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MentalEase - Virtual Solutions for Mental Well-Being

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ABSTRACT
As we know, technology has transformed how we communicate, work, learn, and access information, making life easier in many ways. How can Artificial Intelligence contribute to mental health wellness? Our research is important to promote increased understanding of mental health in India. Despite recent initiatives like the 2022 National Tele Mental Health Programme, challenges persist, including stigma, limited awareness, a shortage of professionals, underfunded services, rural-urban disparities, cultural barriers, and integration gaps with primary healthcare. Addressing these issues is crucial for a more inclusive and effective mental health support system. This study addresses these issues by using an online mental health wellness platform featuring support services and an easily navigable homepage. The core offering is a 120-question Mental Health Assessment covering 12 prevalent disorders, including an option for users to input EEG data. The assessment provides graphical results and EEG analysis, showcasing brain wave variations. For identified disorders, the platform generates a downloadable report with cause, cure, and prescription information. Users receive personalised wellness plans based on their mental health, incorporating exercise, music, meditation, diet, and lifestyle modifications. A virtual therapy system featuring speech-to-text, emotion recognition, and one-on-one support is also included on the platform. Cognitive monitoring features visualise self-awareness through sentiment analysis, sleep analysis, stress analysis, mood tracking, and a thought journal for daily reflections. By integrating technology with individual assistance, this platform provides accessible solutions for mental health and wellness. Our objective is to use innovative technologies, like Generative AI, Machine Learning and Data Science to address severe mental health issues by integrating them into people's everyday lives in an effortless manner.

KEYWORDS - *Artificial Intelligence, Generative AI, Machine Learning, Data Visualization, Natural Language Processing, Mental Health Services, Mental Health Assessment, Self-Wellness Monitoring, Emotion Detection Technology, Mental Disorders, Stigma, Virtual Therapy, Report, EEG, Sentiment Analysis, GPT-3.5 Turbo Instruct, Catboost Classifier.*

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I. INTRODUCTION

Background and Context:

In the dynamic sphere of global health, mental well-being has risen to a crucial position, underscored by its integration into the Sustainable Development Goals. The World Health Organization (WHO) highlights the significant effect of mental disease, estimating that one in every four people globally may face mental health issues during their lifetime. This issue becomes particularly urgent in India, a nation with a diverse demographic and a substantial mental health burden. Mental disorders extend throughout various age groups, socioeconomic backgrounds, and geographical regions, affecting individuals from all walks of life.

Seeking psychiatric assistance should be as fundamental as routine physical health check-ups; however, the country's mental health infrastructure is ill-equipped to meet the needs of its populace. The financial burden associated with mental health issues compounds the problem, leading to increased healthcare expenditures for diagnosis, treatment, and therapy.

Beyond the economic implications, the social aspects of mental health issues in India are profound. Stigma and discrimination persist, acting as obstacles for individuals seeking timely assistance. This stigma creates barriers, with only 41% of Indian youth expressing comfort with seeking mental health support, compared to an international average of 83%. Despite the minimal mental health education initiatives, numerous people still hold misconceptions about mental illnesses. There remains an inconsistent, contradictory understanding between different age groups in society about the true nature and causes of mental illness. Additionally, cultural beliefs may stereotype mental illness, discourage open discussions, and promote harmful practices or ineffective remedies.

The National Mental Health Survey (NMHS) report emphasises on m-Health and e-Health initiatives to strengthen mental healthcare services, which is the need of the hour. These technological advancements can play an important role in bridging existing gaps in mental health care delivery, providing thorough and easily accessible support. The consequences of the current challenges include delayed diagnosis and treatment, continuing a cycle of suffering and increasing the long-term impact.

1.1 Problem Statement:

Effectively addressing mental health challenges is important not only for individual well-being but also for the overall progress and development of the nation. Significant barriers exist around accessibility, affordability, and social stigma surrounding quality care. High out-of-pocket expenses within the fragmented healthcare system worsen financial hardship for sufferers. Broadly, ongoing support is crucial but lacking. Current healthcare fails to provide evidence-based coping strategies, or lifestyle advice modified to needs and symptoms outside clinical settings.

Our challenge lies in the development of an adaptive and user-friendly online platform or software that not only bridges these existing gaps but also serves as a complete solution for mental health wellness. This platform will serve as a lighthouse of support, deeply understanding users' feelings without judgement, and providing 24/7 assistance. An AI-based virtual therapist, engaging users in activities and meaningful conversations. Personalised care plans that promote early interventions and positive outcomes.

