OPTIMIZING MENTAL HEALTH CARE WITH ADVANCED PREDICTIVE TECHNIQUES

[1]I. Divya [2]N. Kumar[3]J.Vishnu Priya[4]G.Madhuri [5]Y. Madhu Sri[6]G.Srinidhi[7]J. Hima Jyothika

[12]Assistant Professor Department of ECE

[34567]UG Scholor, Department of ECE

Narayana Engineering College, Nellore,524004, Andhra Pradesh, India

Abstract: *Mental health disorders such as Schizophrenia, Bipolar Disorder, and Obsessive-Compulsive Disorder (OCD) are challenging to diagnose, often requiring early detection for effective treatment. Traditional diagnosis relies on subjective assessments by healthcare professionals, which can lead to delays or errors. This project develops an automated system using machine learning algorithms—Random Forest, Decision Tree, Logistic Regression, and AdaBoost—to predict the likelihood of these disorders based on patient-reported symptoms like mood swings, hallucinations, and compulsive behaviors. The system processes patient data and achieves high accuracy, with Random Forest and Decision Tree models reaching 99% accuracy in predicting these conditions. The system offers a faster, more reliable way to detect mental health disorders, helping clinicians make data-driven decisions. By integrating machine learning, the system provides real-time predictions, reducing the reliance on manual assessments. The system remains effective for diagnosing Schizophrenia, Bipolar Disorder, and OCD. This approach shows the potential of artificial intelligence to improve mental health diagnosis and support clinicians in identifying conditions early.*

I. INTRODUCTION

This project focuses on developing an automated system for the early detection of mental health disorders such as Schizophrenia, Bipolar Disorder, and Obsessive-Compulsive Disorder (OCD) using advanced machine learning algorithms, including Random Forest, Decision Tree, Logistic Regression, and AdaBoost. Traditional diagnostic methods often rely on subjective assessments, which can lead to delays or inaccuracies in identifying these conditions. By analyzing patient-reported symptoms like mood swings, hallucinations, and compulsive behaviors, the system processes data to achieve high accuracy, with Random Forest and Decision Tree models reaching 99% accuracy. This AI-driven approach offers a faster, more reliable, and data-driven tool for clinicians, enabling real-time predictions that support early diagnosis and improve mental health outcomes.

II. FUNCTIONAL OVERVIEW

This automated mental health diagnostic system is designed to accurately identify disorders such as Schizophrenia, Bipolar Disorder, and Obsessive-Compulsive Disorder (OCD) by analyzing patient-reported symptoms like mood swings, hallucinations, and compulsive behaviors. The system starts by collecting detailed patient data through an intuitive interface, ensuring easy and accurate symptom reporting. This raw data undergoes thorough preprocessing to handle missing values, outliers, and inconsistencies, preparing it for effective analysis.

Once the data is cleaned, it is processed using advanced machine learning algorithms, including Random Forest, Decision Tree, Logistic Regression, and AdaBoost. Each algorithm is trained on large datasets of historical patient information to recognize complex patterns and correlations associated with the targeted mental health conditions. The models evaluate the input data against learned patterns to predict the likelihood of each disorder, offering real-time diagnostic insights with high accuracy.

The system provides comprehensive output, including diagnostic predictions and confidence scores, which assist clinicians in making informed, data-driven decisions. Random Forest and Decision Tree models have demonstrated exceptional performance, achieving up to 99% accuracy in predicting these conditions. Moreover, the system is designed to evolve continuously by integrating new data for model retraining, ensuring sustained accuracy and relevance in clinical practice. This AI-driven approach not only enhances the speed and reliability of mental health diagnoses but also supports early intervention, enabling better management of mental health disorders and improving patient outcomes.

