

# Mental Health Prediction and Support Application

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**Abstract**— Mental health is crucial for persons daily functioning, and advancements in electronic and digital devices have led to the use of the smart technologies to address various mental health challenges. Facial recognition technology has emerged as a method to detect emotions by analyzing facial expressions captured by the device cameras. Another technique employed by the psychologists is measuring the eye contact frequency and the duration using the device cameras, which can provide insights into a person's mental stability. Changes in the voice pattern can also indicate unstable conditions such as anxiety, depression, stress, or pressure. An app can record and process voice notes of users as they read specified text, helping determine their mental state. Chatbots offer a private and friendly conversational interface for individuals seeking an easier way to cope with their condition. Natural Language Processing is utilized to analyze texts, including social media posts or typed content, to gain insights into a person's mental state. This approach also facilitates voice recognition for different languages. The collected data is stored and compared to the trained dataset to derive meaningful results.

**Index Terms**— Mental Health, Facial Recognition, Voice Tone Detection, NLP, Eye Contact Frequency.

## I. INTRODUCTION

Mental health encompasses a person's psychological and emotional well-being and it affects one in four individuals globally. Conditions like anxiety disorders, depression, bipolar disorder, schizophrenia and eating disorders are common. Most of the times the person. Suicide, often linked to underlying mental health issues, is a significant cause of death worldwide. The World Health Organisation has reported that approximately 25 people of the 100 will undergo mental health problem during their lifespan. The anxiety count is over 284 million, schizophrenia count is over 20 million, and the disorder due to eating affects over 9% of the global population. Approximately 35 million people are affected due to substantial disorder. Around 10-20 percent of the youth suffer from the stress. There is need of a platform that will help the individual to discuss the problem one is facing and need proper way to overcome the issues. Proper screening is most important aspect for detecting what one is particularly facing. The person facing the mental health issue are screened using the techniques like Beck Depression Inventory (BDI) and the self-report like psychometric test like General Health Questionaries (GHQ). Detection can be done also by running test on saliva and on blood, however the self-report psychometric test is most effective in determining the early-stage conditions, but may prove as bias based on the condition of consciousness or the unconsciousness of the subject. Various research techniques have proved that the sudden changes in the persons behaviour or the mental health has a deep impact on the one's facial expression and the

voice pitch has some impact too. The facial expression may require some external source such as the sensory devices such as camera while it's easy to implement the detection by using the voice analysis as required devices are less in the numbers.

It is continuously desired to monitor the individual's status regarding the mental health disorder and predict it as early as possible. The capability of the remote devices such as mobile devices has gained a lot of the recognition these days and these devices are able to perform the arithmetic processing's in moderate level. Research has been on the way to utilize these devices like smartphones to detect and develop the mental health applications for the early detection and supportive purpose. In this study, we are developing the system that will be based on the mobile application which will help in the monitoring purpose of the individual's mental condition. This all will be done by using the various techniques using the facial expression detection through the device cameras. Another technique used is the voice tone analysis for analysing persons voice and to process it for the prediction.

Capturing the human face expression is way easy for the system, all it requires is a well-trained dataset and Realtime face expression to generate the result. However, for predicting one's mental health using the voice is bit complicated as the user must be comfortable to communicate in his comfortable native language, for this there is need of Natural Language Processing (NLP). In this study, we are developing the system that will be based on the mobile application which will help in the monitoring purpose of the individual's mental condition. This will be done by voice tone detection method where the voice tone of an individual will be analyzed by some algorithms like Convolutional Neural Network (CNN), Recurrent Neural Network (RNN) algorithms. Mostly Voiceprint Detection is used for biometric recognition techniques for security purposes but here we will be using it to analyze the patient's mental health condition according to the changes in voice tone patterns.

## II. LITERATURE SURVEY

### *A. Application of Natural Language Processing (NLP) in Detecting and Preventing Suicide Ideation, 2023*

According to the paper the mobile apps have an expanded therapy that's given in the traditional ways. A person suffering from mental disorders may have been configured on various stages however suicide is the last stage of the person having the bad mental health. So, the app has been aimed to control the suicide count by performing various analyses. For developing the application and gathering of information by investigating various articles which had medical and scientific responses. They also used the databases from PubMed, MEDLINE, Embrace, PsycINFO, and the Global Health through the OVID platform. The challenges that they have faced is they didn't have the accurate dataset that will help them to decide whether person is suicidal or not. So, lack of the relevant Dataset was the major drawback of the application. [1].