There is a national need for innovative mechanisms that prioritise overall mental wellness. The goal is creating systems enabling healthy, empowered lives without barriers or judgement. The time for change is now.

1.2 Objectives:

- Develop an adaptive online platform providing multilingual support for diverse mental health needs. Implement a continuous assistance system enabling users to access resources 24/7, addressing immediate help requirements during moments of distress effectively.
- Design engaging in-app features such as tracking tools, and activities to promote ongoing self-monitoring and encourage positive health behaviours.
- Use data analytics and machine learning techniques to analyse user interactions and preferences within the platform, enabling personalised recommendations, early detection of mental health issues, and continuous improvement of service delivery.

II. METHODOLOGY

This virtual mental health wellness platform is your one-stop solution for addressing all your mental health-related concerns. It offers a range of services, from diagnosing mental illnesses and providing professional aid to offering mental wellness suggestions, interactive therapy sessions, and self-help tools. With its all-rounder approach, this platform provides everything individuals need to manage their mental health effectively. [4]

2.1 Personalization and Assessment:

To begin using our services, users are directed from the homepage to a personalised input page where they are asked to provide their personal information, including name, age, gender, and medical history. Based on the user's personal details, they will undergo a mental disorder assessment. The number of disorders identified determines the extent of questions in the assessment.

2.2 Questionnaire Development: The assessment questionnaire was carefully designed after conducting a complete literature review of standardised psychological tests and scales, consulting peer-reviewed research publications, diagnostic manuals, and evidence-based practices to identify the most widely recognized and validated assessment tools for mental health disorders.

2.3 Disorder Selection and Questionnaire Structure: Based on the analysis of data and prevalence rates in India, the twelve most common mental disorders were identified for inclusion in the assessment, over a wide range of conditions, including:
Source: mental disorders across the states of India

S.No	Mental Health Disorder	Description
1	Depressive disorders	Characterised by persistent feelings of sadness and loss of interest in activities.
2	Major depressive disorder	A mood disorder marked by persistent feelings of sadness, hopelessness, and loss of interest.
3	Dysthymia	A chronic form of depression characterised by a persistent low mood.
4	Anxiety disorders	Involve excessive worry, fear, or nervousness that can interfere with daily life.
5	Schizophrenia	A severe mental disorder characterised by disturbances in thoughts, perceptions, emotions, and behaviour.
6	Bipolar disorder	Involves alternating episodes of mania or hypomania and depression.
7	Conduct disorder	Behavioural disorder in children and adolescents characterised by repetitive patterns of behaviour that violate societal norms.
8	Autism spectrum disorders	Developmental disorders characterised by difficulties in social interaction, communication, and repetitive behaviours.
9	Eating disorders	Conditions involving disturbances in eating behaviours and body image.
10	Anorexia nervosa	Eating disorder characterised by an intense fear of gaining weight and self-imposed starvation.
11	Bulimia nervosa	Eating disorder characterised by recurrent episodes of binge eating followed by purging behaviours.
12	Attention-deficit hyperactivity disorder (ADHD)	Neurodevelopmental disorder characterised by symptoms of inattention, hyperactivity, and impulsivity.

Table 1: Most Common Mental Disorders in India with Description

A set of relevant questions was carefully picked from the standardised tests to build an in-depth questionnaire. The final questionnaire consists of 120 multiple-choice questions (MCQs), with each disorder represented by 10 questions designed to assess the presence and severity of symptoms associated with each condition, allowing the platform to generate a quantitative score for each condition.

2.4 Piloting and Refinement: The assessment questionnaire went through a test phase with a diverse group of participants to check its validity and appropriateness. Participants were asked to complete the questionnaire and provide feedback on the questions' clarity, the content's relevance, and the overall user experience. The results of the study allowed for iterative improvements to address any issues or concerns that were found.

These 120 multiple choice questions have 4 response options "Rarely or never", "Occasionally", "Frequently", "Almost all the time". Based on diagnostic criteria, each response is assigned a numerical score value. The platform analyses the user's responses to calculate total scores for each of the 12 mental health disorders evaluated in the assessment.

