International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 12 Issue: 02 | Feb 2025 www.irjet.net p-ISSN: 2395-0072

Machine Learning in Mental Health: A Web Application for Personalized Assessment and Care

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Abstract - *Mental illnesses, such as anxiety, depression, and stress, are of significant concern all over the world. This study serves an advanced online system called "Mental Health Analysis Using Machine Learning, which predicts mental health conditions by structured questionnaires and machine learning techniques. It makes use of the algorithms of Decision Trees as well as NLP in order to analyze the user inputs and provide suitable personal feedback while also suggesting professional consultation. Predictive analytics, a recommendation engine, progressive tracking, and real-time monitoring of mood would be the system's key features. All information regarding users is encrypted and properly stored for complete data security and privacy. Currently, no one has created anything like Wysa or Woebot. Such a system provides long-term tracking, real-time insights, and personalized recommendations-bridging gaps between self-assessment tools and professional mental health support. Developed using Python, ReactJS, TensorFlow, and MySQL/PostgreSQL, the platform uses Decision Tree algorithms for prediction, collaborative filtering for recommendations, and linear regression for tracking progress. The system is designed to be scalable, user-friendly, and secure. These would include accurate psychometric assessments, early detection of mental health problems, customized recommendations, long-term progress tracking, and professional integration. Other features like gamification and reminders keep the user more engaged and hold onto the user, making this system a full-fledged, accessible mental health support solution.*

Key Words: **User Progress Tracking**, **Professional Consultation Integration**, **Recommendation System, Decision Tree Algorithm, Natural Language Processing (NLP)**.

1. INTRODUCTION

Mental health is an important component of well-being, influencing emotions, cognitive functions, and social interactions. Anxiety, depression, and stress are some of the mental illnesses that have severe effects on individuals and society as a whole, making it essential to develop new methods for early detection and intervention. Traditional diagnosis of mental health depends mainly on self-reported assessments using structured questionnaires, which may be subjective and prone to inconsistencies [1]. Advances in technology have brought forward powerful tools to analyze complex mental health data that are now able to identify cases in early stages and tailor treatments based on patients, which results in better outcomes for the patients. ML techniques like NLP, Decision Trees, and Neural Networks can be applied to a massive amount of data coming from diverse sources like self-reported surveys, wearable devices, and online interactions to look for patterns related to mental health. These techniques enable researchers and health providers to automate assessments, provide real-time insights, and deliver tailored interventions to people in need [2].

Mental health issues had been part of human life for thousands of years, even with some historical references that go as far back as the 5th century BC. But in the contemporary world, mental health disorders are now widespread with millions affected globally. Statistics from the Indian government reveal that approximately 130 million people may be suffering from some form of mental illness. Despite these alarming statistics, mental health remains a taboo subject, preventing people from seeking timely medical intervention. According to research, only 8–10% of the affected population receives proper treatment, while the majority remain undiagnosed and untreated. This lack of awareness and support has led to an increase in suicide rates and increased psychological distress among all sections of society. Primarily, underdeveloped mental health care in India along with other issues such as scarce funding and a lack of mental health professionals is contributing to this crisis. Data by the World Health Organization stipulates that India has only 0.75 psychologists and psychiatrists per 100,000 people whilst countries like Argentina have 106 psychologists per 100,000 people. Another economic constraint prevents millions from accessing mental health care services. A huge portion of the population in India resides below the poverty line and thus does not even have the means to fulfill simple needs like food, shelter, and medical attention, let alone mental health services. Even if they can afford health care, the cost of psychiatric treatment remains a huge challenge. Amongst the most prevalent mental health conditions are depression, anxiety, PTSD, and insomnia. Depression breaks a person's emotions and renders them into constant sadness and despair, while anxiety is described by excessive worrying and nervousness often accompanied by symptoms such as tachycardia and difficulty in breathing. PTSD occurs because of the effects of trauma resulting in

emotional upset and problems of recovery. One of the sleep disorders most encountered is insomnia where people fail to get the amount of rest that they require in order to better their mental disorder.

