



GROUP 29

Multimodal AI Framework for Social Media Based Mental Disorder Detection and Personalized Wellbeing Insights

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PROJECT-II (PROJ-CS781) [UPID : 007560]

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MOTIVATION

- **Rising global concern over mental health disorders** : Mental health issues are affecting millions worldwide, requiring urgent attention .
- **Social media is a key outlet for emotional expression** : Platforms like Twitter and Reddit reveal mental health struggles in real-time.
- **Early detection of mental health issues can save lives** : Identifying mental health disorders early helps provide timely interventions.
- **Machine learning can automate detection of mental health disorders** : Technology enables efficient analysis of large social media data for early warning signs.
- **Potential to assist mental health professionals and organizations** : Provides valuable insights for mental health monitoring and public health efforts.
- **Opportunity to improve mental health awareness on social platforms** Can support campaigns that foster awareness and reduce stigma online.
- **Lack of a publicly available application** which incorporates text, image, video, audio, emotions and situations derived from images/frames for overall mental issue classification and corresponding wellbeing mapping.

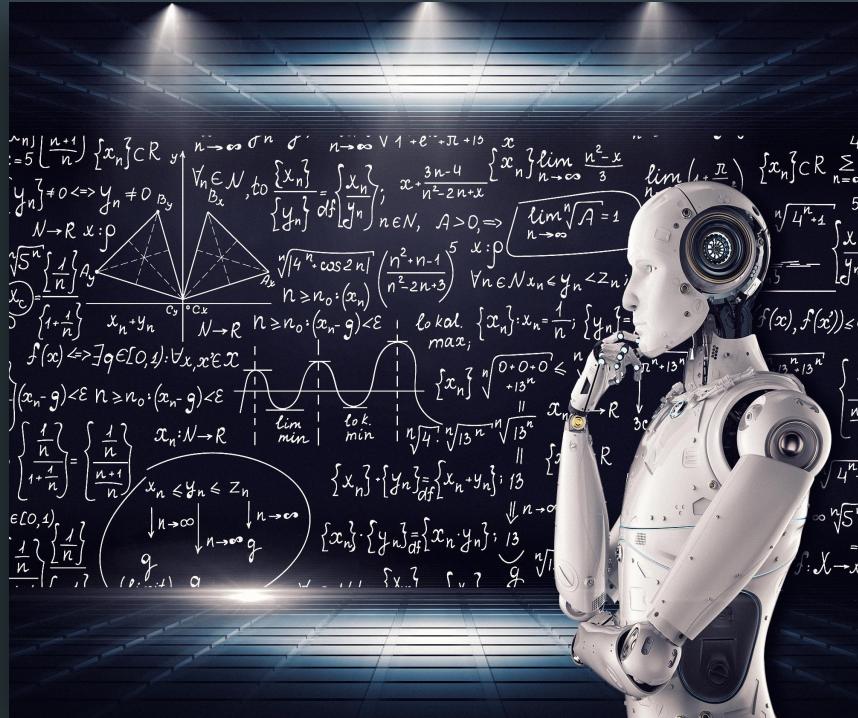
INTRODUCTION

- **Role of social media in mental health expression :** People share emotions, struggles, and experiences on platforms like Twitter and Reddit.
- **Goal of the project :** To detect mental health disorders early through the analysis of social media posts or by uploading images, videos, facial expression recognition, generating image captions ,manually inserting text and retrain model in the process.
- **Leveraging machine learning :** Using advanced techniques like NLP and classification models to analyze text normally posted, extracted from image, audio and video.



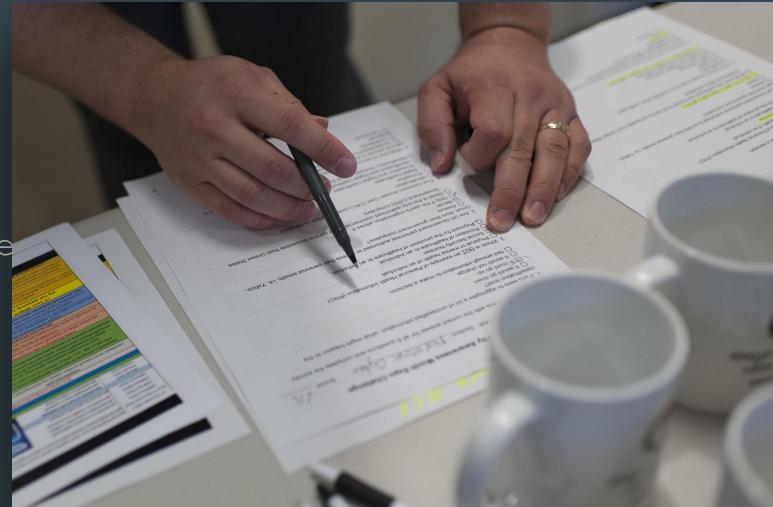
INTRODUCTION (CONTINUED)

- **Focus on text classification for the base model :** Analyzing language patterns to classify posts related to mental health issues.
- **Impact of early detection :** Can enable timely intervention and direct users to mental health support services.
- **Models used in the project :** Techniques like Logistic Regression, XGBoost are applied for high accuracy. Ensemble Model using the individual models is created to get higher accuracy and generalization.



PROBLEM DEFINITION

- **Rising prevalence of mental health disorders :** Increasing cases of depression, anxiety, PTSD, and other mental health issues globally.
- **Challenges in early detection :** Mental health problems are often undiagnosed until advanced stages, limiting timely intervention.
- **Vast amount of unstructured social media data :** Social media platforms generate large volumes of text that can indicate mental health struggles.
- **Need for efficient detection methods :** Manual analysis of social media posts is time-consuming; automation using machine learning is essential.
- **Goal :** To develop a system that accurately classifies social media posts based on mental health disorders.



OUR CONTRIBUTION AND UNIQUENESS OF PROJECT

- ➔ Use technology to assist mental health professionals and enhance public health awareness by implementing different features in a single application
- ❑ **Implement text analysis** to detect mental health concerns from user inputs.
- ❑ **Develop an image analysis** system for text extraction, facial expression recognition, and gesture analysis.
- ❑ Create a **video analysis module** for converting video to audio, extracting text, and recognizing expressions.
- ❑ Incorporate **image captioning** using transformers to contribute to mental wellbeing insights.
- ❑ Build a system to **fetch and analyze Reddit and Twitter user posts** for mental health classification.
- ❑ Enable **multilingual analysis** by translating non-English content to English.
- ❑ Use generative AI to **map mental health classifications to Ryff's Scale** of Psychological Well Being.
- ❑ Provide **data visualization** for emotional trends and post analysis.
- ❑ Develop an **ensemble model with multiple algorithms** for robust mental health classification.
- ❑ Integrate a feature to **retrain the model with user-provided data** for continuous improvement.

RESEARCH WORK

→ *Social media and mental health research*

Explored studies on how social media data can reveal mental health conditions.

→ *Key study by Choudhury et al. (2013)*

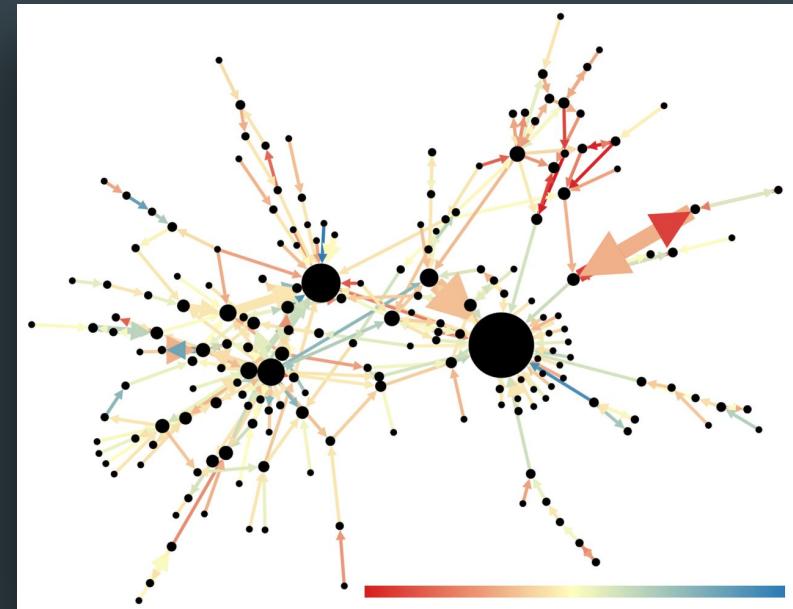
Showed the predictive power of Twitter data in identifying depression through linguistic patterns.

→ *Guntuku et al. (2017) review*

Synthesized various approaches to detecting mental illness using sentiment analysis on social platforms.

→ *Mathur et al. (2022) systematic review*

Highlighted the success of machine learning techniques in detecting disorders like depression and anxiety.



RESEARCH WORK (CONTINUED)

→ **Nadeem (2016) study on Twitter**

Demonstrated the potential of text analysis to identify at-risk individuals based on emotional cues in tweets.