The output displays the disorder with the highest total score, showing the main area of concern for the user. An interactive bar chart is used as another visual representation of this top scoring illness. Based on the user's responses, the severity score for each condition is represented by the height of each bar.

2.5 Machine Learning Model: Users can submit their EEG brainwave readings, if accessible, in the hardware area as well. By using electrodes on the scalp to monitor electrical activity, an EEG test can identify abnormalities in the brain. A professional analyses and interprets the signals. To visualise and forecast mental illness, the data is converted into numerical EEG readings.[7] Neurophysiological data can be analysed, explored, and visualised using the MNE-Python library.
The EEG data entered is used as input. This brain activity data is analysed by a machine learning model to predict mental illnesses based on neurological patterns. The model detects abnormalities compared to normal brain readings. We can have a better understanding of the prevalence and consequences of mental disorders by utilising the data visualisation, which provides insightful information about the facts surrounding these conditions. It consists of:

- A wave-format comparison of brainwave patterns, including - Delta waves, Theta waves, Alpha waves, Beta waves, and Gamma waves.
- A bar or intensity chart showing the statistical range of different brain waves.
- 3D, dynamic, and animated data visualisations to improve the tracking of outcomes that result from data analysis for better understanding.
- Brain mapping from EEG activity, brainwave modelling, and graphic depictions of brain topology and heat maps of individuals with various mental diseases.

The goal is to improve diagnostic accuracy with data-driven insights.

Table 2: Algorithms used for Training EEG Dataset

S.NO	Algorithm	Accuracy
1	LGBM Classifier	73.26%
2	XGBoost Classifier	84.59%
3	Hist Gradient Boosting Classifier	63.69%
4	**CatBoostClassifier**	**86.53%**
5	Random Forest Classifier	67.45%
6	Decision Tree Classifier	59.16%
7	LSTM Classifier	68.89%
8	K Neighbors Classifier	33.63%
9	SVC (Poly Kernel)	54.15%
10	SVC (Linear kernel)	48.94%
11	ElasticNet	66.47%
12	GaussianNB Classifier	44.86%

Report Generation:

The platform generates a report that combines the results of the mental health assessment, including specific treatment recommendations, assistance, and visualisations based on each user's unique profile. The report comprises several key sections to offer an understanding of the user's mental health status and suggested interventions. Firstly, the assessment summary presents an overview of the results, highlighting identified disorders and their severity levels based on scoring algorithms and diagnostic thresholds. Graphical representations, such as bar charts, are incorporated to visually communicate the user's mental health profile.

For users identified with mental health disorders, the report offers personalised treatment recommendations customized to their specific conditions. These recommendations encompass both pharmacological and non-pharmacological interventions, including suggested medications, psychotherapy modalities, and lifestyle changes. The report also provides information on the causes and potential cures for the identified disorders based on scientific understanding and clinical guidelines. If the user opts for optional EEG input, the report includes a section dedicated to visually representing the brain's electrical activity patterns. This may involve topographical maps, waveform plots, or other visualisations that compare the user's brain activity with normative data or known patterns associated with specific mental disorders. The report also displays the same bar chart representation of identified disorders, if any, alongside the EEG visualisations. In cases where no disorders are detected, the report includes a complimentary message acknowledging the user's positive mental health status and encourages them to maintain their well-being. The generated report can be downloaded in a user-friendly format, such as a PDF file, providing easy access and portability. Users can also choose to download only the prescription portion of the report, if desired.

Wellness Plan Generation:
The personalised wellness plan, delivers guidance for individuals eager to enhance their mental well-being.[5] This innovative tool crafts customised plans based on daily, weekly, or monthly preferences, providing hourly recommendations for daily users and daily guidance for those opting for a weekly approach.
Generative AI and Prompt Engineering: The study explores the use of generative AI techniques, particularly the GPT-3.5 Turbo Instruct model, accessed via an OpenAI API key. These models generate human-like text based on user prompts, with prompts crucial in guiding the AI to produce targeted output. Prompt engineering techniques such as iterative testing and refinement were used to optimise prompts for the mental health platform features. For example, prompts were designed to request personalised wellness plan content according to user interests, while elicited text for therapy dialogue and automated reporting.[6] This approach enhances the platform's effectiveness in delivering personalised support and guidance for mental well-being, highlighting the potential of generative AI in addressing individual needs in this domain.[5]

Virtual Therapy Platform:
The platform includes a virtual therapy system that combines an Emotional Intelligence Chatbot with an Emotion Detection model to engage in interactive and empathetic conversations with users, aiming to assess and support their mental health.