### *B. Data Augmentation in Natural Language Processing: A Novel Text Generation Approach for Long and Short Text Classifiers, 2021*

The significance of training data in machine learning introduces a novel text generation method that enhances classifier performance of both long and short texts. Improvement of notable accuracy of 15.53% is demonstrated and particularly in low data scenarios. The method creates new instances through both context-dependent and context-independent sub-methods. The study tackles essential queries regarding data novelty, quality, context inclusion for long texts, and improved classification for short texts. Findings indicate the approach's promise in small data analytics, concluding with practical application implications [2].

### *C. Deep Learning for Mobile Mental Health, 2021*

Work in this presents the vital role of mental health and rapid integration of mobile phones and wearables in mental health research and betterment. It introduces the world with a smartphone mental support (M2Health) and highlights on its potential strengths: Remote Measurement Technologies, Diverse applications, cost-efficiency, and adaptiveness. It recognizes difficulties in M2Health and suggests that creative signal processing and deep learning can tackle these issues, especially in creating user-centric applications. The paper intends to explore recent advancements in deep learning for M2Health, providing a distinct viewpoint compared to earlier research [3].

### *D. Data augmentation in natural language processing: a novel text generation approach for long and short text classifiers, 2020*

Work on Data Augmentation in Natural Language Processing was done in year 2022 that used the accuracy of the non-contextual text generation process, EDA and the baseline with regard to different subsamples. They proposed a theory proposing that in many of the cases of machine learning research suggests that the development of the

training data might have a higher relevance than the choice and modelling of the classifier themselves. However, they faced the consequences of the language barrier during the implementation of the module.[4].

#### *E. The Development of Mobile-based Application for Mental Health Counselling during the COVID-19 Pandemic, 2020*

In 2020 a paper was published; they introduced an integrated system platform for mental health counselling for covid-19 and afterwards for patient's convince to choose the psychologists / psychiatrists that best suit for their problem. For this a dataset was prepared that was based on a local clinic situated in South Tangerang, Banten conducted with a staff, a psychologist and a patient. However, the module just worked to predict the disorder but was unable to guide the person.[5].

#### *F. Predicting the level of generalized anxiety disorder of the coronavirus pandemic among college age students using artificial intelligence technology, 2020:*

A work was done that was used for predicting the level of generalized anxiety disorder of the Corona Virus pandemic among college age students using the AI technology, the aim was Developing the best fit model that can detect the level of anxiety of college students due to Covid-19 using the AI and Machine Learning Technology. For this purpose, 917 instances were collected by the local university in Saudi Arabia. [6].

#### *G. A Mental Health Chatbot for Regulating Emotions (SERMO)-Concept and Usability Testt, 2020-*

In this paper, SERMO, a mobile application with integrated chatbot that implements methods from cognitive behaviour therapy (CBT) to support mentally ill people in regulating emotions and dealing with thoughts and feelings and the conclude the results by taking 21 people (13 female, 8 male) their input and emotion regulating. The challenges in this paper are protection and enhancing quality of algorithms. [7].

### III. MOTIVATION

Depression in youth has become a common problem, young people can feel sad and worried about life events such as exams, fights with family, friends and overthinking. This is something we face and observe around us on daily basis and this is leading to suicides or causing damage to their lives.

### IV. PROBLEM STATEMENT

Creating a application that will help the individual to track the mental state of his/her with accurate prediction, and help them to overcome the issue by providing friendly environment with privacy measures. Mental health apps can be incredibly motivating and empowering tools for individuals seeking support and assistance with their mental well-being

### V. EXISTING SYSTEM

#### *A. Problem Scope*

In the existing system, there are separate modules that will help to predict the state of mind of the person. The application consist of the modules such as facial emotion recondition system, voice analysis and prediction system, a user-friendly chatbot. The system will have the access to the cameras and microphine of the device, which helps to track the variation in voice and facial expression of the person. The captured data will be processed and trained using the machine learning algorithm and stored in the database to generate the overall result. The data captured will be trained by using the already existed dataset. Precision of the results will be also captured by using the machine learning algorithms such as Random Forest, KNN etc.

#### *B. User Interface (UI) Design*

The way the current system is designed with its complicated structure and hard-to-use user interface makes it challenging for users to figure out how to use it easily. This causes users to feel less satisfied, and it may lead to problems when trying to perform tasks effectively. The app will be simple to use and will be less complex so that everyone can use it efficiently. The userface will be developed by using platforms such as Figma and the languages to develop the application will be Dart and Flutter.

#### *C. Chatbot Functionality*

The chatbots or virtual assistants in the existing system are not very useful as they only provide basic information.

