**PROPOSED SYSTEM**

The proposed system aims to identify depression at an early stage by utilizing an **Extreme Learning Machine (ELM)**, a fast and efficient machine learning model. This system addresses the growing need for scalable and accurate methods to detect mental health issues like depression, which impacts millions globally. By leveraging the strengths of ELM, the system provides robust predictions with minimal computational overhead.

The dataset used for this study was obtained from the Centers for Disease Control and Prevention’s National Health and Nutrition Examination Survey (NHANES). It contains 36,259 entries collected from adults in the U.S. over a period from 2005 to 2018. The dataset includes a mix of numerical and categorical features, making it well-suited for machine learning tasks.

To ensure the data's compatibility with the ELM model, preprocessing steps were applied. Categorical features were one-hot encoded, and class labels were converted into binary representations, where 1 indicates a "Depressed" individual and 0 denotes "Not Depressed." Additionally, numeric features were scaled to ensure uniformity, and the dataset was divided into training and testing subsets to facilitate robust evaluation.

To explore patterns within the data, K-Means Clustering was employed, grouping the data into six clusters. This step helped in understanding underlying relationships between the features and depression classification. Various machine learning models, including Logistic Regression, Random Forest, Decision Tree, Gaussian Naive Bayes, and K-Nearest Neighbors, were implemented alongside the ELM for comparative analysis.

The ELM model demonstrated superior performance among all tested algorithms, achieving an accuracy of 91.73% and an AUC (Area Under the Curve) score of 83.82%. Its fast convergence and minimal need for iterative adjustments make it particularly advantageous for large-scale applications. Hyper parameter tuning using Grid Search CV further optimized the model’s performance.

The results indicate that the proposed system can serve as an effective tool for early depression detection, enabling timely interventions and better mental health outcomes.

**ADVANTAGES :**

**Early Detection of Depression**: The system enables early identification of depression, allowing for timely interventions and treatment, which can significantly improve mental health outcomes and quality of life.

**Scalable and Cost-Effective:** The lightweight nature of ELM ensures that the system is scalable for large datasets, like the NHANES dataset with 36,259 entries, making it suitable for national or global-level applications.

**Hyper parameter Optimization**: The use of **Grid Search CV** optimized ELM’s performance, ensuring the model operates at its best for real-world applications.

**Versatility and Adaptability:** The methodology can be adapted to other mental health conditions or datasets, making it a versatile tool for broader applications in healthcare.

**Contribution to Mental Health Research:** By combining traditional machine learning (Logistic Regression, Decision Trees) with advanced techniques (ELM and clustering).