Emotional Intelligence Chatbot: The virtual therapy platform uses a Chatbot that is designed to ask users a set of verified questions related to their personal life, enabling the system to understand their mental health and emotional state. Users can communicate with the Chatbot through text-based chat or voice input, allowing for a flexible and accessible mode of engagement.

Emotion Detection Model: To enhance the empathetic capabilities of the virtual therapist, the platform includes an Emotion Detection model. By analysing the user's facial expressions, the Emotion Detection model can recognize and interpret emotional cues, enabling the Chatbot to respond with appropriate empathy and understanding. [4] Talking to an AI Chatbot can help users open up more than talking to a person. Users may feel less shy or embarrassed sharing personal details with a bot rather than a human therapist.

Speech-to-Text Conversion: For users who prefer to communicate through voice input, the platform employs speech-to-text conversion algorithms, such as the Google Text-to-Speech (gTTS) library, to transcribe the user's spoken words into textual form. This allows the system to process and understand the user's thoughts, regardless of the input modality.

Sentiment Analysis: The Chatbot uses natural language processing techniques, like the TextBlob library, to perform sentiment analysis on the user's textual inputs. [6] By analysing the semantic and contextual information within the user's statements, the system can identify the underlying sentiment, emotional tone, and intent behind the messages.

Dialogue Generation and Feedback: Combining the insights from the Emotion Detection model, sentiment analysis, and natural language processing, the Emotional Intelligence Chatbot generates contextually relevant and empathetic responses to the user's inputs. The system's responses are designed to mimic the conversational style and therapeutic techniques employed by human therapists, providing supportive feedback, guidance, and managing strategies.

Text-to-Speech Conversion: After generating the appropriate response, the Chatbot converts the textual output into speech using text-to-speech conversion algorithms, allowing users to receive auditory feedback and enhancing the conversational experience.

Emotion Synthesis: After a successful therapy session, the user receives an analysis of their emotional state, indicating the levels of happiness, sadness, and other emotions detected throughout the conversation. This analysis is derived by synthesising the information gathered from the user's facial expressions, speech, and textual inputs. [6]

Customised Advice: Based on the user's responses and the analysis of their emotional state, the Emotional Intelligence Chatbot provides tailored advice and suggestions for improving their mental well-being. The system is designed to give positive replies for positive emotions and constructive feedback for negative emotions, aiming to guide users towards a healthier mindset.

Cognitive Self-Monitoring Tools:

Our system integrates various components aimed at promoting mental wellness and self-monitoring. One key feature is a stress analysis module, where users respond to a series of questions to generate stress scores categorized into five levels: very low, low, moderate, high, and very high. Using machine learning models trained on data from wearable devices, such as modern smart watches, metrics like blood pressure, heart rate, sleep stages, respiration rate, body temperature, and body oxygen levels are tracked.

Our system includes a sleep analysis component, using machine learning models to assess sleep quality based on multiple factors including smoking habits, awakening times, hours slept, alcohol consumption, gender, REM sleep, deep sleep, light sleep, and exercise. A threshold value of 0.7 is set for sleep scores, with scores above this value triggering a display of motivational quotes, while scores below prompt recommendations for exercise and techniques to enhance sleep.

Table 3: Input types for Mood Tracking

Input	Type	Description
Primary Mood	Dropdown/Buttons	Selection of the main emotion for the day
Additional Emotions	Checkbox/Radio	Options for secondary emotions (optional)
Notes	Text Input	Space for users to add additional details or thoughts
Activities	Checkbox/List	Selection of activities influencing the mood
Goals	Checkbox/List	Indication of whether daily goals were achieved
Date and Time	Automatic	Record of when the mood entry was made
Weather	Dropdown/Icons	Selection of current weather conditions
Reminders	Checkbox/Time	Option to set reminders for mood tracking

III. RESULTS

The implementation of our mental health wellness platform has shown remarkable results, transforming the field of mental health support. We have developed an integrated approach to address mental health challenges and improve overall well-being through a systematic approach. [4]

The primary output of our platform lies in its ability to provide users with personalised insights into their mental health status. Through the ‘Mental Health Assessment’ module, users receive detailed reports highlighting the presence and severity of various mental disorders based on their responses to the 120-question assessment. Additionally, for users opting for EEG inputs, the platform offers a sophisticated analysis of brainwave patterns, providing further clarity on mental health conditions and comparing them with normative brain topologies.[7] Using machine learning algorithms, including CatBoost and XGBoost Classifiers, enhances the accuracy and reliability of these analyses.