→ **Al Sagri and Ykhlef (2020) approach**

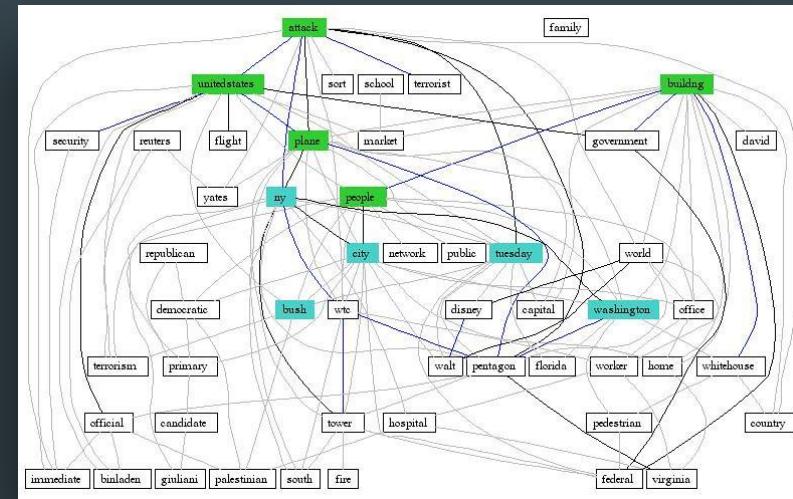
Combined linguistic and behavioral features for more accurate depression detection on Twitter.

→ **Recent study by Vaishnavi et al. (2022)**

Comparative analysis of algorithms to identify mental health conditions from social media posts.

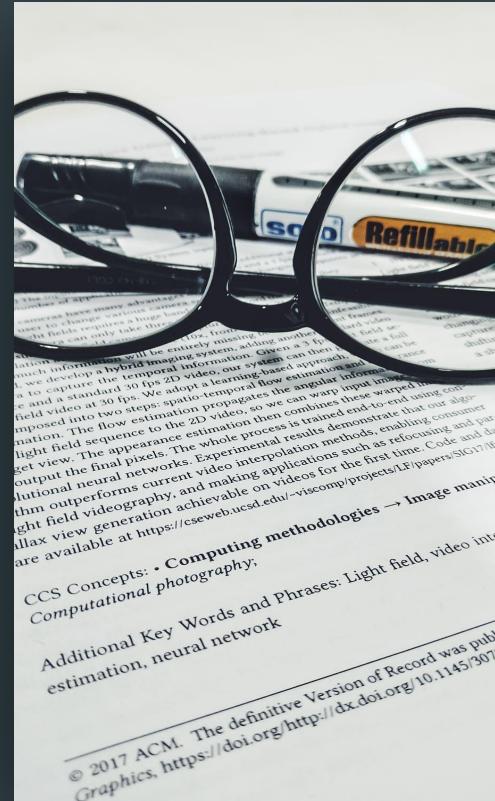
→ **Ethical considerations by Safa et al. (2023)**

Addressed data privacy challenges in mental health detection research using social media data.



RESEARCH WORK (CONTINUED)

- The study "**Single classifier vs. ensemble machine learning approaches for mental health prediction**" demonstrates that Gradient Boosting (88.80%) and Neural Networks (88.00%) outperform ensemble models (85.60%) for mental health issue prediction, based on survey data from OSMI.
- The paper "**Ensemble of hybrid model-based technique for early detection of depression**" introduces a hybrid SVM-MLP model with SMOTE for class balancing, achieving 99.39% accuracy and 99.51% F1-score, highlighting its efficacy in early depression detection.
- The research "**Survey of transformers and towards ensemble learning using transformers for NLP**" reviews transformer models and explores ensemble learning with transformers, showcasing their superior performance in NLP tasks like sentiment analysis and text generation.



Abstract of paper:
Recent advances in deep learning have shown significant improvements in mental health prediction. However, these models often lack interpretability and may miss important contextual information. To address this, we propose a hybrid learning system that combines a single classifier with an ensemble of multiple classifiers. Our system uses a multi-step approach to capture temporal information. Given a sequence of 3D video frames, we first estimate the flow field between consecutive frames. This flow field is then used to warp the frames into a standard 2D view. Our system then processes this 2D sequence using a learned-based approach to estimate the flow field. Finally, the estimated flow field is used to predict the angular motion of the light field sequence. The appearance of the 2D video, so we can warping the input images output the final pixels. The whole process is trained end-to-end using convolutional neural networks. Experimental results demonstrate that our algorithm outperforms current video interpolation methods, enabling consumer light field videography, and making applications such as refocusing and parallax view generation achievable on videos for the first time. Code and parameters are available at <https://cseweb.ucsd.edu/~viscomp/projects/SIGGRAPH17/>.

CCS Concepts: • Computing methodologies → Image manipulation; Computational photography;

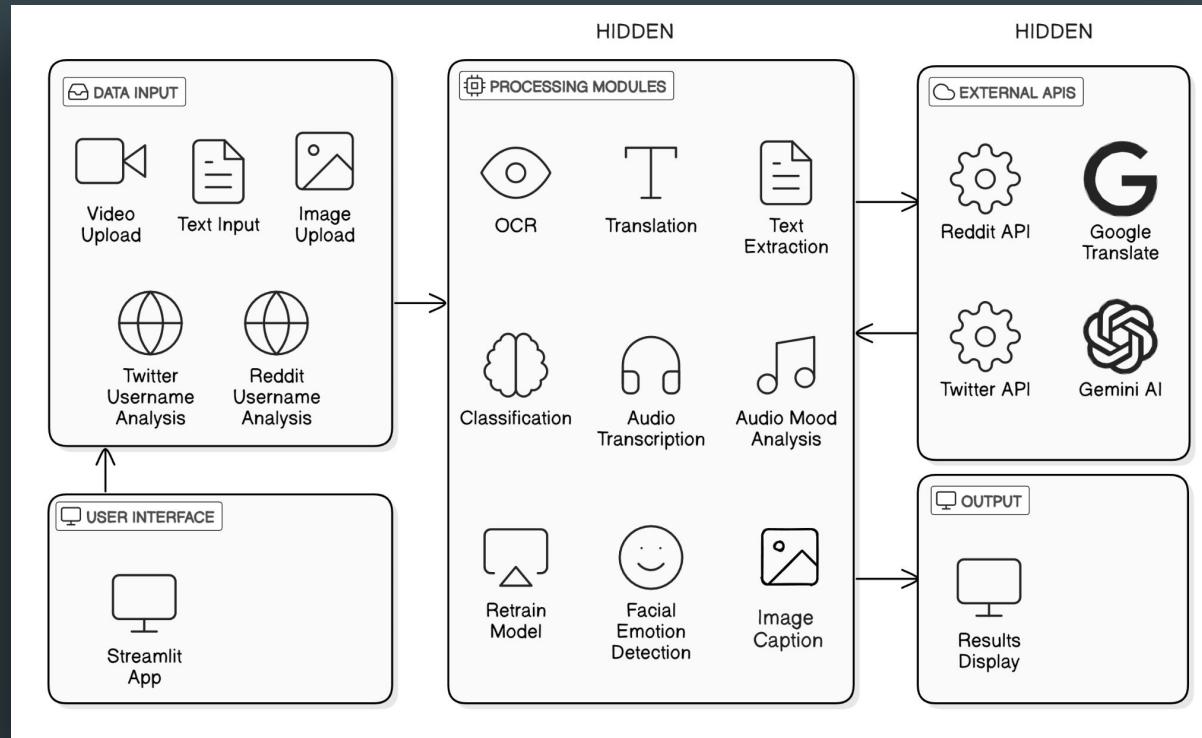
Additional Key Words and Phrases: Light field, video interpolation, neural network

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PROPOSED WORKFLOW

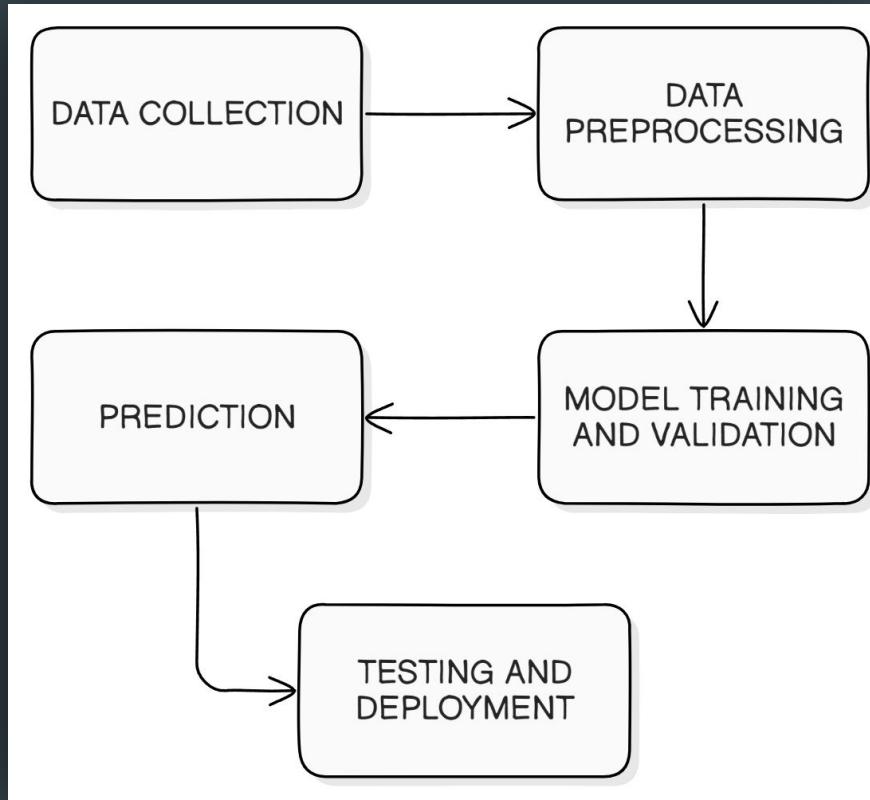
- **Data Collection** : Collect Reddit posts using the PRAW API and extract labeled data for mental health categories like Normal, Anxiety, Depression, PTSD, and Bipolar.
- **Data Preprocessing** : Clean the collected data by removing URLs, stopwords, and special characters. Normalize and tokenize the text, followed by converting it into numerical formats (*TF-IDF, Bag Of Words, Word2Vec, LIWC, N-Gram*) for analysis.
- **Model Training and Evaluation** : Train machine learning models including Logistic Regression, Naive Bayes, SVM, Random Forest, XGBoost, KNN, LSTM and Transformers. Evaluate their performance using metrics such as accuracy, precision, recall, and F1-score. Apply Hyperparameter Tuning on ML models as needed to improve the accuracy further. Leverage Ensemble Learning with multiple models to get higher accuracy.
- **Testing and Deployment** : Test the best-performing models and deploy them on a user-friendly interface using Streamlit. Ensure the system supports real-time classification for various inputs like text, image, video and user profiles from social media platforms like Reddit and Twitter.