To diagnose these conditions, mental health professionals often rely on questionnaire-based assessments that evaluate patients based on situational and objective questions. However, with the rapid advancement of artificial intelligence (AI) and machine learning (ML), automated mental health prediction systems can play a transformative role in early detection and intervention. This study explores the potential of machine learning algorithms to analyze mental health data, predict various psychological disorders, and offer data-driven insights for improved healthcare decision-making [5].

2. LITERATURE REVIEW

Chung and Teo. [1], conducted a systematic review of the application of the use of the ML techniques in predicting mental health problems like schizophrenia, depression, bipolar disorder, PTSD, and children's mental health issues. The authors divided the different categories of ML approaches, including supervised learning, ensemble methods, and deep learning, analyzing their performance across 30 research articles.

Konda Vaishnavi et al. [2], proposed a predictive model based on machine learning to detect mental issues. In this paper, five machine learning techniques, namely, Logistic Regression, K-Nearest Neighbor, Decision Tree, Random Forest, and Stacking, were used. The study concluded that Stacking was the best one of them and produced an accuracy of 81.75%. It was also explained by the authors that feature selection was required as well as ROC curve analysis while testing the performance of models. This study, therefore, calls for a much larger dataset for more accurate prediction and enlarges the scope of the space for more robust applications in diagnosing mental disorders.

Roger Garriga et al. [3], proposed a machine learning model using EHRs to predict mental health crises in the following 28 days: using XGBoost, the AUROC yielded a value of 0.797 and proved clinically useful in a 6-month pilot, thereby contributing to help clinicians manage their caseload and prevent crises in 64% of cases. The research demonstrated challenges in data availability, and continued prediction was advocated as an important component in optimizing mental health healthcare resources, and also changing from a reactive to a preventative approach.

Renugadevi R et al. [4], proposed a predictive model for workplace mental health issues in the workforce using machine learning. With a range of algorithms including Decision Trees, Random Forests, Logistic Regression, and Adaboost the model could be made up to 92.14% accurate, however, the best performance was by Adaboost. It highlighted that the data needs to be preprocessed and there are issues like privacy of data. This pointed out all those possible areas of intervention where the model might be able to intervene at an early stage in improving mental health support and reducing the cost of health care while addressing concerns involving data integrity and the prevention of bias.

Satvik Gurjar et al. [5], presented the machine learning model to predict mental health-related problems like depression, anxiety, PTSD, and insomnia. A survey based on the self-reported data was carried out by gathering data from diverse demographics. The algorithms used here were Random Forest, SVM, Logistic Regression, and Naive Bayes, which had high accuracy in the prediction of anxiety at up to 97.27%. The system integrates into a web application to predict the severity of mental health conditions and gives results based on the input from users. The study was able to learn the lessons for overcoming the mental health epidemic-such as improving mental health consciousness, availability of data, and a shift from reactive care toward prevention.

Ashley E. Tate et al. [6], developed machine learning models to predict mental health issues in adolescents using data from 7,638 twins in Sweden. Using 474 predictors from parental reports and registry data, models such as Random Forest, SVM, XGBoost, and Neural Networks achieved AUC values of up to 0.739, with Random Forest performing slightly better. The study highlighted variables like impulsivity, neighbourhood quality, and parental mental health as important predictors. While the models showed potential, they were not clinically reliable, emphasizing the need for further refinement and the potential utility of simpler logistic regression techniques for similar datasets. The research underscored the importance of early prediction to improve mental health interventions and outcomes.

Anna van Oosterzee. [7], reviewed the applications of supervised machine learning models for mental health diagnosis-auxiliary applications for the purpose of criticizing reliance upon DSM classifications. She argued that these models inherit the validity problems of DSM's heterogeneous and low predictive categories to make them powerless in improving patient outcomes. Though models may achieve a high level of accuracy, this measure is deceptive as it does not translate to genuine clinical utility. Van Oosterzee also suggested directing the focus towards the models that can enhance prognosis, treatment selection, and prevention instead of towards such an application. The application itself can further aid in providing personalized treatment strategies instead of using ground truth data based on DSM.

