, environmental mastery, personal growth, positive relations with others, purpose in life, and self-acceptance. These factors are crucial for evaluating an individual's psychological well-being. The prompt includes specific example statements related to each factor, offering context for how the mental health issue (`top_issue`) might affect the individual in each area. The function sends this prompt to the Gemini model and retrieves the response, which provides detailed advice and reflections on how the issue impacts each well-being factor. The response includes short paragraphs for each of the six factors, analyzing the potential effects of the issue on the individual's ability to function in these areas. After receiving the response, the function uses Streamlit's `st.write()` method to display the wellbeing insights. In case of any errors, such as issues with the Gemini model or the chat session, an error message is displayed using `st.write()`. This function is valuable for generating personalized psychological insights and offering practical advice based on the impact of a specific mental health issue.

Extract Text from Image Using Tesseract

```
# Function to extract text from image using Tesseract
def extract_text_from_image(image):
    extracted_text = pytesseract.image_to_string(image)
    return extracted_text.splitlines()

# Function to extract text from an image using Tesseract
def extract_text_from_image_video(image):
    extracted_text = pytesseract.image_to_string(image)
    return extracted_text if extracted_text else "" #
        Return empty string if no text is found
```

The provided code consists of two functions designed to extract text from an image using the Tesseract OCR (Optical Character Recognition) engine.

The first function, `extract_text_from_image(image)`, takes an `image` object as input, applies the `pytesseract.image_to_string(image)` method to extract text from the image, and then splits the resulting text into individual lines using the `splitlines()` method. This allows the function to return a list where each element corresponds to a line of extracted text, making it easier to handle multiline results. The second function, `extract_text_from_image_video(image)`, operates similarly by extracting text from the image, but it includes an additional check to determine whether any text was successfully extracted. If no text is found, the function returns an empty string (" "), ensuring that it always returns a consistent type rather than `None`, which could potentially cause issues in other parts of the code. Both functions rely on the `pytesseract` library, which is a Python wrapper for the open-source Tesseract OCR engine, to perform the text extraction. These functions are useful for extracting text from images, which can be helpful in various use cases such as document scanning, analyzing images with embedded text, or processing video frames to capture text content.

Extract Frames from Video File

```
# Function to extract 20 frames from a video file
def extract_frames(video_path, num_frames=20):
    cap = cv2.VideoCapture(video_path)
    total_frames = int(cap.get(cv2.CAP_PROP_FRAME_COUNT))

    frames = []
    frame_interval = total_frames // num_frames # Calculate frame interval
```

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Extract Frames from Video File

```
for i in range(num_frames):
    cap.set(cv2.CAP_PROP_POS_FRAMES, i * frame_interval)

    ret, frame = cap.read()

    if ret:
        frame = cv2.cvtColor(frame, cv2.COLOR_BGR2RGB)
        frames.append(frame)

cap.release()
return frames
```

The `extract_frames(video_path, num_frames=20)` function extracts a specified number of frames from a given video file. The function uses the OpenCV library, specifically the `cv2.VideoCapture()` method, to load the video from the file path provided by the `video_path` argument. First, it calculates the total number of frames in the video using `cap.get(cv2.CAP_PROP_FRAME_COUNT)`. Next, it calculates the frame interval by dividing the total number of frames by the desired number of frames to be extracted (`num_frames`). For each of the frames, the function sets the position of the video playback to a specific frame using `cap.set(cv2.CAP_PROP_POS_FRAMES, i * frame_interval)`. It then reads the frame, converts the color from BGR (Blue-Green-Red) to RGB using `cv2.cvtColor(frame, cv2.COLOR_BGR2RGB)`, and appends the frame to a list. This process is repeated for the number of frames specified. Finally, the video capture object is released with `cap.release()`, and the list of frames is returned. This function can be useful in scenarios where frame extraction is needed from videos for further processing, such as image analysis, video summarization, or even object detection tasks.

Transcribe Audio from Video

```
def transcribe_audio_from_video(video_file):
    try:
        # Save the uploaded video file to a temporary file
        with tempfile.NamedTemporaryFile(delete=False, suffix=".mp4") as temp_video_file:
            temp_video_file.write(video_file.read())
            temp_video_path = temp_video_file.name

        audio_path = tempfile.NamedTemporaryFile(suffix=".wav",
                                                delete=False).name
```

Transcribe Audio from Video

```

# Extract audio from video using subprocess
subprocess.run(["ffmpeg", "-i", temp_video_path, "-q:a",
    "0", "-map", "a", audio_path, "-y"])
audio = AudioSegment.from_file(audio_path)

# Use Whisper to transcribe the audio
result = whisper_model.transcribe(audio_path)

# Get the transcribed text and translate if necessary
transcribed_text = result["text"]
translated_text = GoogleTranslator(source="auto", target
    ="en").translate(transcribed_text)

# Clean up temporary files
os.remove(temp_video_path)
os.remove(audio_path)

return translated_text

except Exception as e:
    # Display a user-friendly message if the video is too
    long or another error occurs
    if "duration" in str(e).lower() or "length" in str(e).
        lower():
        return "The_video_is_too_long_to_process._Please_
            upload_a_shorter_video."
    else:
        return f"An_error_occurred:_{e}"

```

The `transcribe_audio_from_video(video_file)` function processes a video file by first saving it to a temporary file on disk. It then extracts the audio using the `ffmpeg` command-line tool, saving the extracted audio as a WAV file. The extracted audio is processed using the Whisper model for transcription, which outputs the transcribed text. Additionally, the function utilizes the `GoogleTranslator` to translate the text into English if necessary. Temporary files created during processing are deleted to manage resources efficiently. In case of errors, the function returns a user-friendly message, especially handling scenarios where the video duration exceeds allowable limits. This function is useful for converting spoken content in videos to text for further processing.

Translate Text Using DeepL

```
# Function to translate text using DeepL
def translate_text(text, target_lang="en"):
    try:
        if text:
            translated_text = GoogleTranslator(source="auto",
                                              target=target_lang).translate(text)
            return translated_text
        return "" # Return empty string if text is empty or None
    except Exception as e:
        return f"Error_translating_text:{str(e)}"
```

The `translate_text(text, target_lang="en")` function provides an interface to translate a given string of text into a specified target language, with English ("en") set as the default. Using the `GoogleTranslator` library, the function automatically detects the source language (`source="auto"`) and translates the text to the desired target language. If the input text is empty or `None`, the function gracefully returns an empty string. In case of any errors during the translation process, such as network issues or invalid input, an error message containing the exception details is returned. This function is particularly useful for applications requiring multilingual support, enabling seamless translation of text between languages.

Extract Audio from Video File

```
# Function to extract audio from a video file
def extract_audio_from_video(video_path):
    try:
        # Generate a temporary audio file path
        audio_path = tempfile.NamedTemporaryFile(delete=False,
                                                suffix=".wav").name

        # Use FFmpeg to extract audio from video
        subprocess.run(["ffmpeg", "-i", video_path, "-q:a", "0",
                      "-map", "a", audio_path, "-y"])

        # Return the path of the extracted audio
        return audio_path

    except Exception as e:
        return f"Error_extracting_audio:{str(e)}"
```

The `extract_audio_from_video(video_path)` function facilitates the extraction of audio content from a video file. It first generates a temporary file path with a `.wav` suffix

to store the extracted audio. The function uses the `ffmpeg` command-line tool to process the video file specified by `video_path`, extracting the audio stream with high quality (`-q:a 0`) and saving it to the temporary file. The path to the extracted audio file is returned for further use. In the event of an error, such as invalid file paths or processing issues, the function catches the exception and returns a descriptive error message. This function is useful in multimedia applications where the separation of audio from video content is needed, such as transcription or audio analysis workflows.