PROPOSED WORKFLOW (CONTINUED)



SYSTEM OVERVIEW

PROPOSED WORKFLOW (CONTINUED)



PROJECT MODULES

IMPLEMENTATION

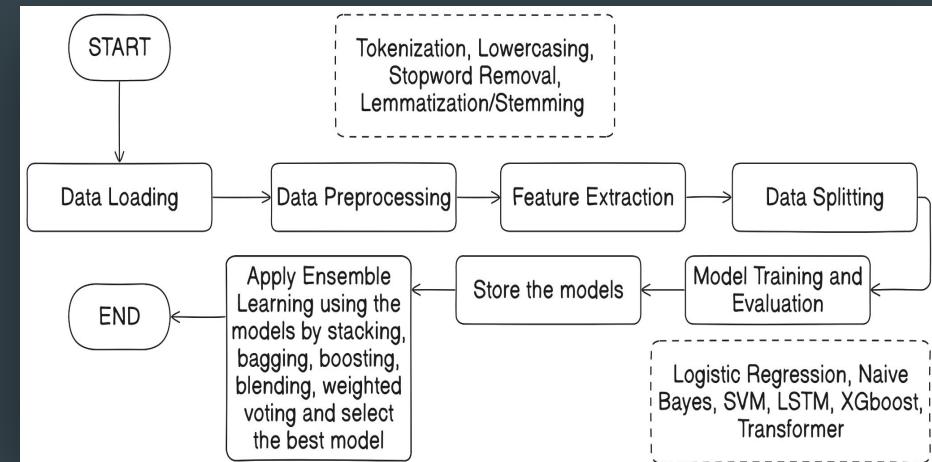
- **Data Collection** : Scrapped Reddit posts related to mental health issues and for analysis.
- **Data Preprocessing** : Cleaned and normalized the text by removing URLs, stop-words, punctuation, and applied tokenization and lemmatization techniques.
- **Feature Extraction** : Utilized Bag of Words, Term Frequency-Inverse Document Frequency (TF-IDF), Word2Vec, LIWC, N-Gram to convert text into numerical format for machine learning models.
- **Splitting the Dataset** : Divided the dataset into training and testing sets to train models and evaluate their performance. Also applied Stratified K-fold Cross Validation

Rqmt ID	Requirement Item	Requirement Analysis Status
FR-001	Collect social media data from Reddit.	Completed ▾
FR-002	Implement data cleaning and preprocessing.	Completed ▾
FR-003	Train machine learning and deep learning models.	Completed ▾
FR-004	Evaluate models using performance metrics (accuracy, recall, F1 Score, Support).	Completed ▾
NFR-001	Testing different features of the web application	Completed ▾
NFR-002	Final Web Application Deployment	Completed ▾

FUNCTIONAL REQUIREMENTS

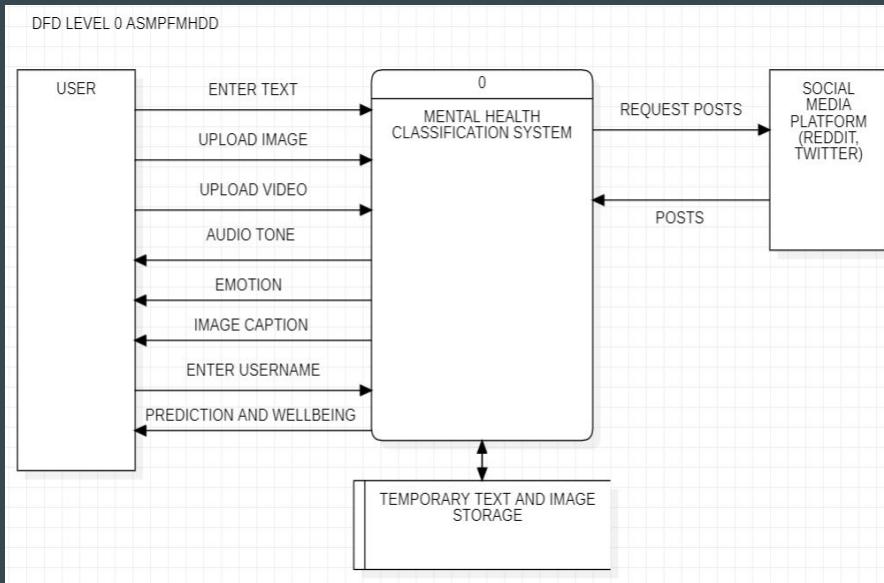
IMPLEMENTATION (CONTINUED)

- **Model Training** : Trained multiple models: Logistic Regression, k-Nearest Neighbors (k-NN), Support Vector Machine (SVM), Naive Bayes, Random Forest, XGBoost, Long Short Term Memory, Transformer and Ensemble Models.
- **Hyperparameter Tuning** : Applied RandomizedSearchCV to optimize the performance of some models.
- **Model Evaluation** : Used metrics like accuracy, precision, recall, F1-score, and confusion matrices to evaluate model effectiveness.
- **Prediction and Deployment** : Implemented the best-performing model and deployed using Google Colab, Pyngrok and Streamlit.



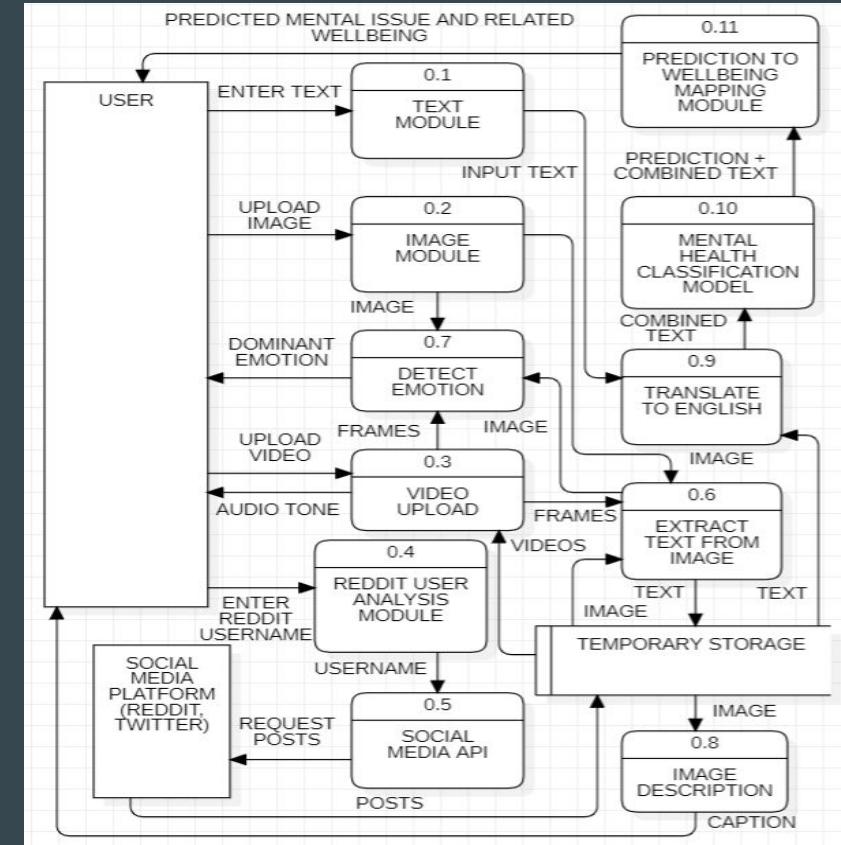
MODEL WORKFLOW

IMPLEMENTATION (CONTINUED)