III. EXISTINGWORK

The detection and prediction of psychological diseases have long been a significant challenge in mental health care. Traditional diagnostic methods for disorders such as schizophrenia, bipolar disorder, and obsessive-compulsive disorder (OCD) have primarily relied on clinical observations, patient history, and basic diagnostic tools. These conventional approaches often lead to delayed diagnoses, inaccurate results, and limited opportunities for early intervention. For schizophrenia, early diagnostic systems depended heavily on clinical observations and basic tools, lacking the precision required for accurate identification. Attempts to incorporate imaging data, like structural or functional MRI, were restricted by single-modality data analysis, which hindered the ability to provide a comprehensive understanding of the condition. Similarly, the detection of bipolar disorder relied on clinical interviews and subjective patient history, often resulting in misdiagnoses and missed chances for early intervention.

In the case of OCD, existing diagnostic systems primarily depended on questionnaire-based assessments and clinical observations, which were both time-consuming and prone to subjectivity, leading to inconsistent or inaccurate diagnoses. Although machine learning techniques like Support Vector Machines (SVM) were introduced in earlier systems, challenges such as overfitting and the need for extensive manual feature selection limited their effectiveness. These limitations contributed to the inefficiency and lack of robustness in existing diagnostic tools. Overall, the reliance on manual methods, subjective assessments, single-modality data analysis, and basic machine learning techniques underscore the need for more advanced, integrated, and automated solutions. Such systems would offer more accurate, timely, and personalized diagnoses, significantly improving mental health care outcomes.

Disadvantages:

1. **Delayed and Inaccurate Diagnoses**: Traditional diagnostic methods, such as clinical observations and basic diagnostic tools, often lead to delayed or inaccurate diagnoses. The reliance on subjective assessments can result in missed or incorrect diagnoses, preventing early intervention and optimal treatment.
2. **Limited Data Integration**: Earlier systems primarily used single-modality data analysis, such as relying on either structural or functional MRI data alone. This limited approach reduces the accuracy and reliability of the diagnosis, as it fails to integrate multiple data sources that could provide a more comprehensive understanding of the patient's condition.
3. **Subjectivity and Bias**: Traditional methods, including clinical interviews and patient history for detecting conditions like bipolar disorder and OCD, are highly subjective. The results can vary depending on the clinician's experience, biases, and the patient's ability to accurately describe their symptoms, leading to inconsistencies in diagnoses.

IV. PROPOSEDWORK

The proposed system for detecting mental health disorders involves a structured approach, starting with data collection. Key parameters are identified for each disorder: for schizophrenia, factors like age, sweating, trouble concentrating, trouble sleeping, and hallucinations are considered; for bipolar disorder, symptoms include suicidal thoughts, repeated thoughts, mood swings, irritability, and other mood-related issues; and for OCD, symptoms such as over-cleanliness, repetitive behaviors, and intrusive thoughts are tracked. Data can be gathered through patient surveys, interviews, clinical records, or publicly available mental health datasets. Once collected, the data undergoes preprocessing, including cleaning to handle missing values and outliers, normalization or standardization to ensure uniform feature scales, and categorical encoding to convert qualitative responses into numerical values. The dataset is then split into training (80%) and testing (20%) sets for model evaluation.

The core of the system involves applying machine learning algorithms—Random Forest, Decision Tree, Logistic Regression, and AdaBoost—to predict the likelihood of mental health disorders. Random Forest, an ensemble method, improves accuracy and reduces overfitting by combining multiple decision trees, while Decision Trees offer interpretability by splitting data based on feature values. Logistic Regression, suitable for binary classification, helps understand relationships between features and outcomes, and AdaBoost enhances performance by combining weak models into a strong one, though it has shown less effectiveness for OCD detection. During model training, hyperparameter tuning using Grid Search or Randomized Search optimizes model performance, while k-fold cross-validation ensures generalization to unseen data. Evaluation metrics like accuracy, precision, recall, F1-score, and AUC-ROC assess model effectiveness, with techniques like SMOTE addressing class imbalances. Once trained, the system predicts mental health disorders based on patient inputs, providing probability scores to support clinical decision-making.