Analyze Audio Mood Based on Extracted Audio

```
# Function to analyze audio mood based on extracted audio
def analyze_audio_mood(video_path):
    try:
        # Extract audio from the video (assuming
        # extract_audio_from_video is implemented)
        audio_path = extract_audio_from_video(video_path)

        # Load the audio file using librosa
        y, sr = librosa.load(audio_path)

        # Extract MFCCs (Mel-frequency cepstral coefficients)
        # from the audio signal
        mfcc = librosa.feature.mfcc(y=y, sr=sr, n_mfcc=13)

        # Divide the MFCC array into 4 frequency bands and
        # calculate scalar mean for each band

        # Low Frequencies: MFCC 0, 1, 2
        low_freq_mfcc = np.mean(mfcc[0:3], axis=1)
        mean_low = np.mean(low_freq_mfcc) # Scalar mean for low
                                         # frequencies

        # Mid-Low Frequencies: MFCC 3, 4
        mid_low_freq_mfcc = np.mean(mfcc[3:5], axis=1)
        mean_mid_low = np.mean(mid_low_freq_mfcc) # Scalar mean
                                                # for mid-low frequencies

        # Mid-High Frequencies: MFCC 5, 6, 7
        mid_high_freq_mfcc = np.mean(mfcc[5:8], axis=1)
        mean_mid_high = np.mean(mid_high_freq_mfcc) # Scalar
                                                    # mean for mid-high frequencies

        # High Frequencies: MFCC 8, 9, 10, 11, 12
        high_freq_mfcc = np.mean(mfcc[8:13], axis=1)
        mean_high = np.mean(high_freq_mfcc) # Scalar mean for
                                         # high frequencies
```

Analyze Audio Mood Based on Extracted Audio

```

# Now use these scalar means for classification

if mean_high <= mean_low and mean_high <= mean_mid_low
and mean_high <= mean_mid_high:
    return "Audio_sounds_normal,_with_no_dominant_
emotion_detected"

elif mean_mid_high <= mean_low and mean_mid_high <=
mean_mid_low and mean_mid_high <= mean_high:
    return "Audio_sounds_neutral,_calm,_or_peaceful"

elif mean_mid_low <= mean_low and mean_mid_low <=
mean_mid_high and mean_mid_low <= mean_high:
    return "Audio_sounds_slightly_melancholic,_or_neutral
"

elif mean_low <= mean_mid_low and mean_low <=
mean_mid_high and mean_low <= mean_high:
    return "Audio_sounds_calm,_or_melancholic,_with_less_
intensity"

elif mean_high > mean_low and mean_high > mean_mid_low
and mean_high <= mean_mid_high:
    return "Audio_sounds_depressive,_or_anxious,in_nature
"

else :
    return "Audio_sounds_upbeat,_and_energetic_(Happy)"

except Exception as e:
    return f"Error_analyzing_audio_mood:{str(e)}"
```

The `analyze_audio_mood(video_path)` function determines the mood of an audio segment extracted from a given video file. It begins by extracting audio using the `extract_audio_from_video` function and loading the audio file with `librosa`. The function computes Mel-frequency cepstral coefficients (MFCCs), which are features widely used in audio signal processing for mood or emotion analysis. The MFCCs are divided into four frequency bands (low, mid-low, mid-high, high), and scalar means are computed for each band. Based on these scalar values, a series of conditions classify the mood as normal, neutral, melancholic, calm, depressive, or upbeat. In case of an exception, an error message with details is returned. This function can be utilized in applications such as multimedia content analysis, emotion recognition, or mood-based music recommendations.

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Twitter API call and post extraction

```
# Initialize Twitter API
BEARER_TOKEN = "<TWITTER-BEARER-TOKEN>"
client = tweepy.Client(bearer_token=BEARER_TOKEN)

# Twitter
def fetch_image_content(image_url):
    """Fetch_and_process_an_image_from_a_URL."""
    try:
        response = requests.get(image_url, timeout=10)
        response.raise_for_status() # Ensure the request was
                                    # successful
        return Image.open(BytesIO(response.content))
    except Exception as e:
        st.write(f"Error_fetching_image:{e}")
        return None

def get_latest_tweets_with_images(username, max_items=10):
    """Fetch_latest_tweets_with_text_and_associated_images."""
    # Fetch user details to get user ID
    user = client.get_user(username=username)
    if not user.data:
        return [], []

    user_id = user.data.id

    # Fetch the latest tweets (exclude retweets and replies)
    response = client.get_users_tweets(
        id=user_id,
        tweet_fields=["attachments"],
        expansions=["attachments.media_keys"],
        media_fields=["url"],
        exclude=["retweets", "replies"],
        max_results=max_items
    )

    tweet_data = []

    if response.data:
        for tweet in response.data:
            # Extract text
            text = tweet.text
```

Twitter API call and post extraction

```

# Extract images if available
images = []
if hasattr(tweet, "attachments") and tweet.attachments is not None:
    if "media_keys" in tweet.attachments:
        for media_key in tweet.attachments["media_keys"]:
            media = next(
                (media for media in response.includes.get("media", []) if
                 media["media_key"] == media_key),
                None
            )
            if media and media.type == "photo":
                images.append(media.url)

# Append tweet data
tweet_data.append({"text": text, "images": images})

return tweet_data

```

The above code snippet initializes the Twitter API using the `tweepy` library, specifically with a BEARER_TOKEN for authentication. It defines two functions: `fetch_image_content` and `get_latest_tweets_with_images`. The `fetch_image_content` function retrieves an image from a provided URL using the `requests` library. It ensures successful HTTP requests via `response.raise_for_status()` and opens the image using the `Pillow` library's `Image.open`, handling errors gracefully by returning `None` if an exception occurs. The `get_latest_tweets_with_images` function fetches the latest tweets from a specified username, extracting text and associated image URLs. It first retrieves the user's unique Twitter ID using `client.get_user`. It then fetches tweets using `client.get_users_tweets`, excluding retweets and replies, and includes `attachments.media_keys` to identify images. For each tweet, it extracts the text and resolves media URLs by matching `media_keys` with `response.includes.media` data, appending only those of type `photo`. The final result is a list of dictionaries, each containing tweet text and a list of image URLs.

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Streamlit Mental Health Disorder Detection App

```
# Define the Streamlit app
def run_app():
    st.title("Mental_Health_Disorder_Detection")

    option = st.sidebar.selectbox(
        "Choose_an_option",
        ["Text_Input", "Image_Upload", "Video_Upload", "Reddit_Username_Analysis"]
    )

    # Text Input
    if option == "Text_Input":
        st.subheader("Enter_Text_to_Classify_Mental_Health_Issue")
        input_text = st.text_area("Enter_your_text_here:")

        if st.button("Classify_Text"):
            if input_text.strip() == "":
                st.write("Please_enter_some_text_to_classify.")
            else:
                translated_text = GoogleTranslator(source='auto',
                                                    target='en').translate(input_text)
                st.write("Translated_Text_(to_English):")
                st.write(translated_text)
                classify_text(translated_text)

    # Image Upload
    elif option == "Image_Upload":
        st.subheader("Upload_an_Image_to_Extract_and_Classify_Text")
        uploaded_image = st.file_uploader("Upload_an_Image",
                                           type=["jpg", "jpeg", "png", "webp", "bmp", "tiff"])

        if uploaded_image is not None:
            image = Image.open(uploaded_image)
            st.image(image, caption="Uploaded_Image",
                     use_column_width=True)

            extracted_text = extract_text_from_image(image)
            translated_text = GoogleTranslator(source='auto',
                                                target='en').translate("\n".join(extracted_text))

            st.subheader("Translated_Text_(to_English) ")
            st.text(translated_text)
```

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Streamlit Mental Health Disorder Detection App

```
if st.button("Classify_Extracted_Text"):
    if not translated_text or translated_text.strip() == "":
        st.write("It_is_normal_with_probability_100%")
    else:
        classify_text(translated_text)

# Video Upload
elif option == "Video_Upload":
    st.subheader("Upload_a_Video_to_Extract_and_Classify_Text")
    video_file = st.file_uploader("Choose_a_video_file",
                                  type=["mp4", "mov", "avi"])

    if video_file:
        video_path = "/tmp/uploaded_video.mp4"
        with open(video_path, "wb") as f:
            f.write(video_file.getbuffer())

        st.video(video_file)

        frames = extract_frames(video_path)
        combined_text = ""

        st.write("Extracting_frames_from_video...")
        for idx, frame in enumerate(frames):
            st.image(frame, caption=f"Frame_{idx+1}",
                     use_column_width=True)
            text_from_frame = extract_text_from_image_video(
                frame)
            if text_from_frame and text_from_frame not in combined_text:
                combined_text += text_from_frame + " "

        st.write("Text_Extracted_from_Video_Frames:")
        st.text(combined_text)

        transcribed_audio_text = transcribe_audio_from_video(
            video_file)
        st.write("Transcribed_Audio_Text:")
        st.text(transcribed_audio_text)

        full_combined_text = combined_text + " " +
            transcribed_audio_text
        translated_combined_text = translate_text(
            full_combined_text)
```