Miryam Elizabeth Villa-Pérez et al. [8], developed machine learning models for the analysis of English and Spanish Twitter datasets for the detection of nine mental health conditions, including ADHD, anxiety, and depression. With the use of n-grams, q-grams, POS tags, topic modeling, LIWC, and word embeddings, the binary classification achieved AUC scores of 0.846 (English) and 0.835 (Spanish). For multiclass classification, AUC scores were 0.697 (English) and 0.712 (Spanish). The XGBoost and CNN models were the best performing models. Overall, this research pointed out challenges like overbalanced datasets while emphasizing the potential for using data from social media to allow for the possibility of early detection, hence helping shift mental health care from reactive toward more preventative approaches.

3. PROPOSED SYSTEM

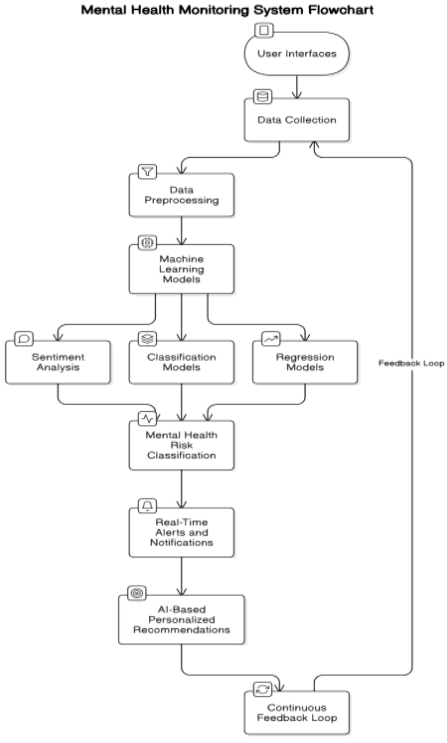

Fig 1. Proposed system architecture

Mental health became a critical issue that needed to be problematized regarding this global challenge, as at the same time, many are finding refuge in dealing and helping to cope with emotional wellbeing. This technology advanced digital solutions, such as mental health application, opened windows towards accessible and scalable methods for addressing difficulties.

Fig.1 describes the architecture framework for a mental health application meant to promote users to maximize their levels of well-being based on personalized recommendations and professional advice plus analytics meant to be predictive in nature. The proposed application architecture should define the layers that ensure the functional, secure, as well as scalable nature of the system and implementing the user privacy in ethical considerations.

The five layers constituted in the proposal include the User Interface Layer, the Application Logic Layer, the Data Management Layer, the Integration Layer, and the Security Layer. Each layer is designed with particular components working in tandem with one another towards delivering a smooth yet impactful user experience. It is a system based on modern technologies such as NLP, ML, and secure management of a database, handling the complex needs of a mental health management system with integrity and trust in data.

The rest of the sections outline architecture, starting from the base User Interface Layer, and progressing to sophisticated logic, data, integration, and security mechanisms.

1. User Interface Layer

The UI Layer, the front-end layer of an application, lets the users of the system have a direct relationship with the application. The primary elements are comprised of the following major components.

Profile & Progress Dashboard: The user interface, therefore, brings in a particular view related to the trend in mood, a progress report, and activity log, thus making the users know about their time scale mental condition.

Main Research Focus: Concentrated on UX design, data visualization techniques, and accessibility features of intuitiveness and inclusiveness.

Questionnaire Module: It acquires user input through a set of questions or assessments of mental health conditions.

Main Research Focus: Adaptive questionnaire design, integration of psychometric models, and real-time validation of enhancements in the accuracy and responsiveness of assessments.