The ‘Generated Reports’ serve as invaluable resources, providing users clear explanations of the causes, potential cures, and prescribed medications for identified mental health disorders. This encourages users to make informed decisions about their mental health care and seek appropriate treatment options.

Furthermore, the platform's 'Personalized Wellness Plan' feature has been instrumental in promoting proactive mental health management. Users can customise daily, weekly, or monthly wellness plans to fit their specific needs and preferences, giving them useful tools for improving their mental health. By including natural language processing techniques and GPT-3.5 Turbo Instruct for wellness plan generation, the platform ensures personalised and effective recommendations for each user.

Our platform's 'Virtual Therapy Platform' makes it a key component, providing users personalised and easily accessible therapy sessions. The platform engages users in meaningful conversations by using emotion detection and speech-to-text technologies. It provides users with empathetic support and expert guidance to address their mental health issues.

Additionally, the 'Self-Wellness Monitoring' features enable users to track various aspects of their mental health, including sleep patterns, stress levels, thought patterns, and mood fluctuations. By using wearable devices (smart watches) and machine learning models, such as those employed in sleep analysis and stress assessment, users receive actionable insights and early intervention opportunities, empowering them to actively manage their mental health on a daily basis. [1]

In conclusion, the results of our mental health wellness platform highlight visible outcomes such as personalised wellness plans, actionable insights, accessible therapy sessions, and self-monitoring tools. Together, these results make an impactful contribution to a transformative user experience, fostering empowerment, resilience, and overall mental well-being.

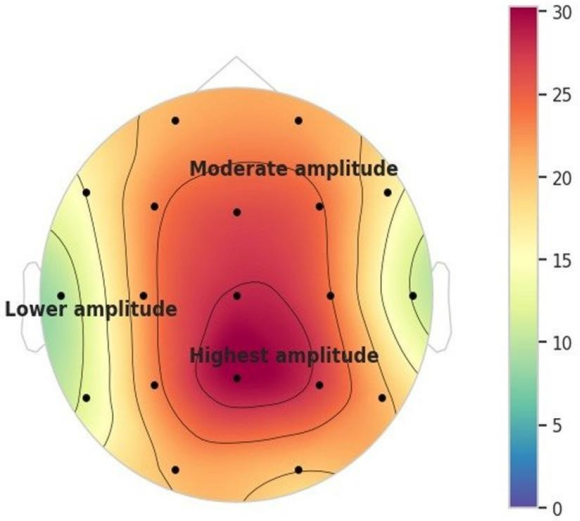

Fig 1: Visualisation of EEG brainwave topography showing illustrating the spatial distribution of neural behind activity associated with specific mental health therapy Disorders.

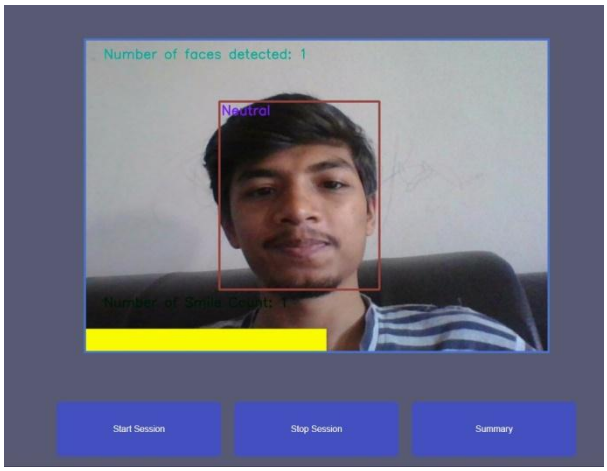

Fig 2: Sentiment analysis results the emotional tone and intent user interactions during virtual sessions.