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Streamlit Mental Health Disorder Detection App

```
st.write("Translated_Combined_Text_(Frames+_Audio):")
st.text(translated_combined_text)

st.write("Analyzing_Audio_Mood...")
mood_result = analyze_audio_mood(video_path)
st.write(mood_result)

if st.button("Classify_Extracted_Text"):
    classify_text(translated_combined_text)

# Reddit Username Analysis
elif option == "Reddit_Username_Analysis":
    st.subheader("Enter_Reddit_Username_for_Analysis")
    username = st.text_input("Enter_Reddit_username:")

if st.button("Analyze"):
    text_posts = fetch_user_text_posts(username)
    image_texts = fetch_user_images_and_extract_text(
        username)

    all_text = text_posts + image_texts
    if all_text:
        predictions = [model.predict(vectorizer.
            transform([text]))[0] for text in all_text]
        issue_counts = Counter(predictions)
        top_issue, top_count = issue_counts.most_common
            (1)[0]
        st.write(f"The_most_frequent_issue:_{top_issue}_"
            f"({(top_count/_len(predictions))_*100:.2f}%")
        issue_distribution = pd.DataFrame(issue_counts.
            items(), columns=['Mental_Health_Issue', 'Count'])
        st.write("Mental_health_issue_distribution_"
            "across_posts:")
        st.write(issue_distribution)

    # Call the Gemini model to get well-being
    # insights
    get_wellbeing_insight("".join(all_text),
        top_issue)
else:
    st.write("No_valid_text_found_for_analysis.")
```

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Streamlit Mental Health Disorder Detection App

```
# Twitter Username Analysis
elif option == "Twitter_Username_Analysis":
    st.subheader("Enter_Twitter_Username_for_Analysis")
    username = st.text_input("Enter_Twitter_username:")

    if st.button("Analyze"):
        if username.strip() == "":
            st.write("Please_enter_a_Twitter_username.")
        else:
            # Fetch the latest tweets with associated images
            tweets_with_images =
                get_latest_tweets_with_images(username)

            # Extract text content from tweets
            text_posts = [tweet['text'] for tweet in
                tweets_with_images if tweet['text']]
            st.write("Recent_Text_Posts_from_Tweets:")
            st.write(text_posts[:3]) # Display a few posts
            for review

            # Extract and process text from associated
            # images
            image_texts = []
            for tweet in tweets_with_images:
                for image_url in tweet['images']:
                    image = fetch_image_content(image_url)
                    if image:
                        st.image(image, caption=f"Image_from
                            _Tweet", use_column_width=True)
                    if image:
                        extracted_text =
                            extract_text_from_image(image) # Assuming a text extraction
                        function is defined
                    if extracted_text:
                        image_texts.append(
                            extracted_text)

            # Combine text from both tweet text and
            # extracted image text
            all_text = text_posts + image_texts

            # Ensure all entries in all_text are strings
            all_text = [str(text) for text in all_text if
                text]
```

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Streamlit Mental Health Disorder Detection App

```
if all_text:
    predictions = []
    for text in all_text:
        try:
            # Vectorize and classify each text
            input_vectorized = vectorizer.
                transform([text])
            prediction = model.predict(
                input_vectorized)
            predictions.append(prediction[0])
        except Exception as e:
            st.write(f"Error_processing_text:{text[:50]}...-{e}")
            continue

    # Count the most common mental health issue
    issue_counts = Counter(predictions)
    top_issue, top_count = issue_counts.
        most_common(1)[0]
    top_percentage = (top_count / len(
        predictions)) * 100

    st.write(f"The_most_frequently_detected_
        mental_health_concern_is:{top_issue},_
        appearing_in_{top_percentage:.2f}%_of_
        analyzed_text.")
    issue_distribution = pd.DataFrame(
        issue_counts.items(), columns=['Mental_
            Health_Issue', 'Count'])
    st.write("Mental_health_issue_distribution_
        across_posts:")
    st.write(issue_distribution)

    # Call the Gemini model to get well-being
    # insights
    get_wellbeing_insight("".join(all_text),
        top_issue)
else:
    st.write("No_valid_text_found_for_analysis."
        )

# Run the app
if __name__ == '__main__':
    run_app()
```

The `run_app()` function defines a Streamlit application to detect mental health disorders using multiple input methods: text input, image upload, video upload, and Reddit username analysis. Users can interact with a sidebar to choose their preferred mode of input. Each mode processes the data accordingly, utilizing pre-defined helper functions for text translation, text extraction from images, audio transcription, and Reddit user data retrieval. Depending on the mode, the app combines extracted and processed data to classify mental health concerns or display insights. It leverages libraries like `GoogleTranslator`, `librosa`, and `FFmpeg` for processing and analysis. The results include mood analysis, classification probabilities, and potential mental health issues. This app provides a comprehensive tool for mental health-related data analysis. For the Twitter analysis mode, the app allows users to input a Twitter username, fetches the latest tweets from the user, and extracts both text content and any associated images. It uses the `tweepy` library to interact with the Twitter API and retrieve tweets that are not retweets or replies. For each tweet, the app extracts the text and checks for any media attachments, specifically images. If images are found, it fetches and processes them using the `fetch_image_content` function, which downloads the image and uses OCR (Optical Character Recognition) to extract text from the image. Both the tweet text and any extracted text from the images are combined to create a comprehensive dataset for analysis. This data is then passed through a pre-trained machine learning model to classify the mental health concerns present in the posts. The model generates predictions, and the app displays the most frequently detected mental health issue along with its percentage occurrence. It also shows the distribution of mental health issues across the posts and provides insights using a separate well-being model. This feature enables the app to offer a detailed analysis of the mental health state inferred from Twitter posts, based on the extracted text and images. Additionally, the app integrates the Gemini API for advanced mood analysis and mental well-being insights. The Gemini API, accessed through a Flask server, provides an external service that can process large volumes of text data for sentiment analysis, mood classification, and mental health predictions. The Gemini API is a machine learning-powered API that allows users to analyze textual data by passing in relevant text input. In this case, the app sends the combined text from Twitter posts (including extracted text from images) to the Gemini API for analysis. The API returns insights such as sentiment scores, emotional tones, and relevant mental health classifications based on the input. The Flask server acts as an intermediary between the Streamlit app and the Gemini API. It handles HTTP requests from the Streamlit app, passes the text data to the Gemini API, and processes the responses before sending them back to the Streamlit interface. When a user submits their data, the app makes an HTTP request to the Flask server, which in turn queries the Gemini API. The Flask server ensures that the data is properly formatted and can handle various types of inputs, whether they are text, audio, or other formats. The Gemini API processes this data and returns a structured response that contains mood-related insights and mental health predictions.