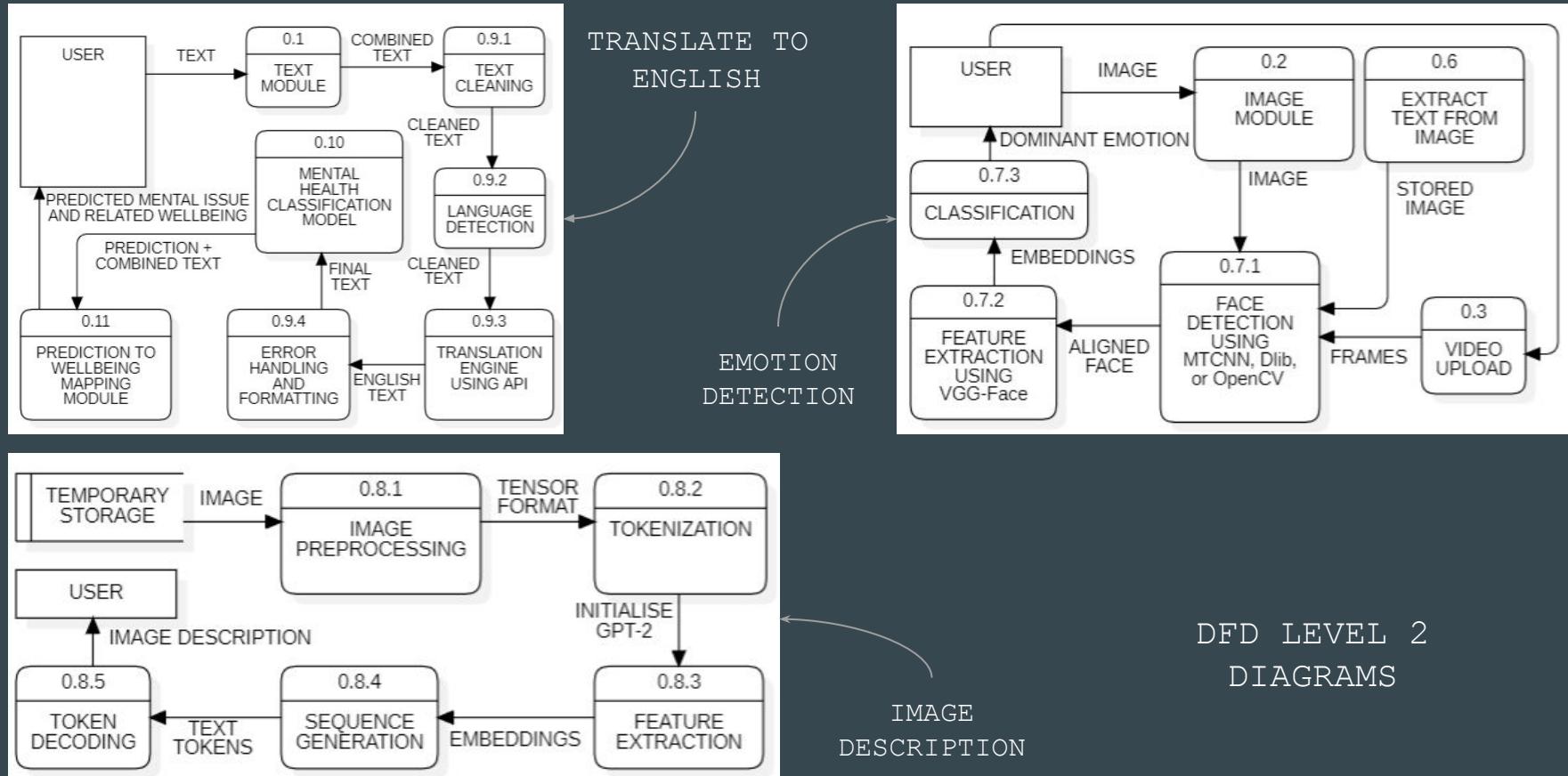


DFD LEVEL 0

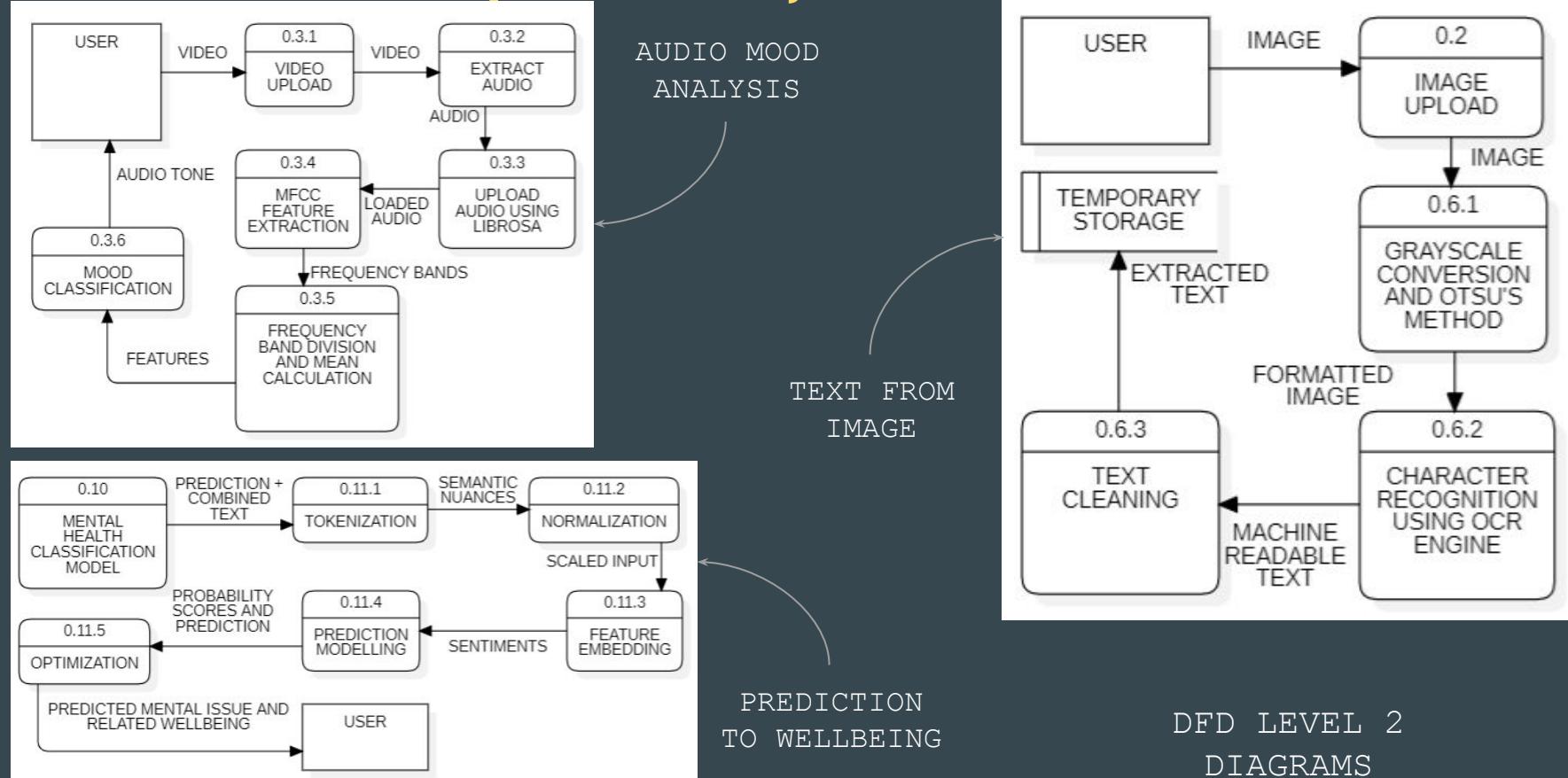
DFD LEVEL 1



IMPLEMENTATION (CONTINUED)



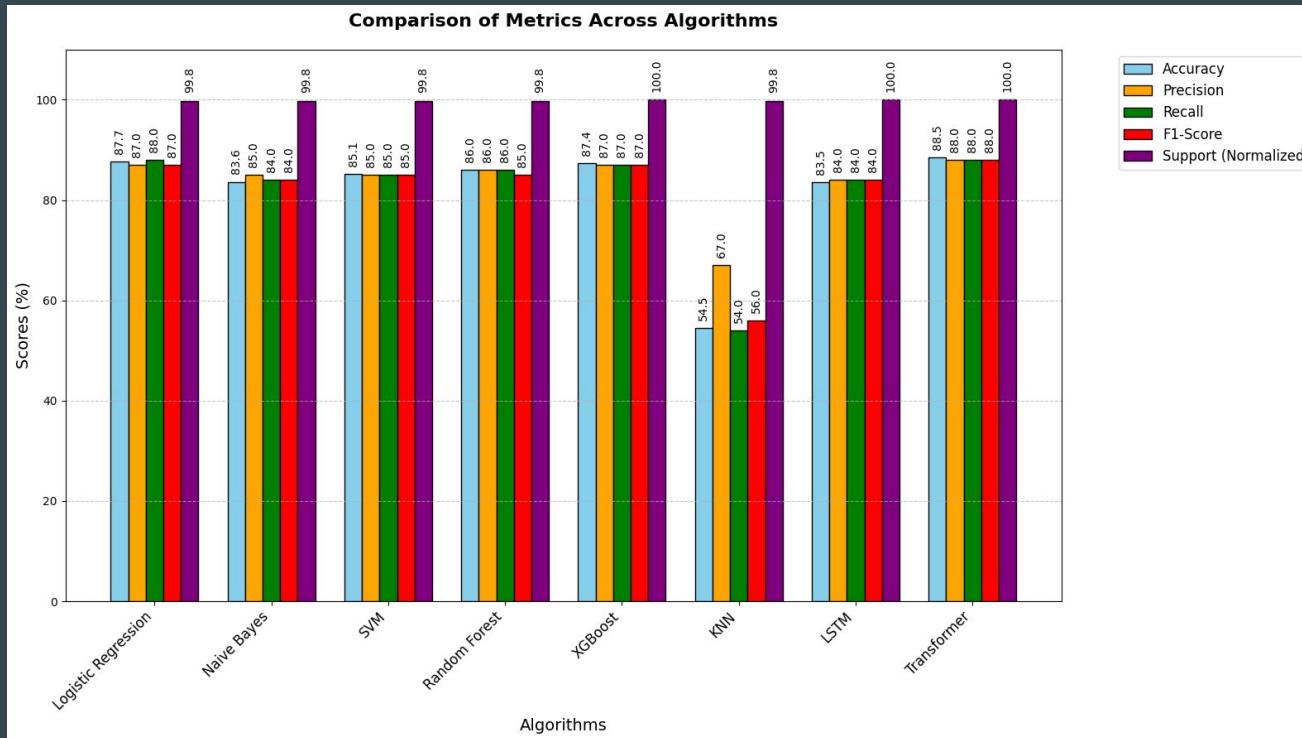
IMPLEMENTATION (CONTINUED)