Advantages:

1. **High Accuracy:** The system achieves up to 99% accuracy in detecting mental health disorders like Schizophrenia, Bipolar Disorder, and OCD using powerful algorithms like Random Forest, Decision Tree, and Logistic Regression.
2. **Early Detection:** Machine learning enables early identification of disorders based on patient-reported symptoms, allowing timely intervention to improve patient outcomes.
3. **Scalability:** The method is scalable, suitable for large datasets, and can be integrated into clinical settings to enhance diagnostic efficiency.
4. **Interpretability:** Algorithms like Decision Trees, Random Forest, and Logistic Regression provide clear, understandable predictions, helping clinicians trust and interpret the results.
5. **Adaptability:** The model can be adapted to detect other mental health disorders and improved over time by incorporating new data for better predictive performance.

V.DESIGN

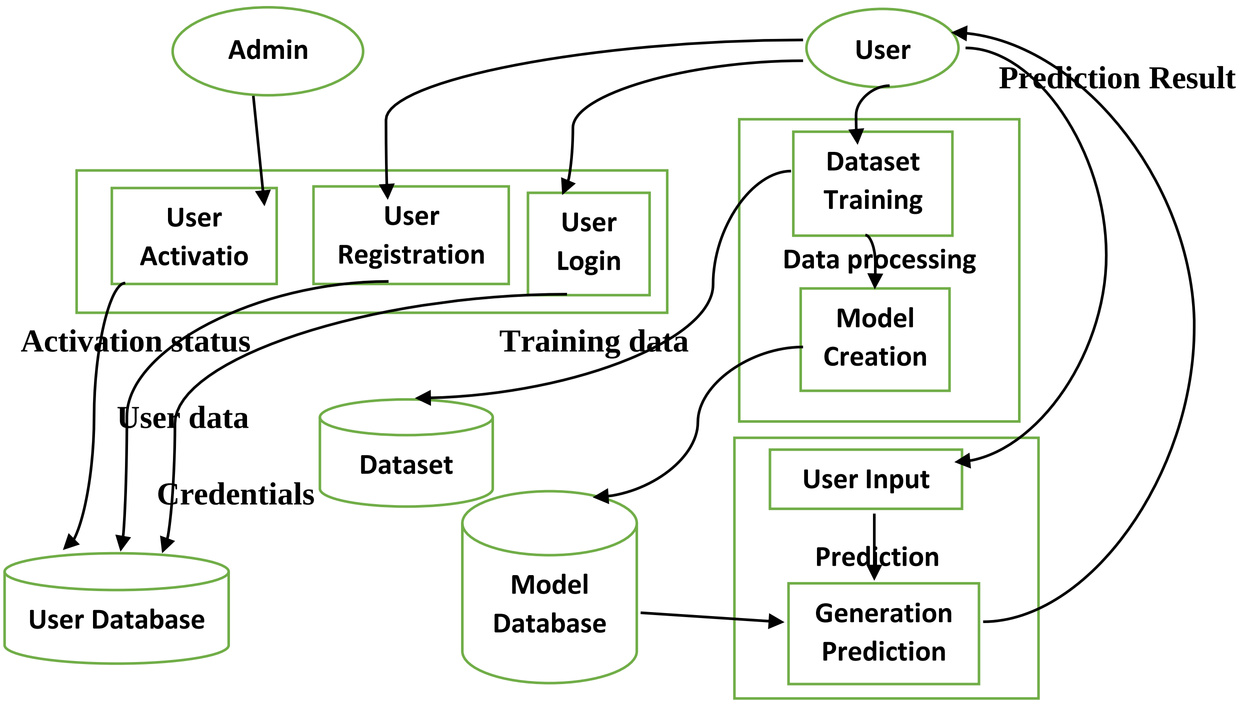

Fig 1: Data Flow Diagram

The DFD is also called as bubble chart. It is a simple graphical formalism that can be used to represent a system in terms of input data to the system, various processing carried out on this data, and the output data is generated by this system.The data flow diagram (DFD) is one of the most important modeling tools. It is used to model the system components. These components are the system process, the data used by the process, an external entity that interacts with the system and the information flows in the system.