ASMPFMHDD

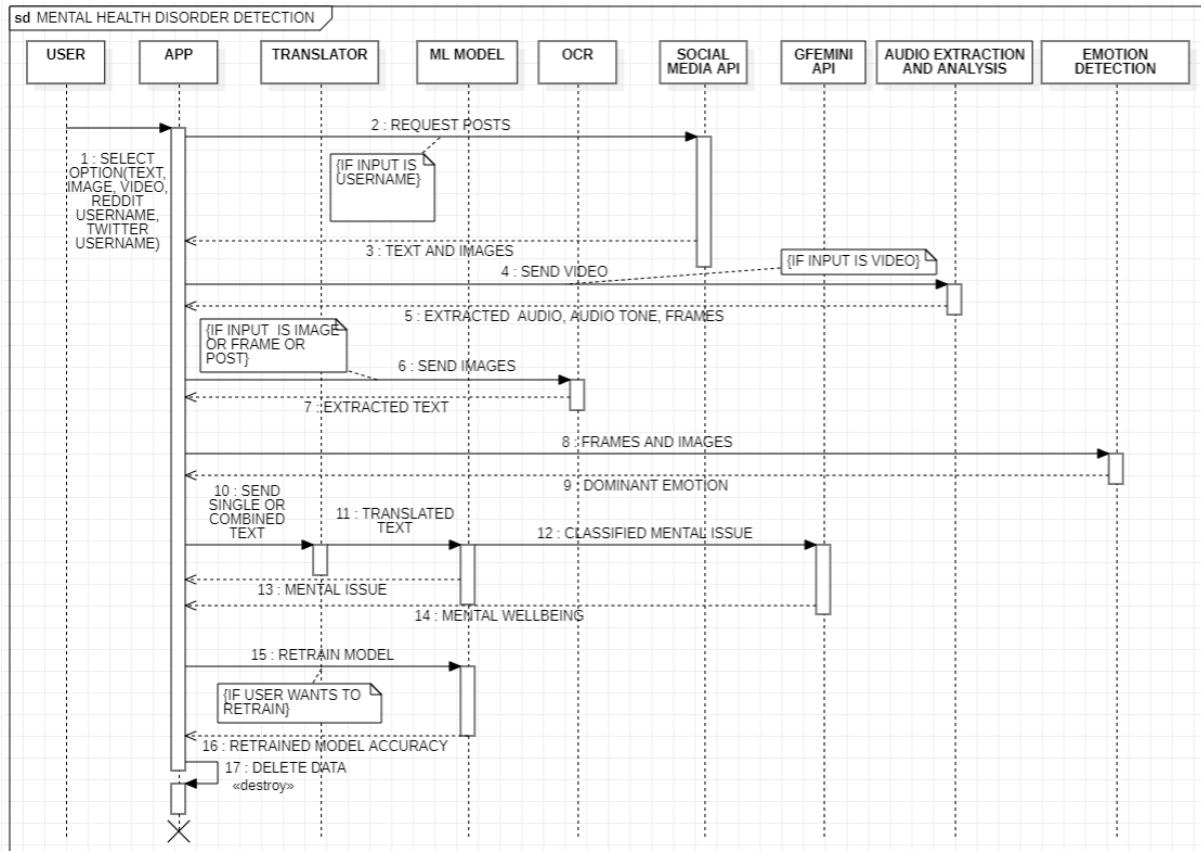


Figure 38: Sequence Diagram of the Application

Below are some screenshots from the web application.

The screenshot shows the user interface for the Mental Health Disorder Detection application:

- Left Sidebar:** A dropdown menu titled "Choose an option" with the following items:
 - Text Input (selected)
 - Image Upload
 - Video Upload
 - Reddit Username Analysis
 - Twitter Username Analysis
- Main Content Area:**
 - Mental Health Disorder Detection**
 - Enter Text to Classify Mental Health Issue**
 - An input field labeled "Enter your text here:"
 - Buttons:**
 - Classify Text
 - Classify Text and Retrain Model

Figure 39: Website with all options

ASMPFMHDD

Choose an option

Text Input

Mental Health Disorder Detection

Enter Text to Classify Mental Health Issue

Enter your text here:

তোমার মন যেন প্রতিদিন হাজারটা চিন্তা আর সন্দেহের মধ্যে আঁচ্ছকে থাকে। মাঝে ভাঙ্গার মতো এক অনন্তর্ভূতি, একধরনের চাপ, যা বিছুটেই কাটে না। তোমার ভিতরে একটা আজানা ভয় কাজে করে, যা বলে —“কিছু একটা খারাপ হবে!” হয়তো তুমি জনো, কিছু ইওয়ার সন্তানবন্ধনা নেই, কিন্তু মনের গভীরে এক অসংক্ষিপ্ত ভয় জেগে উঠে। সারা শরীরে এক ধরনের আঁচ্ছিকতা অনুভূত হয়, বুকের মধ্যে চাপ বাড়তে থাকে,

Classify Text

Classify Text and Retrain Model

Translated Text (to English):

Many things disappear when you are alone or feel lonely. Nothing is clear in front of the eyes, only one thing keeps spinning in the mind - "Is this what I want?" Life? Days pass, but nothing changes. Everything outside is moving, the world is spinning, but you are still, stopped somewhere. People around you are laughing, moving, living life, but you seem to be far away from each other.

Sincerity or compassion are just words to you. Relationships are also empty, hidden behind an old cover, only some words of mouth. The lack of deep attention, love or compassion is sometimes so intense that

Figure 40: Entering Text for classification

Choose an option

Text Input

May your mind be stuck in a thousand thoughts and doubts every day. A nerve-wracking feeling, a kind of pressure, that just doesn't go away. An unknown fear works within you, which says—"Something will go wrong." Maybe you know, nothing is likely to happen, but an impossible fear rises deep in the mind. A kind of restlessness is felt throughout the body, the pressure in the chest increases, it is difficult to breathe. You know, it's just a mental error, but still it permeates every cell of your body. The world feels like a dark hole, where you are alone and helpless.

The most likely mental health concern is: depression with a probability of 52.37%

Wellbeing Insight:

1. **Autonomy:** Depression significantly impairs autonomy. The debilitating apathy and lack of motivation characteristic of depression make it difficult for individuals to independently regulate their behavior. Simple tasks become overwhelming, leading to reliance on others and a diminished sense of self-efficacy. The internal struggle with negative self-perception further undermines confidence in one's opinions and choices, hindering independent decision-making. This dependence can perpetuate the depressive cycle, making it harder to break free from negative patterns.

2. **Environmental Mastery:** Depression severely compromises environmental mastery. The pervasive fatigue and cognitive dysfunction associated with depression make managing daily tasks and responsibilities incredibly challenging. Individuals may struggle to maintain their homes, work effectively, or even engage in basic self-care. This lack of control over one's environment contributes to feelings of helplessness and hopelessness, exacerbating depressive symptoms. The ability to create situations beneficial to personal needs is severely restricted.

3. **Personal Growth:** Depression stagnates personal growth. The persistent negativity and low self-esteem