Users expect more personalized and insightful interactions, but the existing chatbots fall short in meeting these expectations. Users desire better assistance and more relevant responses, but the current chatbots lack the capabilities to deliver that, leaving users dissatisfied and seeking more helpful alternatives

#### D. Data Analytics Utilization

The already existing application does not provide the support to analyse the data captured. So data utilization and processing is the most main and crucial step. To predict the mental state the analysis of the data is required as there may be a lot of variations in the data .

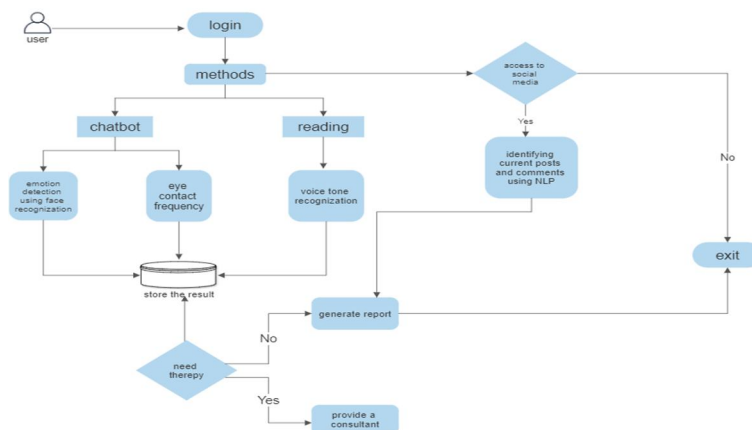
#### E. Predictive Mental Health Analysis

The results captured from the camera and microphones of the device are processed and the prediction is made on the results captured. Depending on the various results captured by the various modules the mental health is predicted. The mental state of the person is determine as he is in depression or has anxiety attacks. And the proper measure to the state is provided so it can help them to overcome the problem.

#### F. Data Security

The existing system has serious data security issues, which means that sensitive information like personal information and health records could be at risk. This poses a threat to the confidentiality and privacy of such data, and unauthorized access could lead to harmful consequences. It is essential to address these security concerns to protect the data and ensure the system's integrity and trustworthiness.

### VI. PROPOSED SYSTEM



(NLP) section concentrate on analyzing sound tones using modern subject like machine learning, artificial intelligence (AI), and deep learning. These both techniques ensures that the understanding of the emotional state of the person is most proficient. Algorithms used in the chatbot will leverage to analyze facial expressions and eye contact frequency exhibited by the user. In the application two techniques are combined: a Chatbot and Reading analysis. The chatbot utilizes algorithm that will be tested by facial expression and the contact frequency of the eyes. The user emotional state during the interaction with the chatbot will be processed by the algorithm to get understandable by the chatbot. At the same time, the Reading (NLP) section concentrate on analyzing sound tones using modern subject like machine learning, artificial intelligence (AI), and deep learning. These both techniques ensures that the understanding of the emotional state of the person is most proficient.

Algorithms used in the chatbot will leverage to analyze facial expressions and eye contact frequency exhibited by the user. The user's emotional state in real-time is being comprehended by the chatbot using the algorithms by using the computer vision techniques to interpret facial features, expression and the patterns of eye movement. Analysis of the voice tone is acquired by sophisticated technologies such as machine learning, AI and deep learning. These technologies are employed by the NLP component. The various characteristics associated with the emotional state are processed using the user's voice data, extracting the unique patterns these are all enabled by the Machine learning techniques.

Complex algorithm are being employed to make accurate predictions about the various mental health conditions that depends upon the voice tone variations. Gathering of relevant information from the user interaction is most

important part, and the gathered information is stored as the data. The data consists of the facial expression, eye contact timings and voice tone variations.

All the gathered data is then comprehended and processed, creating a comprehensive mental health profile for the users. All the comprehensive profile of the mental health is thoroughly analysed. All the results are integrated based on the cues from the facial expression, eye contact and voice tone variations. Advanced algorithms are applied for decoding the complex relationships between the cues and the mental state of the person. A comprehensive and human like evolution of the user's mental health status is the aim and goal of the system by matching the advanced technologies and methodologies. This concern explaining emotional clue, voice tone, and other relevant indicators to gain a deep understanding of the user's emotional state. Goal of the application is to attract users' attention toward the mental illness and their mental well-being.