DFD shows how the information moves through the system and how it is modified by a series of transformations. It is a graphical technique that depicts information flow and the transformations that are applied as data moves from input to output. DFD is also known as bubble chart. A DFD may be used to represent a system at any level of abstraction. DFD may be partitioned into levels that represent increasing information flow and functional detail.

VI. EXPERIMENTAL RESULTS

USER REGISTRATION PAGE

The above page is a registration page where the users should first enter their details and then the model will allow them to go to the login page. The registration form consists of name, login ID, email, password, mobile, locality and state. So, are the basic and simple things where very user can easily register into this portal.

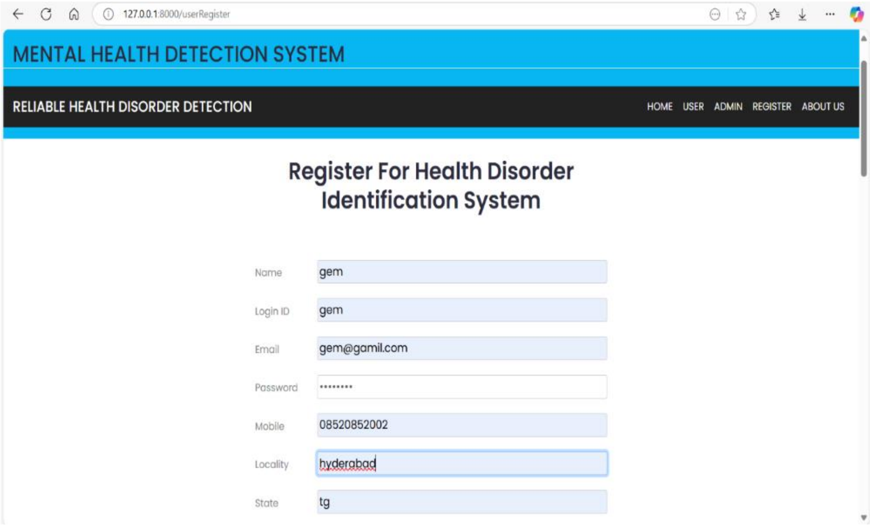

Fig 2: User registration page

USER LOGIN PAGE

The user login form is a crucial entry point that ensures system security and controlled access. Upon launching the system, users are presented with a clean and structured login page that requires valid credentials for entry. New users can register by providing their details, including username, email, and password, ensuring that only authorized personnel can access sensitive medical data.