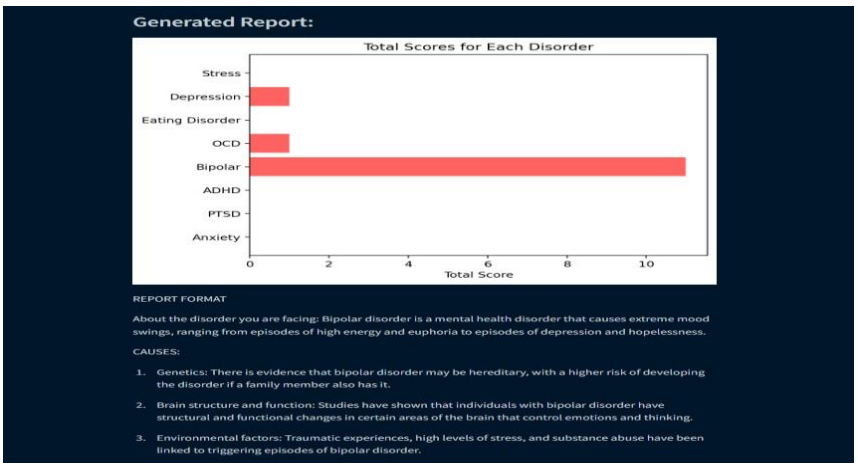

Fig 3: Example of a personalised report generated by the platform, showcasing various visualisations including a bar graph, summarising assessment results and treatment recommendations based on the user's mental health profile.

Day	Wake Up Time	Breakfast	Lunch	Dinner	Evening Activity	Before Bed
Monday	7:00 AM	Boiled eggs, whole grain bread, and orange juice	Grilled chicken, quinoa, and steamed vegetables	Vegetarian chili with brown rice and salad	Guided meditation or yoga	Chamomile tea and 15 minutes of reading
Tuesday	6:30 AM	Overnight oats with fruits and nuts	Grilled salmon, sweet potato, and green beans	Grilled tofu stir-fry with vegetables	30 minutes of light cardio workout	Warm shower and journaling
Wednesday	7:00 AM	Avocado toast with poached eggs	Turkey and cheese sandwich with fruit	Baked fish, roasted vegetables, and quinoa	30 minutes of outdoor walk	Herbal tea and 10 minutes of deep breathing exercises

Fig 4: Sample personalised wellness plan generated using generative AI, offering tailored recommendations for mental well-being activities.

IV. DISCUSSION

➢ The MentalEase highlights its innovative capacity to tackle significant gaps in the provision of mental health care. Our main findings highlight how well the platform works to give users personalised assessments, useful insights, and accessible support. Our platform ensures an interactive self-care culture by providing a complete approach to mental health assessment and support through cutting-edge technologies like Artificial Intelligence (AI) and EEG analysis.

➢ Our findings point to a shift in the direction of personalised care models and highlight the significance of customised therapy for the management of mental health. The platform's focus on early detection and ongoing self-monitoring is in line with new developments in safeguarding mental health care, which aim at reducing the long-term effects of mental health disorders and enhance general wellbeing.

➢ The implications of our findings extend beyond individual users, encompassing broader impact for mental health equal opportunity and access. By overcoming barriers to mental health care and empowering users to take an active role in their well-being, our platform contributes to a more in-depth approach to mental health care delivery.

➢ However, limitations exist, particularly concerning the scope of our platform's assessment capabilities and the generalizability of our findings across diverse populations. Further studies or analyses are recommended to explore the long-term effectiveness of the platform, its impact on reducing stigma surrounding mental illness, and its scalability in different cultural contexts. These recommendations pave the way for future research endeavours aimed at advancing mental health equity and accessibility through technology-driven solutions.

V. CONCLUSION

➢ In conclusion, this study aims to tackle the complex issues facing mental health services in India through the use of innovative technologies in a unique manner. The problem statement clarifies the ongoing obstacles to receiving high-quality mental health care, which include stigma, resource constraints, and gaps in system integration. Our study suggests an all-inclusive online mental health wellness platform that can be customised to meet the requirements of a wide range of users by using artificial intelligence and data-driven techniques, such as machine learning algorithms for mental disorder prediction and advanced data visualisation for result interpretation.

➢ The findings of our research highlight the possibility of change of the proposed platform in encouraging early detection, personalised support, and continuous monitoring of mental health conditions. By integrating features like cognitive monitoring tools, virtual therapy sessions, personalised wellness plans, and the Mental Health Assessment, the platform offers comprehensive support to enhance mental well-being. The Catboost Classifier results in the platform's efficacy in providing accurate diagnostics and targeted treatments.

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