## VII. TECHNOLOGIES

### A. Natural Language Processing (NLP)

1. Script Characteristics can be used as a text analysis technique for mental state reasoning. This method makes use of algorithms to determine a person's mental state through the analysis of handwriting traits. From handwritten writing, these algorithms extract particular characteristics using stroke patterns, pressure, slant and spacing. The individuals emotional and cognitive style information can be attained by analysing these features. This entire process is a combination of handwriting analysis with machine learning algorithms that are beneficial to learn patterns associated with the class of stress

2. Natural Language Processing (NLP) Algorithms: NLP algorithms are basically used for designing a process that helps machine to understand the human language. While studying the language various tasks are performed, that involves: Text classification, Sentiment Analysis, Translation, Question Answering. The text input is processed and categorize according to predefined categories. The individual's mood of being happy, sad, stressed, anxiety and other emotional states are classified by classifying the text and its category. Sentiment analysis is used to determine the sentiment or the state of mind based on the textual data. The written text communication will be beneficial in understanding the state of mind of the person. The translation of the text from one language to the other can be done by the translation method. Translation method helps in overcoming the language barriers and understand the text or speech.

In the context of the mental health the user must have comfort during interaction, so for that process Natural language processing plays a important role. To minimize the hinderance in between the effective interaction, NLP helps in overcoming the language barrier to enable communication and understanding of different languages. To provide a supportive and comfortable environment for the one seeking mental health assistance is the most crucial part. By enhancing the overall experience all the contextually relevant and aligned responses are NLP driven

### B. Chatbot

The chatbot provides a program for users to act with the system and deal with their issues. This action is designed to be open-ended, allowing users to independent interact with their trouble. The chatbot apply a formulation known as "unsupervised question approach". This means that users are not affected by specify options; instead, they have the flexibility to respond in their own words. The unattended enquiry formulation enables users to depict their trouble using their own words and phrases. This approach is planned to adapt a wide range of user reaction, allowing for a more natural and open interaction.

*Recurrent Neural Network* : RNN receives the word embedding vectors representing the words that are in the lowers dimensions. By using the hidden state in the RNN the next word can be easily predicted by using the prior probability, then its being processed by using the softmax activation function. Training of these networks is done via the generalized backpropagation algorithm called truncated backpropagation through time. The calculation of the error is carried out by the help of the cross-entropy loss function, it calculates the prediction and the difference in them as compared to the true labels.

The user can interact with the chatbot and can describe their problems with system analyze through the descriptions. Efficient measures and suggestions can be generated that will be beneficial for user to overcome the specific situations. This could concern distinguishing related reference, coping plan of action, or suggested act.

'Rule based approach' is the mechanism used by the chatbot. This means that the already designed patterns and method are provided to the guide of the chatbot. The rules are developed and designed depending upon user queries and the correctness of the response to the particular query. The user inputs are matched to the existing rules to determine the appropriate response.

Rule based chatbots are easy to implement and are useful in handling the straight forward user interaction most efficiently. The chatbot may face some issue in case if the complex or unexpected user problems are registered that may not fall under the predefined rules. If some of these inputs are registered the user may not get the accurate or helpful response. The user interaction with the chatbot must be friendly to share their problem.

### C. Emotion Detection

The application will capture the real-time facial expression of user while they are interacting with the system. The collected data of facial expression will be stored for the further processing. The results are generated depending upon the data stored during the entire process and are then extracted. The term real-time facial expression is used because they offer most clear insight for the user emotions, hence the quality of the result generated will be optimal and with accuracy. The Machine learning technique involves the training of the ML algorithms on the labelled dataset, such that they mean each data point will be associated with predefined emotion or the labelled sentiment. The specific emotional state expressed by individual are indicated with the help of those labels according to the facial expression.

ML Techniques for Emotion Classification:

The task of classifying the emotions based on the captured facial expression data is done by various ML techniques. These techniques include:

1. Support Vector Machines (SVM): It's supervised learning algorithm that finds a region to separate the classes based on their characteristic.

a. Image based classification: The images are classified optimally. The images are segmented by dividing into sub images.

b. In training stage, the received data as input in machine learning algorithms, i.e,

$$s = ((x_1, y_1), \dots, (x_i, y_i)), y_i \in \{-1, 1\}$$

Where  $x_i$  is input data and  $y_i$  is class label.