User Authentication: Ensures secure access to the application by giving personalized experiences for each of the users.

The focus of the study is implementation of secure authentication methods such as biometric login and two-factor authentications and efficient session management.

2. Application Logic Layer

The Application Logic Layer serves as the actual core of the system where data processing and functionalities occur. It comprises:

Happiness Meter: This feature is responsible for calculating user happiness based on input data from the Questionnaire Module and other features.

Research Focus: Here, a focus is given to development of algorithms related to sentiment analysis, wearable integration, and other real-time feedback mechanisms.
Recommendations Engine: Displays personalized recommendations made based on the assessment of the user's mental health conditions.
Research Focus: Machine learning models for personalization, collaborative filtering techniques, and ethical considerations in recommendation systems.
Predictive Analytics Module: This module analyzes data to predict the potential risks of mental health or emerging trends.
Research Focus: Predictive modeling, time-series analysis, and anomaly detection for proactive mental health management.

3. Data Management Layer

This layer is involved in the storage, processing, and analysis of large volumes of data. The key components are:
NLP Module: This help analyze user-generated text to sense emotions, stress, and anxiety.
Research Focus: Training NLP models, managing multilingual inputs, and improving model accuracy for mental health applications.
Database Management: This deals with both structured and unstructured data and has good scalability and security features.
Research Focus: Database architecture design, data normalization, and compliance with data protection regulations such as HIPAA and GDPR.

4. Integration Layer

The integration layer facilitates collaborations with external and extends the system's functionalities. It includes
Professional Consultation Module: This will link users with professional certified mental health professionals.
Research Focus: Telemedicine platforms, WebRTC-based real-time communication protocols.

5. Security Layer

E The safety and privacy of a user's information are important. The Security Layer focuses on
Data Encryption & Privacy: Protects sensitive user data during storage and transmission through advanced encryption methods.
Research Focus: Studying the security of robust encryption techniques like AES and RSA, which will secure user data from breaches and unauthorized access.

4. METHODOLOGY

The mental health application makes use of the modular architecture, advanced machine learning algorithms, NLP, secure data management techniques to provide personalized and secure user experience. The system is designed into multiple modules: Profile and Progress Tracking, Mental Health Recommendations, Predictive Analytics, Natural Language Processing for Emotional Analysis, and Professional Consultation Integration. These modules work together seamlessly to provide total mental health management.

4.1 PROFILE & PROGRESS DASHBOARD MODULE

Data Collection: Users are queried on a daily basis with questionnaires, self-reporting of emotions, and, if available, wearable technology integration to enhance data accuracy and depth.

Preprocessing: Collected data is standardized and normalized for uniform analysis and visualization. For instance, timestamps are transformed into a common format for aligning with the generation and comparison of trends.

Model Training: The preprocessed data is fed into machine learning models like Random Forest and Support Vector Machines (SVM) to learn patterns in mood trends, user activities, and emotional states.

Visualization: Interactive charts, graphs, and dashboards are used to represent mood fluctuations over time, completed activities, and progress toward mental wellness goals.

User Feedback Loop: Users can adjust their preferences and confirm the correctness of trends visualized. This user feedback is recorded to further improve the visualization cycle and maintain a proper standard of overall satisfaction with insightfulness.

4.2 HAPPINESS METER MODULE

Sentiment Analysis: Summarizes the text inputs, questionnaires, and other user interactions. NLP models extract sentiment from text, highlighting states of emotion.
Algorithm Design: Using weighted averages of sentiment scores, questionnaire responses, and other metrics to deliver a "happiness index."

Visualization: Presentation as a simple, intuitive meter, providing actionable insights for improvement.
Research Focus: Improves sentiment analysis models through continuous revision based on user feedback for accuracy.