Figure 41: Text Classification Result

ASMPFMHDD

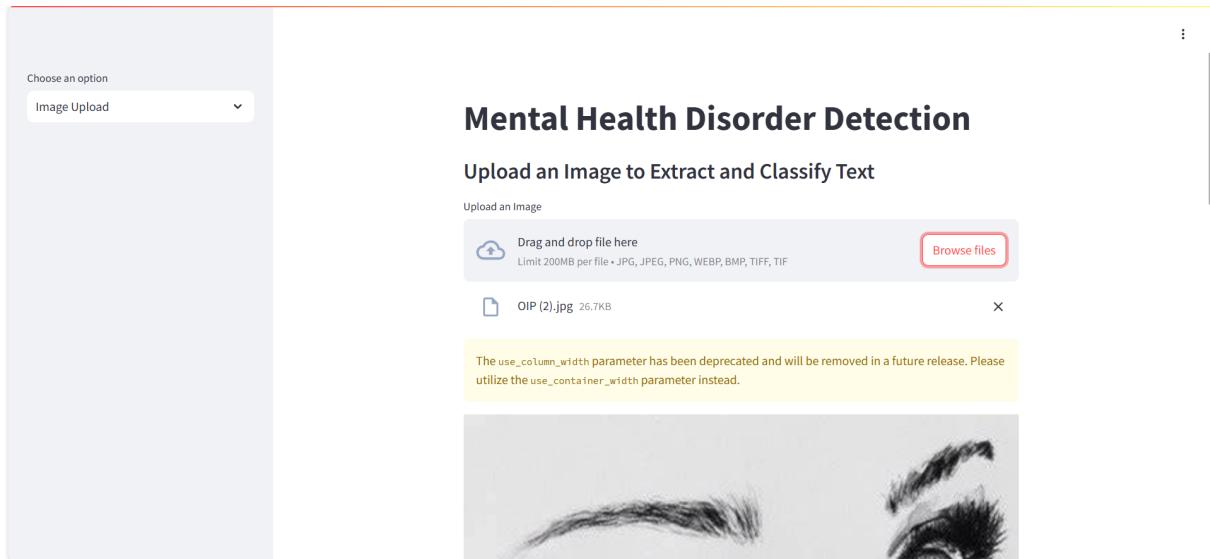


Figure 42: Upload Image

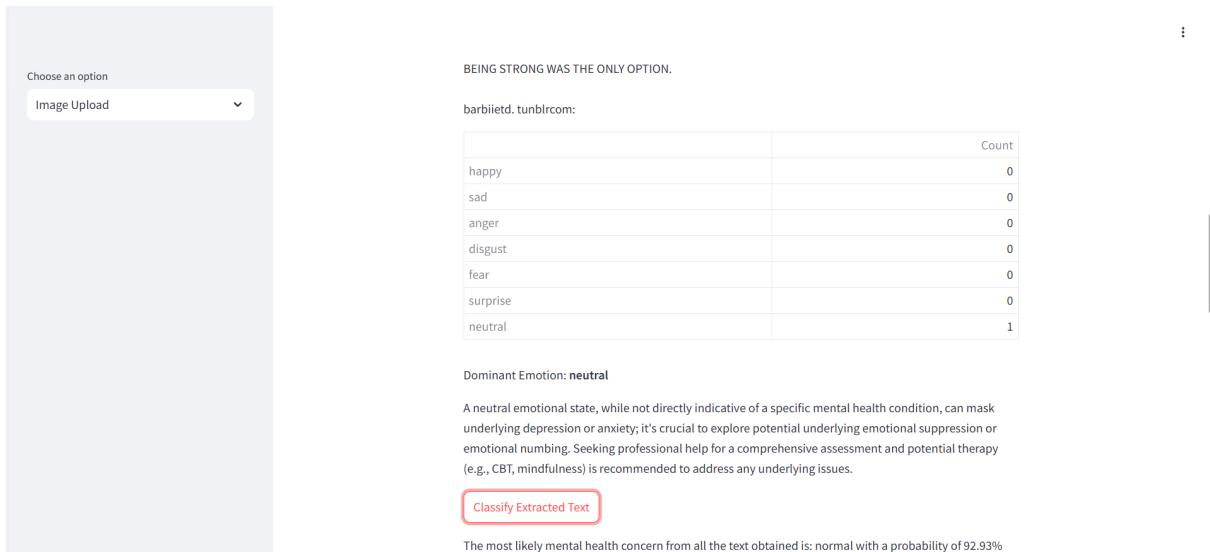


Figure 43: Image Classification Result

ASMPFMHDD

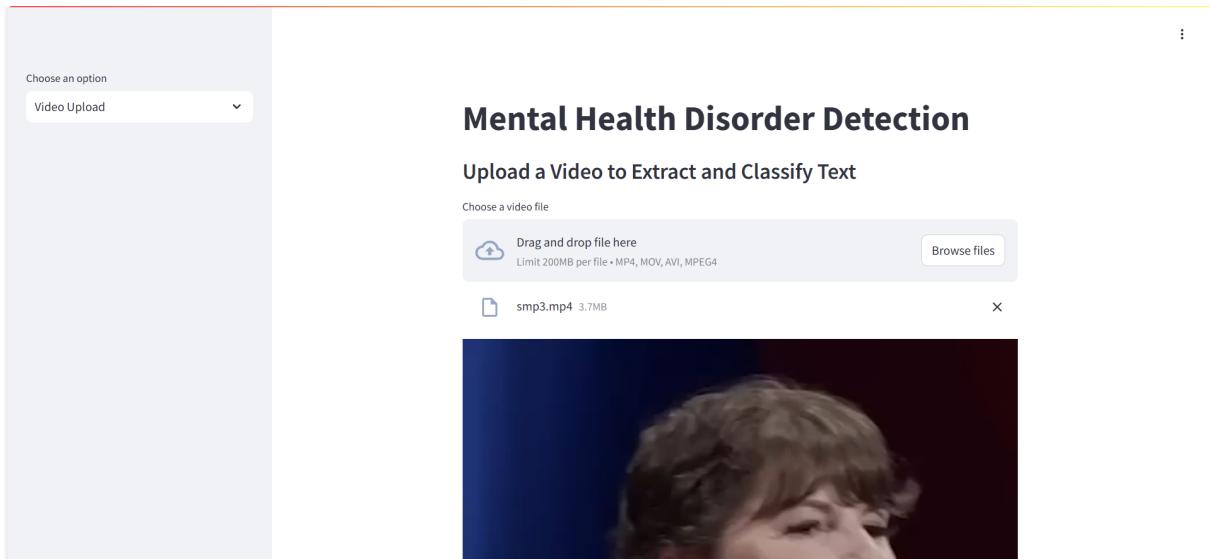


Figure 44: Upload Video

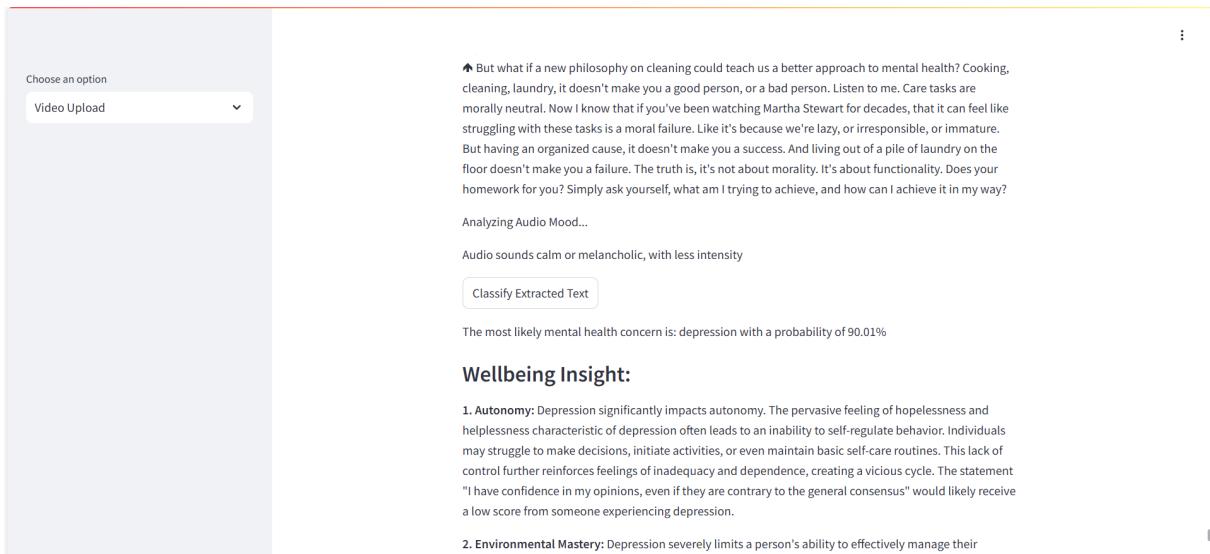


Figure 45: Video Classification Result

ASMPFMHDD

The screenshot shows the ASMPFMHDD application interface. At the top, there is a navigation bar with a user icon, the status "RUNNING...", and a "Stop" button. Below the navigation bar, a dropdown menu titled "Choose an option" is open, showing "Reddit Username Analysis". The main content area is titled "Mental Health Disorder Detection" and has a sub-section "Enter Reddit Username for Analysis". A text input field contains the username "flowerpower0601". A red-bordered "Analyze" button is positioned below the input field. To the right, under "Recent Text Posts:", there is a list of posts from a user named "flowerpower0601". The first post at index 0 says: "Taylor Swift's 'Eras' show. What's ACTUALLY going on? What do you guys think of this?". The second post at index 1 says: "Taylor Swift's 'Eras' show. What's ACTUALLY going on? [removed]". The third post at index 2 says: "Taylor Swift und die Eras Tour". Below these posts, a larger text block reads: "Ich habe letztens dieses Video gefunden, welches behauptet das die Eras Tour von Taylor Swift überhaupt nicht live ist und das selbst, dass was sich "live" anhört einfach pre-recorded ist und die Band gar nicht live spielt sondern die ganze Show ein Backing Track ist, der abgespielt wird."