2. Naive Bayes: Using the Bayes Theorem, it calculates the likelihood of the class given input features.

$$f(x) = \text{sgn} \left( \sum_{i=1}^l a_i y_i K(x_i, x) + b \right)$$

is the nonlinear function  $p(c | F_1, \dots, F_n)$ , here  $c$  is dependent class variable,  $F_1$  and  $F_n$  are featured variables. By applying the Bayes theorem can be written as:

$$p(c | F_1, \dots, F_n) = \frac{p(c) p(F_1, \dots, F_n | c)}{p(F_1, \dots, F_n)}$$

The accuracy calculation is calculated as:

$$\text{accuracy} = \frac{(\text{tested images} - \text{failed images}) \times 100}{\text{tested images}} \%$$

The learning of the patterns and feature from the facial expression data is done by the ML techniques. Various relation between Facial features like eyebrow position, mouth shape and emotions are represented using the patterns. Features are pulled out from the characteristics that assist in identifying different feeling. Adjustment of the parameters are concluded, due to this the ML model will optimize its ability to accurately distinguish in between the emotions.

Emotion analysis is a processed on the basis of the Real-time facial expression. Emotion classification involves ML algorithm that uses the labelled dataset and involves their training on the basis of these dataset. Learning pattern and features from the data is quite a challenging task that can be implemented using the techniques namely SVM, Naive Bayes, Decision Tree, random forest. Emotion classification process can be complemented by extracting the textual features from the textual data or textual information.

### D. Voice tone Detection

Assessment of mental health from user interaction through Voice: While being active on the application the user will be provided some of the paragraphs that the particular one will read aloud and will interact with the system

through voice. The mental health assessment is carried out for featuring the mental state of the person depending upon the characteristics of their voice including voice pitch, the degradation, and the pitch trends while the interaction. The user's emotional state is determined by using these attributes as they prove to be impactful in providing the insights to it.

#### *Using Labelled Datasets For Machine Learning*

The process involves a machine learning (ML) approach where models are trained using datasets that have been labelled. A set of predefined emotion label are made to associate with each data point in the dataset, justifying the emotional state impacted by the user's voice characteristics.

#### *ML Techniques for Emotion Classification*

A variety of ML techniques can be used for the task of classifying emotions based on the voice characteristics. These techniques include:

1. *Naive Bayes*: A probabilistic classifier that calculates the probability of an emotion class given the voice features and attributes. Bayes Theorem is stated as:

$$p(A_i|B) = \frac{p(B|A_i)p(A_i)}{p(B)} \quad (1)$$

Where,

- P(A) and P(B) are the observing A and B without regard of each other.
- P(A | B) is the conditional probability, which is for observing event A when event B is stated as true.
- P(B | A) is the probability of observing event B given that A is true.

*Learning Patterns and Features from Voice Data*: The selected ML techniques learn patterns and features from the voice data. These patterns represent relationships between voice pitch, degradation, and high-level pitch trends with specific emotions. The features extracted from the voice data contribute to distinguishing various emotional states. The ML models adjust their parameters through training to optimize their ability to accurately classify emotions.

## VIII. CONCLUSION

Future developments in mental health apps can focus on personalization, tailoring interventions to an individual's unique mental health needs. This involves utilizing machine learning and artificial intelligence (AI) algorithms to analyze user data, such as behavioural patterns, preferences, and responses. These algorithms can then recommend and deliver interventions that are specifically suited to the individual's requirements. The use of machine learning and AI can enable apps to dynamically analyze and process large volumes of user data. These algorithms can learn from user interactions, predict trends, and recommend interventions based on patterns detected in the data. This allows for real-time customization of interventions for each user's mental health journey.

Mental health apps can evolve to play a role in prevention and early intervention. By identifying individuals at risk of developing mental health problems through data analysis, these apps can initiate early interventions and support. This involves detecting subtle patterns in user behaviour that might indicate the early stages of mental health challenges. Future apps can establish seamless integration with healthcare providers, such as psychiatrists and therapists.

This integration facilitates better continuity of care by allowing healthcare professionals to access relevant user data, track progress, and make informed decisions. The app becomes a tool that assists in the ongoing monitoring and management of mental health. Mental health apps can be instrumental in monitoring users' progress and offering support between appointments with healthcare providers. Users can input data about their experiences, moods, and behaviours, which the app then analyzes over time. This analysis helps users track their own progress and provides them with relevant insights or interventions. The future design of mental health apps should prioritize accessibility for all individuals, including those with disabilities and diverse linguistic backgrounds. This involves considering various user needs and implementing features that accommodate different abilities and languages. User interfaces should be designed to be usable and understandable by a wide range of people.

After the successful deployment of the product there will be a medium available for sharing the various problems causing the mental health issue that someone cannot share with another person. The accurate result generation will be done based on the facial expression of the person, voice tone. The user can interact with the system in his



comfortable language with minimum language barrier. According to the report the user will be recommended the solution or will be advised to the therapist if needed. The application will help making people aware about the mental health issues and will help them to focus on it.

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