RESULTS AND ANALYSIS

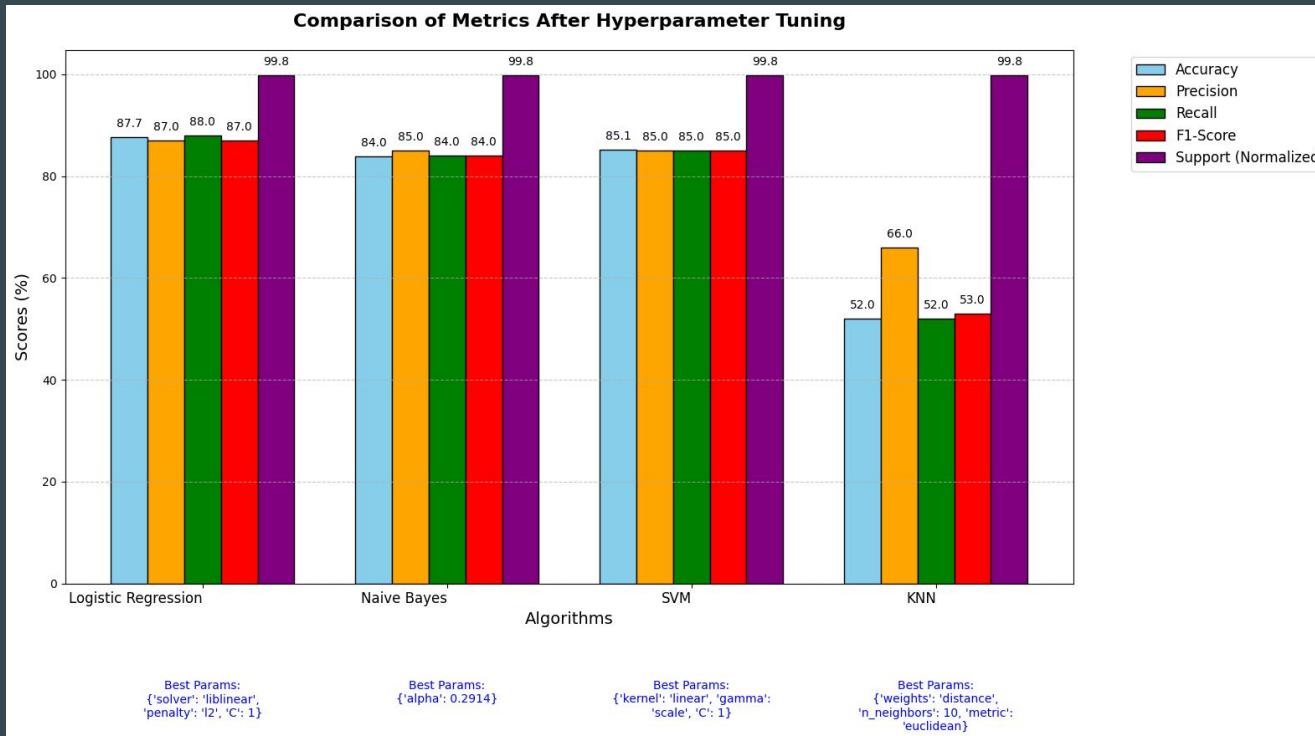
- **Logistic Regression** : Achieved consistent performance with high accuracy. Precision and recall indicate reliable classification for balanced datasets.
- **Naive Bayes** : Performed well with text data, especially for independent features. Precision was slightly lower for imbalanced classes but remained effective overall. Got better performance after applying hyperparameter tuning.
- **Support Vector Machine (SVM)** : Delivered high accuracy for nonlinear classification tasks. The model showed robustness with complex feature interactions.
- **Random Forest** : Provided strong classification performance with reduced overfitting. Achieved balanced precision and recall across all mental health classes.
- **XGBoost** : Delivered the highest accuracy and efficiency. The model demonstrated excellent handling of imbalanced datasets with robust predictions.
- **LSTM** : Outperformed traditional methods for sequential data. Captured contextual and temporal information effectively, achieving competitive results with complex text patterns.
- **Transformer** : Gave the highest accuracy when implemented separately. Used in Ensemble Learning and improved the overall accuracy of the final model.
- **K-nearest Neighbours** : Performed poorly and gave the worst accuracies among all.

RESULTS AND ANALYSIS (CONTINUED)



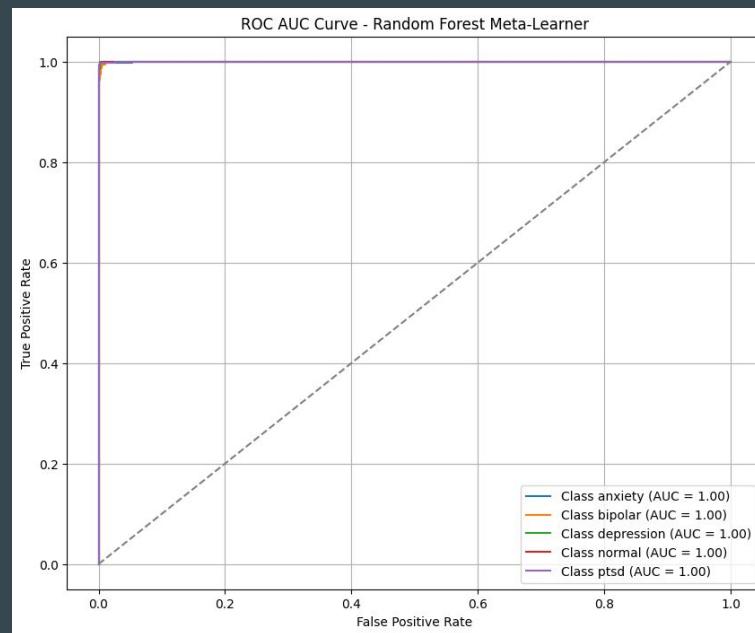
RESULT COMPARISON OF DIFFERENT MODELS

RESULTS AND ANALYSIS (CONTINUED)

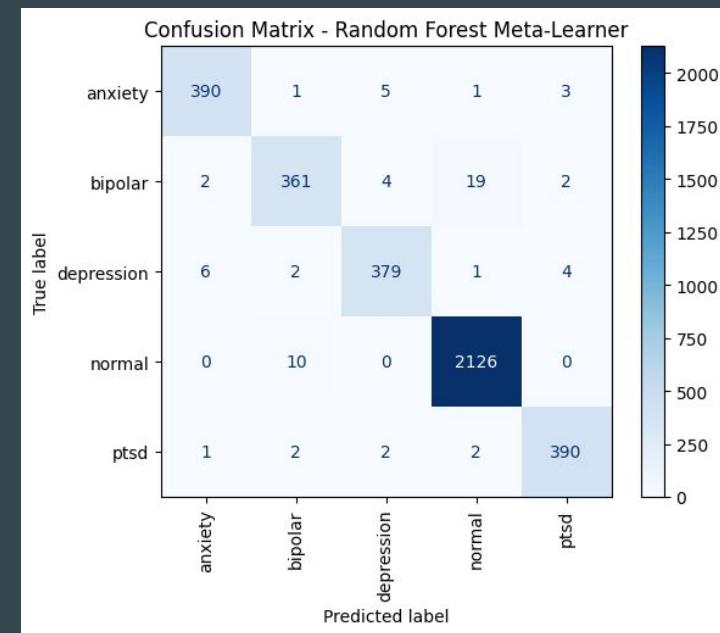


RESULT COMPARISON OF DIFFERENT MODELS AFTER HYPERPARAMETER TUNING

RESULTS AND ANALYSIS (CONTINUED)