Figure 46: Reddit User Analysis

The screenshot shows the ASMPFMHDD application interface. At the top, there is a navigation bar with a user icon, the status "RUNNING...", and a "Stop" button. Below the navigation bar, a dropdown menu titled "Choose an option" is open, showing "Reddit Username Analysis". The main content area displays a post by user "@soulsearcher2523" with the timestamp "vor 0 Sek". The post content is: "Gutgestimmt war ich je geworden." Below the post, there are three icons: a thumbs up, a thumbs down, and a comment. The text "Fetched Image" is displayed next to the post. Below the post, a message states: "Error processing image <https://i.redd.it/oyuo8fpnuaxd1.png>: 'list' object has no attribute 'strip'". A note follows: "The most frequently detected mental health concern is: normal appearing in 75.00% of analyzed text." Underneath, a section titled "Mental health issue distribution across posts:" shows a table:

	Mental Health Issue	Count
0	normal	15
1	depression	5

A section titled "Wellbeing Insight:" contains the following text: "It's important to clarify that "normal" isn't a mental health issue; it's a baseline descriptor. Analyzing its impact on well-being is therefore about understanding how typical functioning relates to the Ryff factors. We will examine how typical functioning, or the lack of clinically diagnosable mental health issues, correlates with each of the six factors. Since "normal" is a broad spectrum, the observations below reflect

Figure 47: Result from Reddit Posts Analysis

ASMPFMHDD

Choose an option

Twitter Username Analysis

Mental Health Disorder Detection

Enter Twitter Username for Analysis

Enter Twitter username:

Analyze

Recent Text Posts from Tweets:

0 :
"Well said. It is good that this truth is coming out, and that too in a way common people can see it.

A fake narrative can persist only for a limited period of time. Eventually, the facts will always come out! <https://t.co/8XXo5hQe2y>"

1 :
"महान बालासाहेब ठाकरे जी यांचा पुण्यतिमोळिमित मी खंगा आदराजी अर्पण करते. महाराष्ट्राचा विकास आणि मराठी लोकाच्या समस्ता यांची अवाही असे ते एक शैष व्यक्तिमत्त होते. भारतीय संस्कृती आणि मूर्खांचे सर्वोन कर्तृत लाविष्याचा अस्थिरान् वृद्धित करण्यावर याचा दर्श... <https://t.co/oHRV3DUFKj>"

2 :

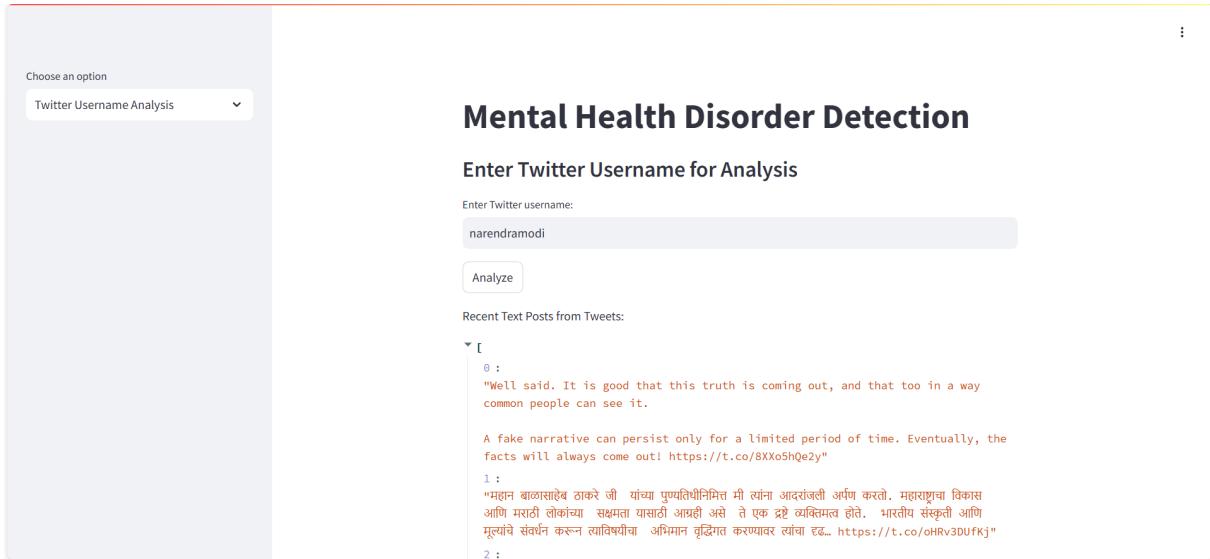


Figure 48: Twitter User Analysis

Choose an option

Twitter Username Analysis

The most frequently detected mental health concern is: normal, appearing in 100.00% of analyzed text.

Mental health issue distribution across posts:

Mental Health Issue	Count	
0	normal	24

Wellbeing Insight:

It's important to clarify that "normal" in the context of mental health is a relative and complex term. It doesn't represent a specific clinical diagnosis but rather a general state of mental well-being without significant impairment. Therefore, the following analysis explores how a lack of significant mental health challenges might relate to the Ryff scales, acknowledging that variations within the "normal" range are expected.

- Autonomy:** Individuals experiencing "normal" mental well-being typically demonstrate a high degree of autonomy. They are able to make independent choices, regulate their behavior effectively, and resist undue social pressure. They confidently express their opinions, even if they differ from the majority. A lack of autonomy, even within the "normal" range, might manifest as occasional indecisiveness or a tendency to seek excessive external validation.
- Environmental Mastery:** "Normal" mental health often correlates with a strong sense of environmental mastery. Individuals can effectively manage their daily lives, overcome challenges, and create environments conducive to their well-being. Those on the lower end of the "normal" spectrum might experience occasional feelings of being overwhelmed or lacking control in specific areas of their life.

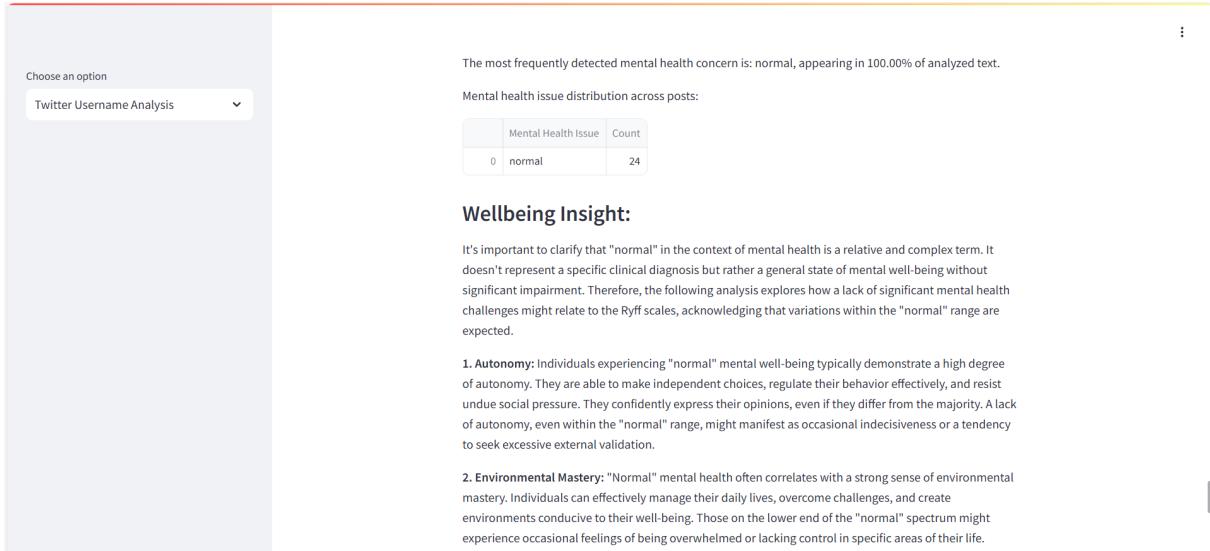


Figure 49: Result from Twitter Posts Analysis

Model Retraining Functionality

```

# File path for dataset
dataset_path = 'preprocessed_mental_health.csv'

def update_dataset(new_text, mental_health_issue):
    if os.path.exists(dataset_path):
        dataset = pd.read_csv(dataset_path)
    else:
        # If the dataset doesn't exist, create a new one
        dataset = pd.DataFrame(columns=['text', 'mental_health_issue', 'cleaned_text'])

    # Clean the text (adjust cleaning based on your preprocessing)
    cleaned_text = new_text.lower()

    # Create a new DataFrame for the new row
    new_row = pd.DataFrame({
        'text': [new_text],
        'mental_health_issue': [mental_health_issue],
        'cleaned_text': [cleaned_text]
    })

    # Use pd.concat to append the new row
    dataset = pd.concat([dataset, new_row], ignore_index=True)

    # Save the updated dataset
    dataset.to_csv(dataset_path, index=False)

def retrain_model():
    """Retrain the Logistic Regression model with the updated dataset."""
    # Load the updated dataset
    dataset = pd.read_csv(dataset_path)

    # Ensure required columns exist
    if 'cleaned_text' not in dataset.columns or 'mental_health_issue' not in dataset.columns:
        st.error("Dataset must have 'cleaned_text' and 'mental_health_issue' columns.")
    return None, None

    # Preprocessing
    dataset.dropna(subset=['cleaned_text'], inplace=True)
    vectorizer = CountVectorizer()
    X = vectorizer.fit_transform(dataset['cleaned_text'])
    y = dataset['mental_health_issue']