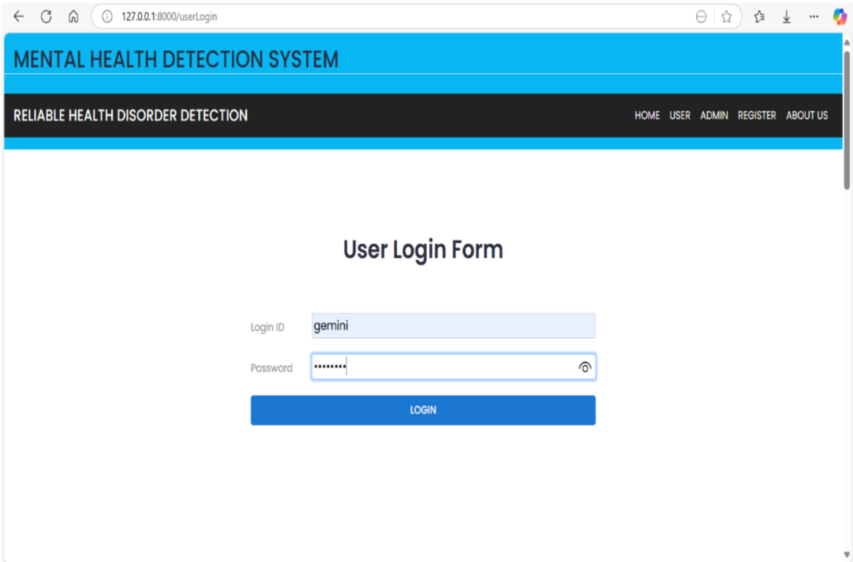

Fig 3: User login page

The system effectively validates the provided credentials and prevents unauthorized users from entering. This security measure ensures the protection of patient data, aligning with healthcare industry standards for data confidentiality. The seamless navigation between login, registration, and logout functionalities makes the system intuitive for healthcare professionals.

WELCOME PAGE

The welcome screen provides a professional and organized introduction to the system. It features clear navigation options that guide users to key functionalities, such as prediction, patient data entry, and visualization dashboards. This well-structured interface ensures that healthcare providers can quickly access critical features without confusion.

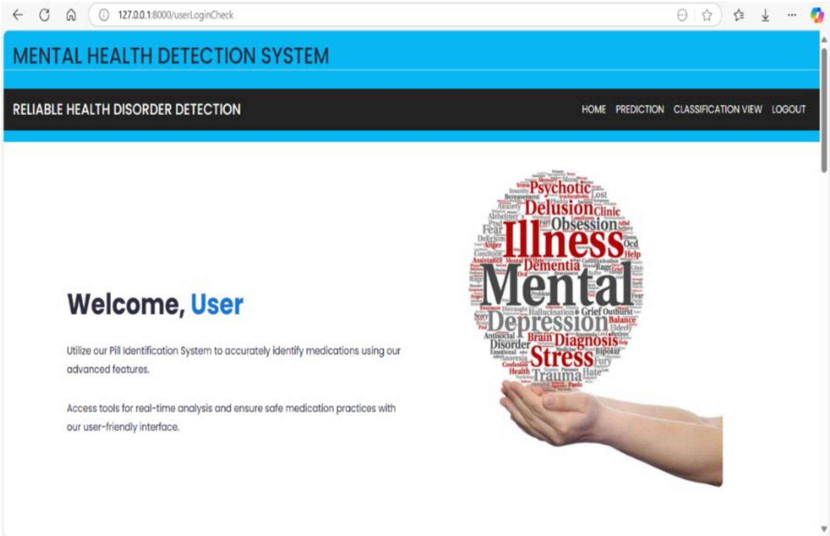

Fig 4: User welcome page

The design emphasizes user-friendliness, ensuring that users with minimal technical expertise can efficiently operate the system. This layout significantly improves the system's accessibility, particularly in fast-paced clinical environments.

USER INPUT PAGE

The user input page is used to take the various parameters like age, Feeling nervous, panic, breathing Rapidly, sweating, trouble in concentration, trouble in sleep, hopelessness, anger, overreact, change in eating and some other factors which are used to predict the mental health of the patient.