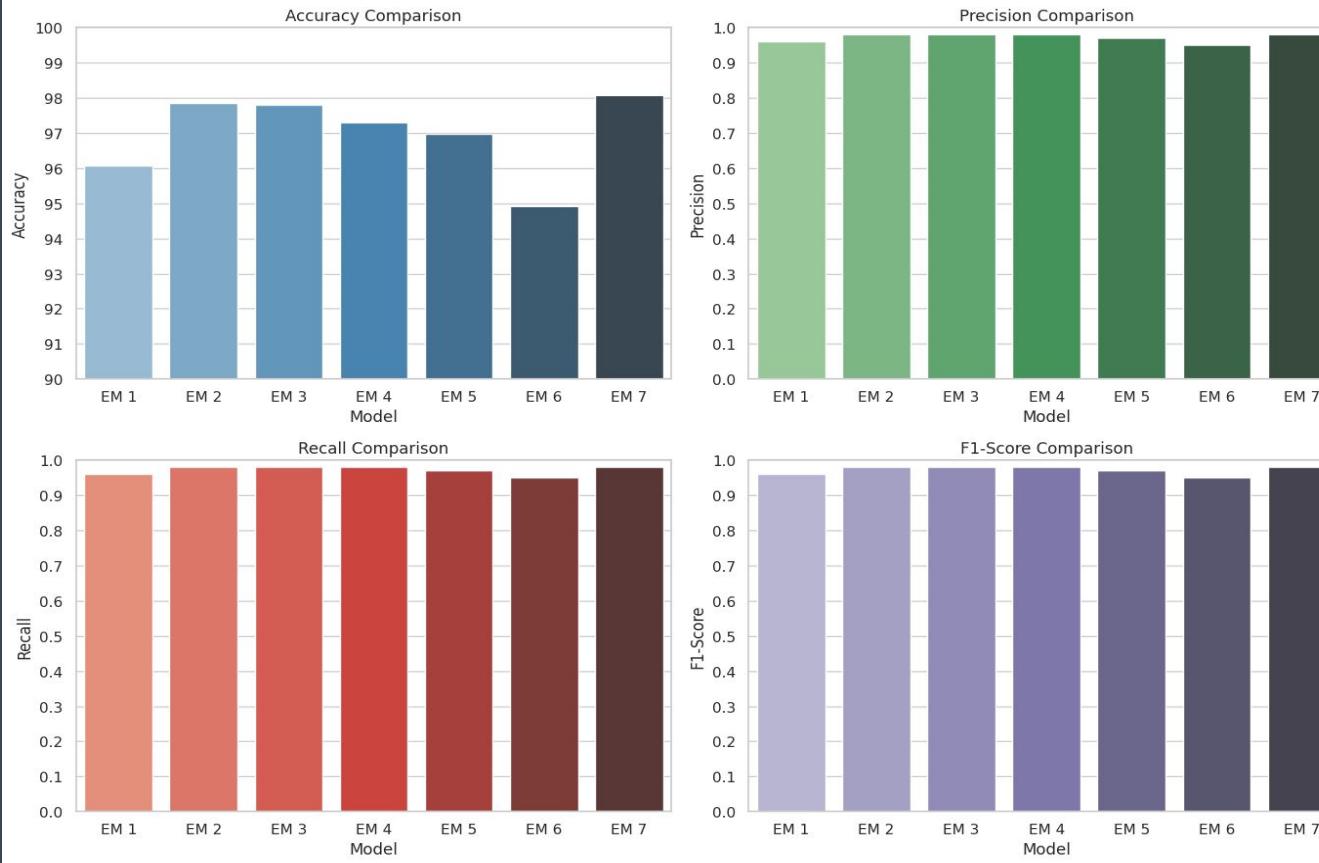
ROC AUC CURVE



CONFUSION MATRIX

ENSEMBLE MODEL (BASE MODELS : LOGISTIC REGRESSION, NAIVE BAYES, SVM, XGBOOST, LSTM, TRANSFORMER & META LEARNER : RANDOM FOREST) WITH ACCURACY OF 98.03% WAS USED IN WEB APPLICATION

RESULTS AND ANALYSIS (CONTINUED)



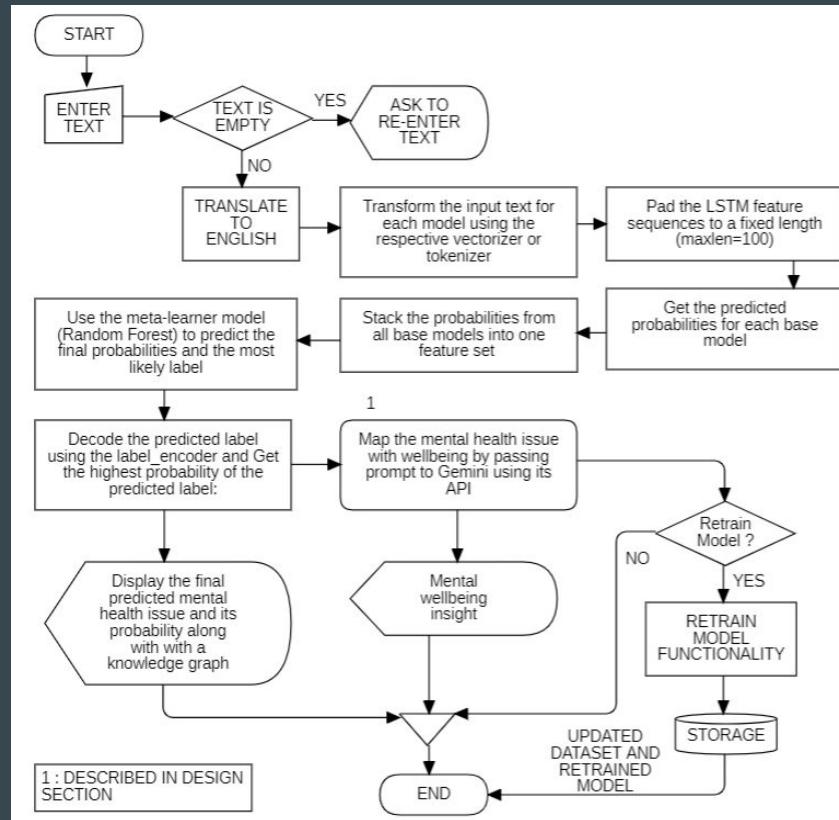
COMPARISON OF
DIFFERENT ENSEMBLE
MODELS

PROTOTYPE

- A functional prototype was developed to classify mental health concerns from social media posts.
- The system allows users to input text, upload images, or submit video for classification.
- Key functionalities include text preprocessing, feature extraction, and prediction using trained machine learning models.
- Real-time results display the most probable mental health concern with confidence scores.
- Allow user to retrain model.

- **Text Classification :** Users can directly input text for immediate analysis and classification.
- **Image-based Classification :** Extracts text from uploaded images using OCR (pytesseract), get captions and facial emotions to classify the content.
- **Video-based Classification :** Processes uploaded video files, extract text from frames, transcribes speech to text, get captions and facial emotions to classify the content.
- **Userprofile Analysis :** Enables analysing user profiles based on posts in Reddit and Twitter

PROTOTYPE (CONTINUED)



TEXT CLASSIFICATION

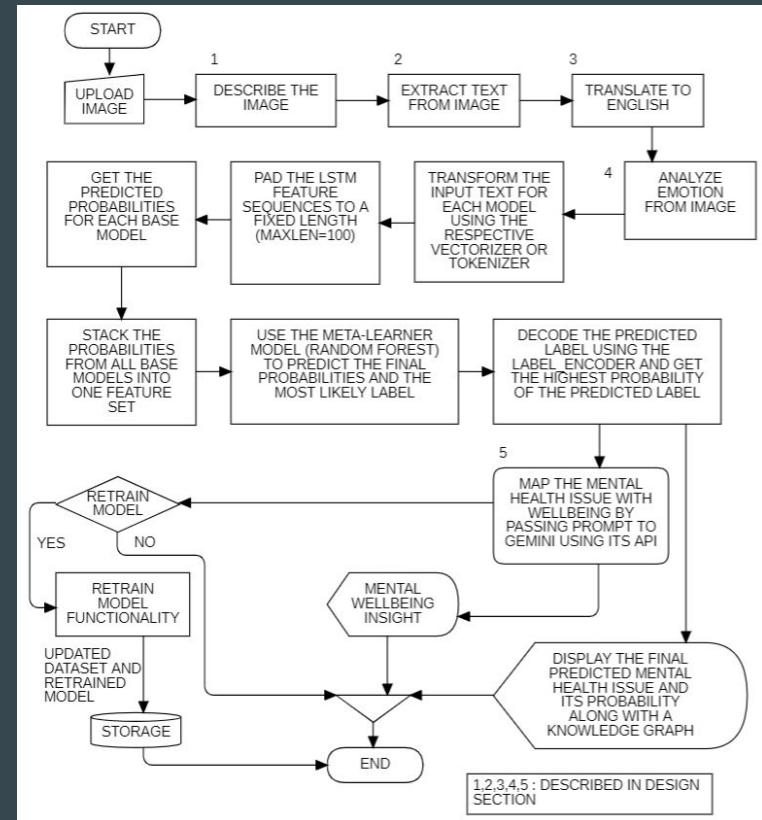
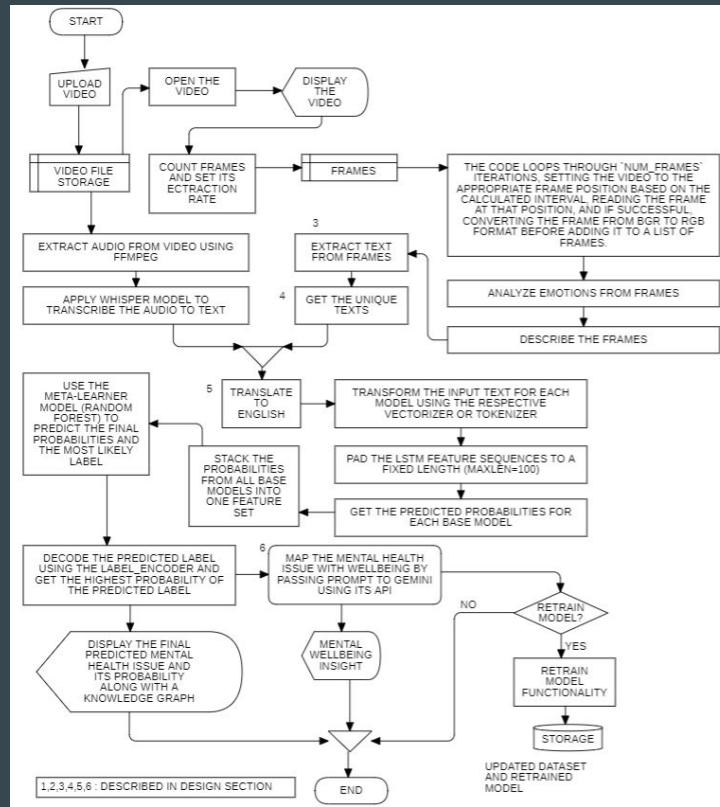
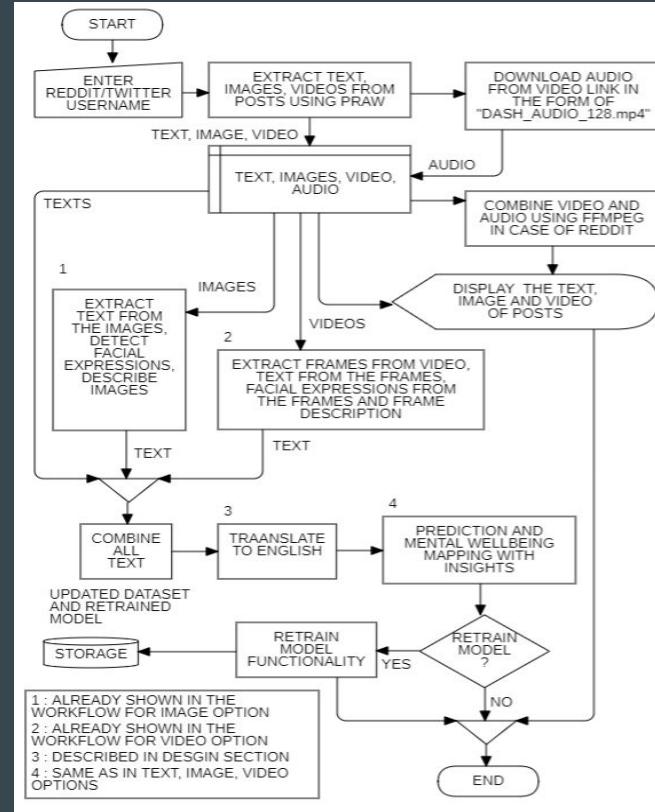