```

Model Retraining Functionality

```

# Split dataset
X_train, X_test, y_train, y_test = train_test_split(X, y,
    test_size=0.2, random_state=42)

# Train Logistic Regression
model = LogisticRegression(multi_class='ovr', max_iter
    =10000)
model.fit(X_train, y_train)

# Save the updated model and vectorizer
joblib.dump(model, 'LRmodel.pkl')
joblib.dump(vectorizer, 'LRvectorizer.pkl')

# Evaluate
accuracy = accuracy_score(y_test, model.predict(X_test))
return model, accuracy

def update_and_retrain(example_text, example_issue):
    try:
        # Update dataset
        update_dataset(example_text, example_issue)

        # Display the last three rows of the updated dataset
        dataset = pd.read_csv(dataset_path)
        st.write("Updated_Dataset_(Last_3_Rows):")
        st.write(dataset.tail(3))

        # Notify user about retraining process
        st.info("Model_is_being_retrained...")

        # Retrain model
        model, accuracy = retrain_model()

        # Display retraining success message
        if model:
            st.success(f"Model_retrained_successfully!_Accuracy:
                {_accuracy_*_100:.2f}%")
        except Exception as e:
            st.error(f"An_error_occurred:_{e}")

# Function to classify text, display result and retrain model
def classify_text_retrain_model(text):
    input_vectorized = vectorizer.transform([text])
    prediction_proba = model.predict_proba(input_vectorized)

```

Model Retraining Functionality

```

issue_labels = model.classes_
proba_df = pd.DataFrame(prediction_proba, columns=
    issue_labels).T
proba_df.columns = ['Probability']

top_issue = proba_df['Probability'].idxmax()
top_probability = proba_df['Probability'].max()

st.write(f"The most likely mental health concern is: {top_issue} with a probability of {top_probability:.2%}")

get_wellbeing_insight(text, top_issue)

# Adding Model Retraining Functionality
update_and_retrain(text, top_issue)

```

This code provides a system for updating a dataset with new text data, retraining a Logistic Regression model based on the updated data, and classifying new input text while also retraining the model. The `update_dataset` function appends new text and its associated mental health issue to an existing CSV file. If the dataset doesn't already exist, it creates a new one with columns for the text, the mental health issue, and the cleaned version of the text. The text is then cleaned (in this case, by converting it to lowercase). After updating the dataset, the function saves it back to the CSV file. The `retrain_model` function reads the dataset, ensures it contains the necessary columns, cleans the data by removing any rows with missing values, and preprocesses the text using a `CountVectorizer`. It splits the dataset into training and testing sets, then trains a Logistic Regression model. The model and vectorizer are saved to disk using `joblib`, and the function returns the trained model and its accuracy on the test set. The `update_and_retrain` function combines these operations, first calling `update_dataset` to add new data, then displaying the last three rows of the updated dataset using Streamlit's `st.write`, and finally retraining the model. If successful, it shows the retrained model's accuracy. The `classify_text_retrain_model` function takes an input text, vectorizes it using the pre-trained vectorizer, and uses the trained model to predict the probability of different mental health issues. It converts these probabilities into a DataFrame and identifies the mental health issue with the highest probability. The function displays this prediction along with its associated probability and calls another function, `get_wellbeing_insight`, to provide additional insights. Finally, it calls `update_and_retrain` to update the dataset and retrain the model with the new prediction.

ASMPFMHDD

Choose an option

Text Input

Mental Health Disorder Detection

Enter Text to Classify Mental Health Issue

Enter your text here:

তোমার মন কখনো চরম উচ্চতায় পৌছায়, এক ধরনের অদম্য শক্তি অনুভব হয়...এটি মনে হয় জীবনের সবচেয়ে চমকপ্রদ মুহূর্ত। তোমার আবনায় এমন এক তরঙ্গ, যা সারা পৃথিবীকে জয় করার মতো। কিন্তু টিক প্রের মুহূর্তে, সর্বকিছু বদলে যায়, মন হয় পুরো তেজে পড়ছে। এক মুহূর্তে ভূমি একেবারে শক্তিশালী। আবার পরফর্মেই, পরিবো তোমাকে অসহায় মনে হতে থাকে। একদিনকে এক

Classify Text

Classify Text and Retrain Model

Translated Text (to English):

Sometimes your mind reaches extreme heights, you feel a kind of invincible power - it seems like the most amazing moment in life. There is a wave in your thoughts that is like conquering the whole world. But the next moment, everything changes, it seems like the world is falling apart. One moment you are absolutely strong, and the next moment, the world seems helpless to you. On one side there is a frenzy of feelings, on the other side there is darkness. Sometimes it feels like you are floating on clouds, and the next moment your feet start falling to the ground. Sometimes you feel like you are living in a different world, where

Figure 50: Text Classification and Retrain Model

Choose an option

Text Input

- **Purpose in Life:** Identify your values, set meaningful goals, and engage in activities aligned with your purpose.
- **Self-Acceptance:** Practice self-compassion, challenge negative self-talk, and focus on your strengths.

Regular self-reflection, mindfulness practices, and seeking support when needed can significantly contribute to maintaining and enhancing psychological well-being even within the "normal" range.

Updated Dataset (Last 3 Rows):

	text	mental_health_issue
18,595	Does anybody else get really anxious from hearing a phone ring or even vibrate? I've	anxiety
18,596	I was born trying to kill myself Came out looking like fucking megamind. Some bable	depression
18,597	Sometimes your mind reaches extreme heights, you feel a kind of invincible power - i	normal

Model is being retrained...

Model retrained successfully! Accuracy: 87.51%

Figure 51: Result from Text Classification and Model Retraining

ASMPFMHDD

Choose an option

Reddit Username Analysis

Mental Health Disorder Detection

Enter Reddit Username for Analysis

Enter Reddit username:

Analyze

Analyze and Retrain Model

Recent Text Posts:

① :
"Unpredictability is the suckiest part of life. Some people never drink or smoke, but they still get cancer and die young. Some people drink and smoke still gets to live a long fulfilling life.
Some people study so hard to get their dream job, have a promising future, but on his first day to work, he got killed by a drunk driver.
Some people work so hard and accumulate a lot of fortune for enjoying retirement"

Figure 52: Reddit Analysis with Model Retraining

Choose an option

Reddit Username Analysis

• Seeking support: Don't hesitate to reach out to friends, family, or professionals for support when needed, even if challenges are not considered clinically significant.

By proactively engaging in these activities, individuals can cultivate and maintain optimal well-being within the spectrum of "normal" mental health.

Updated Dataset (Last 3 Rows):

	text	mental_health_issue
18,596	I was born trying to kill myself Came out looking like fucking megamind. Some babbie	depression
18,597	Sometimes your mind reaches extreme heights, you feel a kind of invincible power - i	normal
18,598	Unpredictability is the suckiest part of life. Some people never drink or smoke, but th	normal

Model is being retrained...