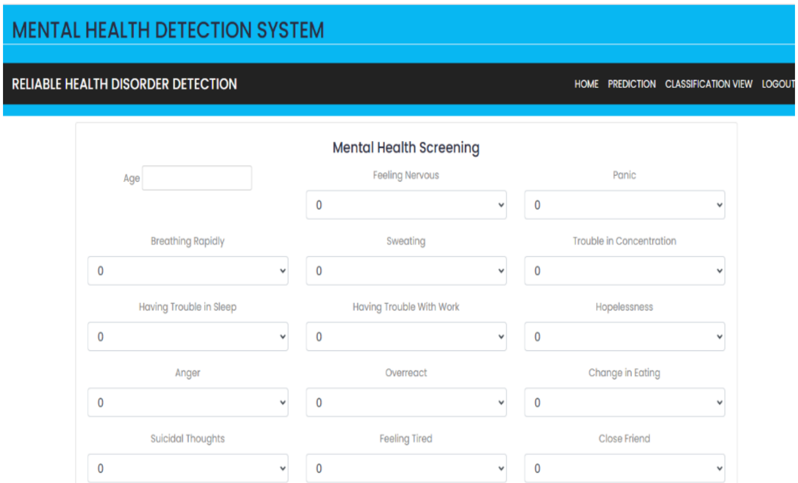

Fig 5: User input page

USER PREDICTION PAGE

The user prediction page is used to show the mental health disease based upon the given inputs. The model used to give two types of outputs:

1. If the patient is suffering from the sever mental health it is used to give the disease the patient is suffering from.
2. If the patient is not having that much sever symptoms than it gives the suggestion like " accurate pill identification."

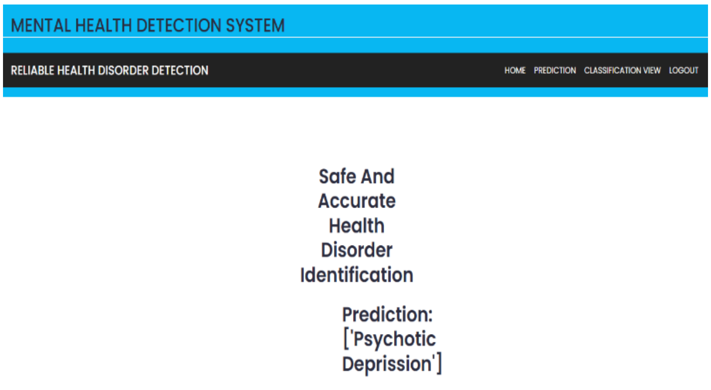

Fig 6: Prediction of the disease page

ACCURACY OF ALGORITHMS

Model	Accuracy (%)
Logistic Regression	0.9765625%
AdaBoost	0.3515625%
Random Forest	0.9921875%
Decision Tree	0.9921875%

Fig 7: Accuracy of the algorithms

Users can choose from Random Forest, AdaBoost, Decision Tree and Logistic Regression to predict mental health. Each algorithm processes the entered data and delivers a assessment score. The system's ability to provide comparative insights allows healthcare providers to understand which model performs optimally for their patient demographics. This feature enhances the system's versatility, empowering users to rely on the most effective algorithm for their needs.

VII. CONCLUSION

The Prediction of Mental Health System is an advanced AI-powered solution designed to assess an individual's mental health based on key medical indicators. By leveraging sophisticated machine learning algorithms, the system facilitates early detection of mental health conditions, enabling proactive healthcare interventions and potentially reducing mortality rates associated with mental health disorders. This approach addresses the critical need for timely diagnosis, which is often overlooked in traditional healthcare settings.

Traditional risk assessment methods primarily rely on manual analysis and generalized risk factors, which can result in delayed diagnoses and missed opportunities for early intervention. In contrast, this system employs the Random Forest algorithm, a powerful machine learning technique known for its accuracy and robustness in handling complex datasets. It analyzes critical health parameters such as age, feelings of nervousness, panic, rapid breathing, and other relevant factors to identify early signs of mental health issues.

The system processes patient data through a secure web-based interface, allowing users to input relevant health metrics easily. This user-friendly design ensures accessibility while maintaining data privacy and security. Once the data is submitted, the trained Random Forest model evaluates the information against learned patterns from historical data, generating a detailed risk prediction for mental health conditions.

To enhance the interpretability of the results, the system provides a classification report that displays key performance metrics, including accuracy, precision, recall, and F1-score. These metrics offer valuable insights into the system's predictive performance, helping healthcare professionals make informed decisions. By combining advanced AI with user-friendly features, the Prediction of Mental Health System represents a significant step forward in improving mental health diagnosis and patient care.

VIII. REFERENCES

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