IMAGE CLASSIFICATION

PROTOTYPE (CONTINUED)



VIDEO ANALYSIS



REDDIT AND TWITTER USERNAME ANALYSIS

PROTOTYPE (CONTINUED)

The screenshot shows a web application interface for mental health disorder detection. On the left, a sidebar titled "Choose an option" contains a dropdown menu with "Text Input" selected, and other options like "Image Upload", "Video Upload", "Reddit Username Analysis", and "Twitter Username Analysis". The main content area has a title "Mental Health Disorder Detection" and a subtitle "Enter Text to Classify Mental Health Issue". Below the subtitle is a text input field with placeholder text "Enter your text here:". At the bottom of the main area are two buttons: "Classify Text" and "Classify Text and Retrain Model".

WEB APPLICATION INTERFACE

PROTOTYPE (CONTINUED)

Mental Health Disorder Detection

Enter Text to Classify Mental Health Issue

Enter your text here:

অসুস্থির কাছে হেঁসে গেঠে। সামাজিকের এক ধরনের আইনিতা অনুভূত কর, যুক্তি মধ্যে চাপ বাড়তে থাকে, শব্দ নিয়ে কষ্ট করা তুমি আমা, এটি কেবল মনসময়ের ভুল, কিন্তু তাপমাত্র এতো দেশের প্রতিটি কথে উচ্চিতে পড়ে। পৃষ্ঠাটি এক অক্ষতার গহনের মধ্যে অনুভূত হয়, যেখানে তুমি একা এবং অসহ্য।

Classify Text

Classify Text and Retrain Model

Translated Text (to English):

Your mind seems to be stuck in a thousand thoughts and doubts every day. A feeling like a nerve-wracking, a kind of pressure that never goes away. An unknown fear works inside you, which says —“Something bad will happen.” Maybe you know, nothing is likely to happen, but deep down in your mind an impossible fear awakens. A kind of restlessness is felt throughout your body, the pressure in your chest increases, it becomes difficult to breathe. You know, this is just a mistake in concentration, but still it seems to spread to every cell of your body. The world feels like a dark hole, where you are alone and

chest increases, it becomes difficult to breathe. You know, this is just a mistake in concentration, but still it seems to spread to every cell of your body. The world feels like a dark hole, where you are alone and helpless.

The most likely mental health concern from all the text obtained is: anxiety with a probability of 99.95%

Wellbeing Insight:

1. Autonomy and Anxiety: Anxiety can severely impair autonomy. The overwhelming fear and worry associated with anxiety can make it difficult for individuals to confidently assert their opinions or make independent decisions, even when they disagree with the majority ("I have confidence in my opinions, even if they are contrary to the general consensus"). The need for external reassurance and validation becomes prominent, hindering self-regulation and leading to dependence on others for decision-making. This dependence contradicts the Ryff scale's definition of autonomy.

2. Environmental Mastery and Anxiety: Anxiety significantly diminishes environmental mastery. The inability to manage overwhelming feelings can lead to avoidance behaviors, preventing individuals from effectively managing daily tasks and opportunities ("In general, I feel I am in charge of the situation in which I live"). Anxiety can manifest as procrastination, difficulty focusing, and an inability to anticipate and plan for future events, resulting in a decreased sense of control over one's environment.

3. Personal Growth and Anxiety: Anxiety often impedes personal growth. The constant worry and fear can stifle exploration of new experiences and opportunities ("I think it is important to have new experiences that challenge how you think about yourself and the world"). Individuals might avoid situations that

Mental Health Disorder Detection

Upload an Image to Extract and Classify Text

Upload an Image

Drag and drop file here
Limit 200MB per file • JPEG, PNG, WEBP, BMP, TIFF, TIF

OIP (2).jpg 26.7KB

[Browse files](#)



Mental Health Disorder Detection

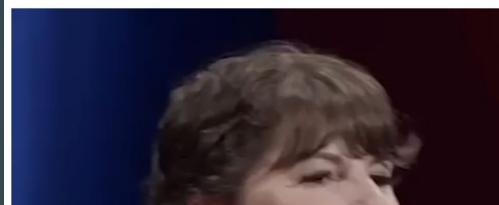
Upload a Video to Extract and Classify Text

Choose a video file

Drag and drop file here
Limit 200MB per file • MP4, MOV, AVI, MPEG4

[Browse files](#)

smp3.mp4 3.7MB



Mental Health Disorder Detection

Enter Reddit Username for Analysis

Enter Reddit username:

flowerpower0601

Analyze

Recent Text Posts:

```

0 :
"Taylor Swift's 'Eras' show. What's ACTUALLY going on? What do you guys think of this?"
1 :
"Taylor Swift's 'Eras' show. What's ACTUALLY going on? [removed]"
2 :
"Taylor Swift und die Eras Tour"

```

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.

Mental Health Disorder Detection

Enter Twitter Username for Analysis

Enter Twitter username:

narendramodi

Analyze

Recent Text Posts from Tweets:

```

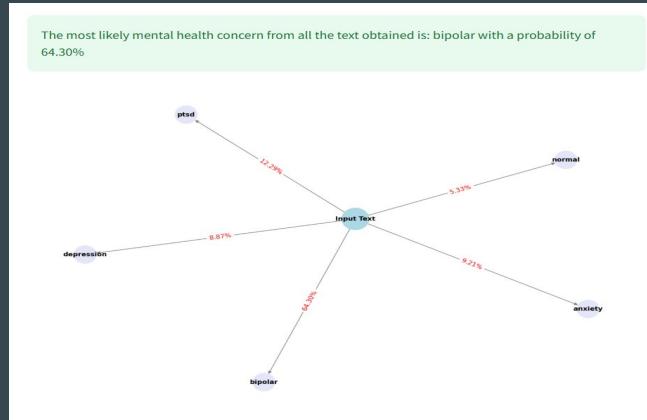
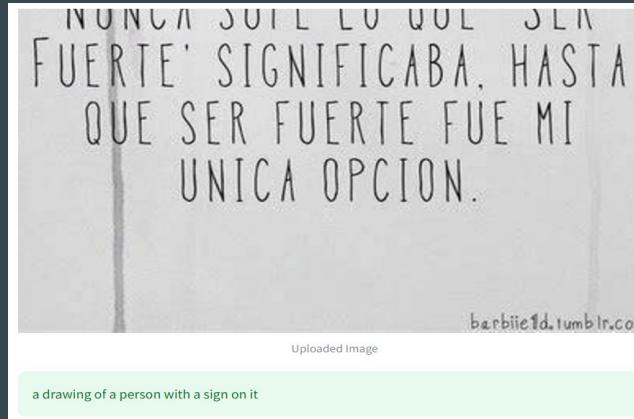
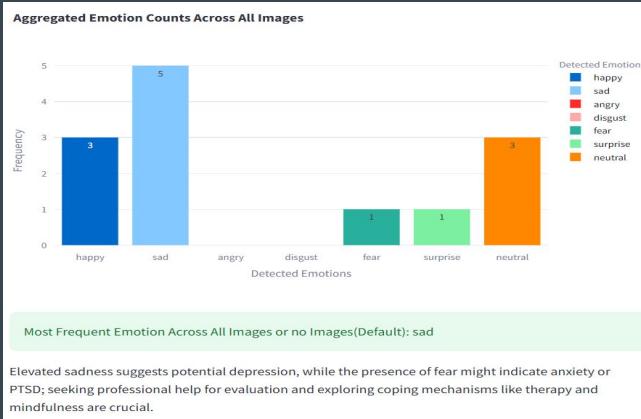
0 :
"Well said. It is good that this truth is coming out, and that too in a way common people can see it.

A fake narrative can persist only for a limited period of time. Eventually, the facts will always come out! https://t.co/8Xx0s5Qqe2y

1 :
"মহান বালাসেব তাকে জি যঁচা পুণ্যতীর্থিমিসি মী লানে আদর্শজলী অৰ্পণ কৰলো, মহারাষ্ট্ৰ বিকাস আপি মৰণী লোকোচা সুস্থলা যাসাঠী আগ্ৰহী অসে তে এক ইটে ব্যক্তিমত হোৱে, ভাৰতীয় সংস্কৃতী অৰ্পণ মূলধৰণ কলন ল্যাবিলিবল অভিযন্তা সুট্টোত কৰণ্যাত লাগিব দ... https://t.co/oHRv3DUFKj

```

PROTOTYPE (CONTINUED)



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 babie	depression
18,597	Sometimes your mind reaches extreme heights, you feel a kind of invincible power - i	bipolar

Model is being retrained...