Model retrained successfully! Accuracy: 87.40%

Figure 53: Result from Reddit Analysis and Model Retraining

Emotion Analysis and Mental Health Insights

```

def detect_emotions_from_frame(frame):
    try:
        # Use DeepFace to analyze emotions
        result = DeepFace.analyze(frame, actions=['emotion'],
                                  enforce_detection=False)
        return result[0]['dominant_emotion']
    except Exception as e:
        print(f"No_expression_or_error_detecting_emotion:{e}")
        return None

def analyze_emotions_from_frames(frames):
    # Initialize an emotion counts dictionary
    emotion_counts = {'happy': 0, 'sad': 0, 'angry': 0, 'disgust':
                      0, 'fear': 0, 'surprise': 0, 'neutral': 0}
    frame_emotions = []

    for idx, frame in enumerate(frames):
        # Detect emotions from the current frame
        emotion = detect_emotions_from_frame(frame)
        if emotion:
            frame_emotions.append(emotion)
            if emotion in emotion_counts:
                emotion_counts[emotion] += 1

    return emotion_counts, frame_emotions

def display_emotion_summary(emotion_counts):
    # Convert the emotion counts to a DataFrame for display
    emotion_df = pd.DataFrame(list(emotion_counts.items()),
                              columns=['Emotion', 'Count'])
    st.write("Emotion_Analysis_Summary:")
    st.table(emotion_df)
    return max(emotion_counts, key=emotion_counts.get)

def analyze_with_gemini(dominant_emotion, emotion_counts):
    try:
        # Start a chat session with the Gemini API
        chat_session = gemini_model.start_chat(history=[])

        # Summarize emotion counts for the prompt
        emotion_summary = ", ".join([f"{emotion}:{count}" for
                                    emotion, count in emotion_counts.items()])

```

Emotion Analysis and Mental Health Insights

```

# Create a prompt for the Gemini API
prompt = (
    f"The_detected_dominant_emotion_is_{"
    f"dominant_emotion}' ."
    f"{emotion_summary}.Based_on_this_information,"
    f"analyze_the_potential_implications_for_mental_"
    f"health"
    f"conditions_such_as_depression,_anxiety,_PTSD,_or_"
    f"bipolar_disorder._Provide_actionable_insights_in_"
    f"three_lines."
)

# Send the prompt and get a response
response = chat_session.send_message(prompt)
st.write(response.text)
except Exception as e:
    print(f"Error in Gemini API call: {e}")
    return "An error occurred while communicating with the"
    Gemini_API._Please_try_again_later."

```

Explanation:

1. `detect_emotions_from_frame(frame)`: This function uses the DeepFace library to detect the dominant emotion from a given video frame. If no emotion is detected or an error occurs, it returns None.
2. `analyze_emotions_from_frames(frames)`: This function iterates through multiple frames of a video, applies `detect_emotions_from_frame` to each frame, and counts the frequency of detected emotions in a dictionary.
3. `display_emotion_summary(emotion_counts)`: This function displays a summary of detected emotions in a table format using Streamlit. It also identifies the dominant emotion with the highest count.
4. `analyze_with_gemini(dominant_emotion, emotion_counts)`: This function communicates with the Gemini API. It prepares a prompt summarizing the emotion analysis, sends it to the API, and displays the response in Streamlit. It also handles potential errors during API interaction.

The DeepFace Python module is a comprehensive framework for facial recognition and facial attribute analysis using deep learning. It provides a high-level interface to process and analyze facial data through a variety of pre-trained deep learning models. The module is designed to

make facial recognition, emotion detection, age estimation, and gender detection straightforward by abstracting the complexities of deep learning. DeepFace supports multiple state-of-the-art face recognition models, including VGG-Face, Google FaceNet, OpenFace, Facebook DeepFace, and Dlib. Users can choose any of these models depending on their specific requirements. It also integrates with various facial attribute models for emotion analysis, enabling it to classify emotions such as happiness, sadness, anger, and more. The module uses TensorFlow and Keras as its backend frameworks to run deep learning operations efficiently. At its core, DeepFace operates by detecting and aligning faces in an image using a pre-trained facial detector, ensuring consistent positioning before feeding the face into recognition or analysis pipelines. This preprocessing step is critical because it eliminates variability caused by head tilt, lighting, and facial orientation. For emotion detection specifically, DeepFace uses a softmax classifier at the final layer of its models to predict probabilities for different emotions. DeepFace is also known for its flexibility and simplicity. Users can invoke facial analysis or recognition with a single line of code. Additionally, the module includes an **analyze** function for emotion, age, and gender detection, as well as a **verify** function to compare two images for identity matching. It also allows users to toggle between facial detectors, including OpenCV, SSD, and MTCNN, depending on their hardware and processing needs. The module emphasizes usability with optional parameters for tuning accuracy, speed, and error handling. For example, users can enable or disable facial detection enforcement, which is useful in scenarios where non-human faces or partial occlusions are present. The ability to batch process multiple images and integrate seamlessly with large datasets makes DeepFace a preferred choice for production-level applications. Overall, DeepFace abstracts the complexities of implementing deep learning models for facial analysis, providing a user-friendly and powerful tool for a variety of facial recognition and emotion detection tasks.

In a mental health disorder detection application, DeepFace plays a pivotal role in extracting facial expressions from images and videos, which can be critical for assessing emotional states and providing insights into potential mental health concerns. The module leverages deep learning models trained to recognize a wide array of facial expressions, such as happiness, sadness, anger, surprise, fear, and disgust. These expressions are vital indicators of a person's emotional state, which, when analyzed over time, can offer valuable clues about their mental health. DeepFace first processes the input image or video by detecting faces through a facial recognition model, ensuring that only human faces are analyzed. Once faces are detected, the module aligns and normalizes the images to account for variations in lighting, angles, and head positions, ensuring that the analysis remains accurate regardless of how the subject is positioned or oriented. DeepFace's emotion detection model then works by analyzing the subtle changes in facial muscle movements that correspond to different emotional expressions. For instance, a furrowed brow and tight lips may indicate anger, while a smiling face may suggest happiness.

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These expressions are captured and classified using convolutional neural networks (CNNs), which are adept at identifying patterns in visual data. DeepFace outputs these emotions as probability scores, allowing the application to interpret the likelihood of each emotion being present in a given frame. In a video context, the module processes each frame sequentially, enabling the tracking of emotional transitions over time, which is particularly valuable in detecting mood fluctuations or episodes commonly associated with mental health conditions like depression, anxiety, or bipolar disorder. The ability to extract and analyze these facial expressions in real-time or from pre-recorded content empowers mental health disorder detection systems to better understand the emotional well-being of individuals. By assessing facial expressions in conjunction with other data points, such as speech or text analysis, DeepFace helps build a comprehensive profile of a person's emotional state. This can aid in detecting mental health issues early, identifying stress triggers, or tracking the effectiveness of therapeutic interventions. In this way, DeepFace's emotion detection capabilities become an essential tool in a mental health disorder detection application, providing critical insights that can inform diagnosis and personalized care plans.

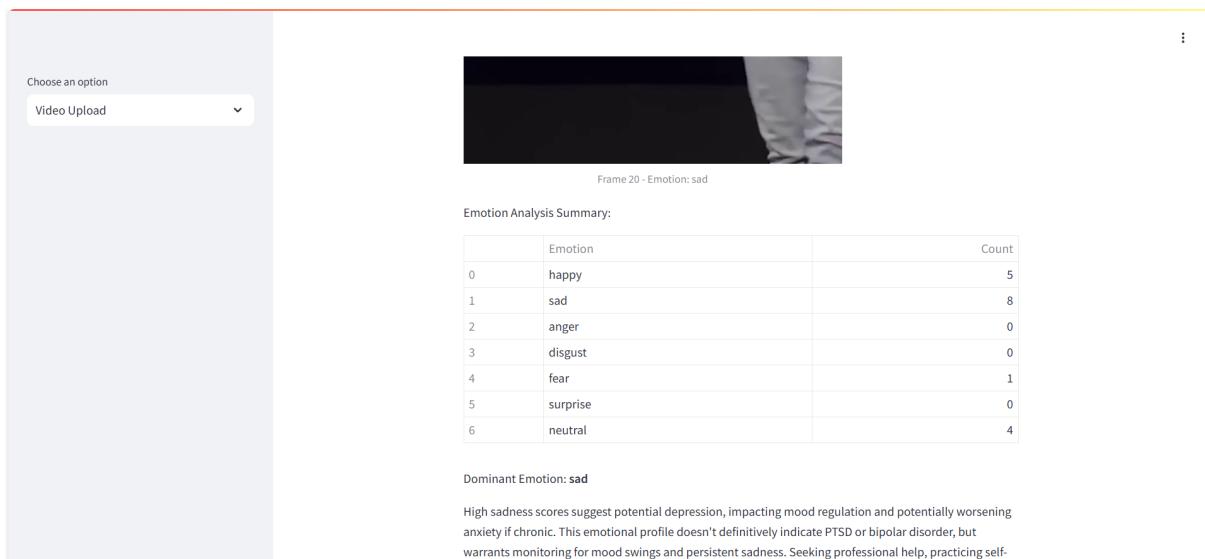


Figure 54: Result from the emotion analysis of facial expression