4.3 RECOMMENDATIONS ENGINE MODULE

Data Input: It integrates data from Happiness Meter, mood trends, and questionnaires to provide personalized recommendations.
Recommendation Generation: It combines collaborative filtering and content-based filtering algorithms to produce an individual-specific model of recommendations. This user may require mindfulness practices or exercise and sport-related resources or professional help.
Feedback Loop: The user's ratings on the suggestions develop feedback for future interactions by improving the algorithm used in suggestion.
Tools Used: Python libraries Scikit-learn and TensorFlow are primarily developed using and fine-tuned to build models of recommendation.

4.4 PREDICTIVE ANALYTICS MODULE

Data Collection: The module performs analysis on the historical data consisting of users' responses, emotional trends, and behavioral patterns.
Model Training: The system can train LSTM (Long Short-Term Memory networks) or even ARIMA (AutoRegressive Integrated Moving Average) as the time-series models in order to predict the potential risks towards the mental health risks or future emotional states.
Risk Detection: It alerts the user depending on the prediction, identifying their risks based on predictions and suggesting measures of prevention.
Feedback and Validation: It provides input from users and experts to continuously validate the predictions of the model.

4.5 NLP MODULE FOR EMOTIONAL ANALYSIS

Input Parsing: This module reads through text inputs from the users based on journals or a chatbot interaction to determine emotional states.
Sentiment Classification: In this stage, it utilizes pre-trained models from NLP, such as BERT or GPT, to classify the text inputs in categories of happiness, stress, or anxiety.
Custom Training: Trains NLP models on anonymised datasets to enhance performance for specific mental health language.
Output: Offer detailed emotional insights, and these are passed onto the other modules such as Happiness Meter and Recommendations Engine.

4.6 PROFESSIONAL CONSULTATION MODULE

User Matching: This module matches the users with licensed mental health professionals from the appropriate regions and according to need, preference, and location.
It has a calendar system for users and professionals to schedule sessions easily.

4.7 SECURITY MODULE

Data Encryption: AES-256 encryption and SSL/TLS are also implemented for secure data storage and data in motion.
Privacy preservation techniques like differential privacy and federated learning are used to protect the information of users.
Compliance: Adhere to global data protection laws, which encompass HIPAA, GDPR, and other local privacy laws.
Authentication: Multi-factor authentication for log-in, that itself puts in an extra layer of security for the user.

5. EXPERIMENTAL RESULT

The mental health analysis system is designed to provide accurate insights across all its modules, ensuring user satisfaction through ease of use and effectiveness. It uses machine learning models such as Random Forest and Support Vector Machines (SVM) to identify mood patterns, detect emotional trends, and offer personalized recommendations. It will improve self-awareness and mental well-being because the system gives users actionable insights based on their daily responses and behavioral data. Interactive visualizations will enhance user engagement, making mental health tracking more intuitive and insightful with an adaptive feedback mechanism, the system can refine its analysis over time, increasing the accuracy of mood predictions and enhancing recommendation quality. This personalized approach is likely to contribute to improved mental health outcomes, including reduced stress levels, better emotional regulation, and higher overall happiness. The system is designed to be scalable, so more data sources, such as wearable devices and external mental health assessments, can be integrated to make the analysis more comprehensive. It is also projected to be cost-effective, making it a valuable tool for individuals, therapists, and mental health professionals without requiring expensive resources. Overall, these results suggest that the system has the potential to enhance mental health awareness, improve well-being, and provide an accessible AI-driven approach to mental health management.

6. CONCLUSION

In this paper we introduced mental health analysis application to improve mental health care with the help of advanced technologies. Modules of emotional tracking, personalized recommendations, predictive analytics, and professional consultation integrate in the technology to provide holistic and efficient management of mental health.

Its higher accuracy with results, user satisfaction, and cost-effectiveness makes it practical and scalable among diverse user groups. Mental well-being improvement is supported through the ability of the application in order to decrease management time, improve wellness plans adherence, and

boost self-awareness. Therefore, it is an innovative solution that is a giant leap towards the facilitation of making mental health support accessible, personalized, and effective for the users.

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