Detailed Status

Retrained Model Accuracy

98.05%

WEB APPLICATION INTERFACE

CONCLUSION

→ *Significance of the Project*

Developed a robust system for early detection of mental health disorders through social media analysis.

→ *Effective Use of Machine Learning*

Leveraged various machine learning models, identifying SVM as the most accurate for sentiment classification.

→ *Impact on Mental Health Awareness*

Provides valuable insights for mental health professionals and public health organizations, enabling proactive interventions.

→ *Potential for Future Development*

Future enhancements with deep learning and multimodal data can lead to even better accuracy and insights.

→ *Commitment to Ethical Practices*

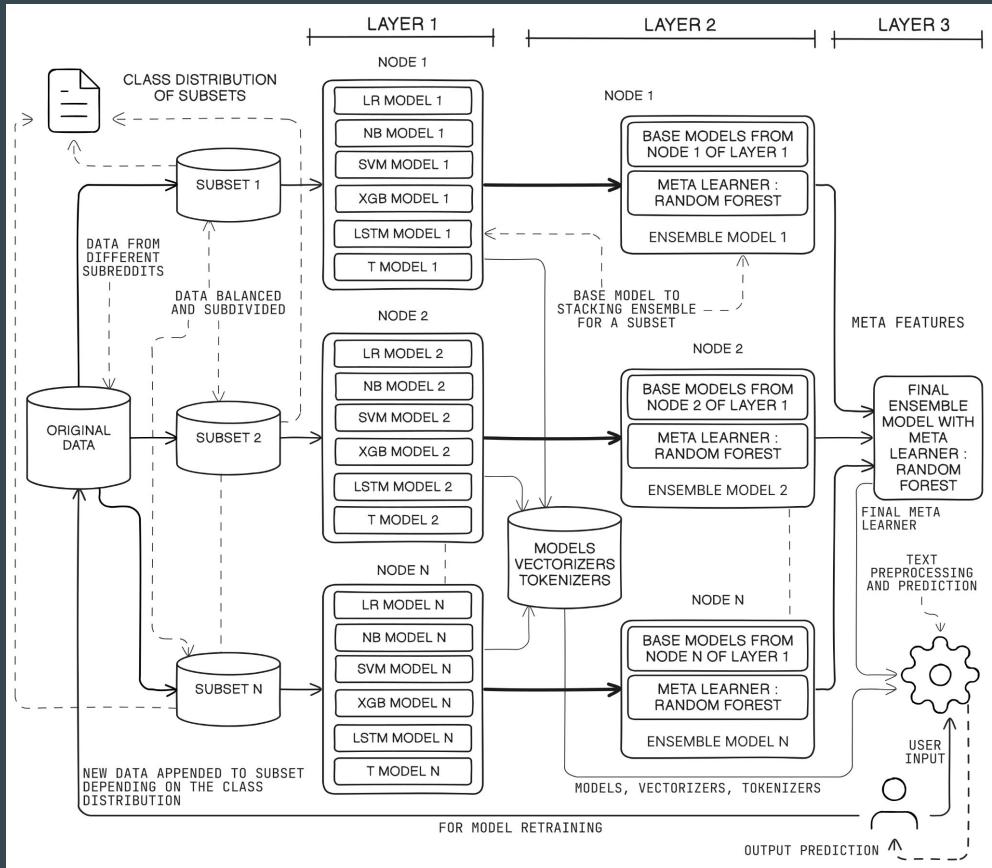
Emphasizes the importance of user privacy and ethical considerations in handling sensitive mental health data.

FUTURE SCOPE

- Leveraging **hierarchical ensemble learning** and suggest probable distributed architectures (tested in a sequential manner) for training models and implement them in the application.
- Optimize the application to **train models on larger datasets** by partitioning the data and distributing workloads effectively across available resources.
- Establish **associations** between the model's mental health classifications (Normal, Depression, Anxiety, Bipolar, PTSD) and the six Ryff's Scale parameters of psychological well being.
- Use these associations to generate **personalized prompts** for the Gemini API, providing deeper and actionable mental wellbeing insights.

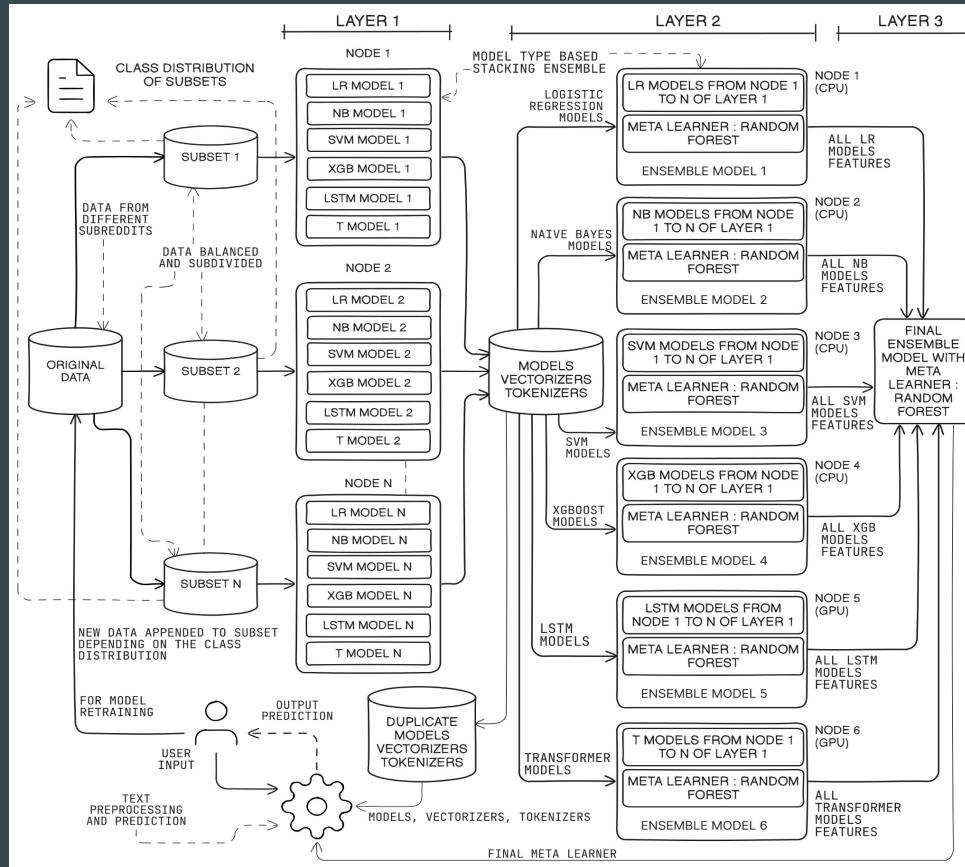


FUTURE SCOPE (CONTINUED)



ARCHITECTURE 1 , WHERE FINAL ENSEMBLE MODEL IS BASED ON N INTERMEDIATE ENSEMBLE MODELS FROM N SUBSETS

FUTURE SCOPE (CONTINUED)



ARCHITECTURE 2 , WHERE FINAL ENSEMBLE MODEL IS BASED ON 6 INTERMEDIATE ENSEMBLE MODELS FROM N SUBSETS

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- *Single classifier vs. ensemble machine learning approaches for mental health prediction by Dip Kumar Saha, Tuhin Hossain, Mejdl Safran, Sultan Al Farhood, M. F. Mridha, and Dunren Che* demonstrates that Gradient Boosting (88.80%) and Neural Networks (88.00%) outperform ensemble models (85.60%) for mental health issue prediction, based on survey data from OSMI.
- *Ensemble of hybrid model-based technique for early detection of depression by Konda Vaishnavi, U Nikitha Kamath, B Ashwath Rao, and N V Subba Reddy* introduces a hybrid SVM-MLP model with SMOTE for class balancing, achieving 99.39% accuracy and 99.51% F1-score, highlighting its efficacy in early depression detection.
- *Survey of transformers and towards ensemble learning using transformers for NLP by Hongzhi Zhang and M.Omair Shafiq* reviews transformer models and explores ensemble learning with transformers, showcasing their superior performance in NLP tasks like sentiment analysis and text generation.



THANK YOU