AI FOR EEG EMOTION RECOGNITION TO ENHANCE MENTAL WELL BEING

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Branch: *Master Of Computer Applications*
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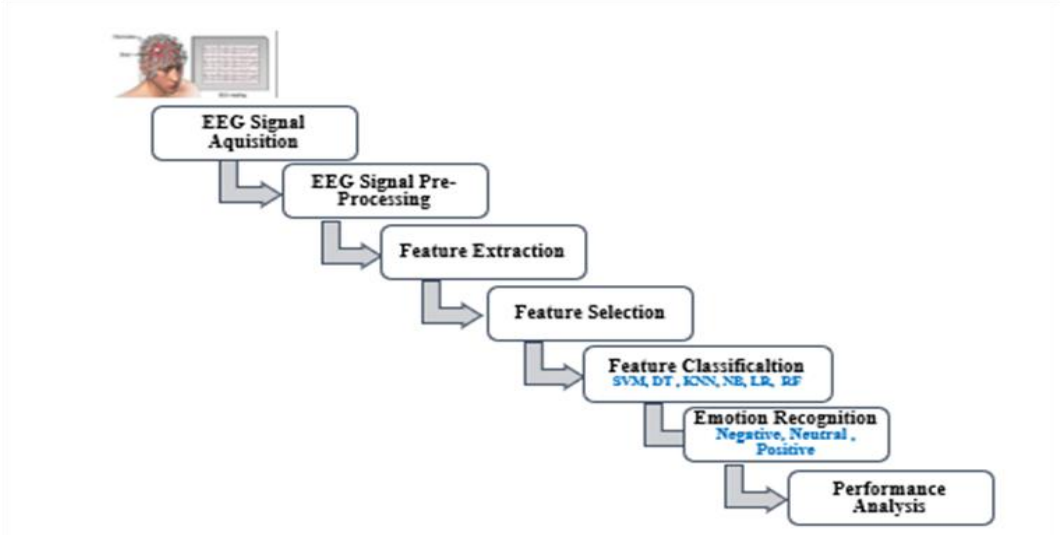
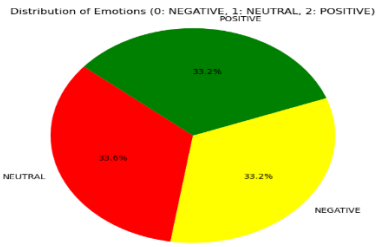
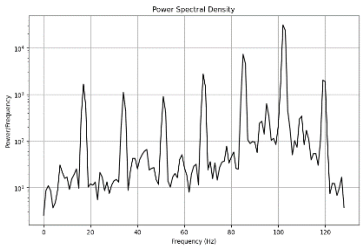
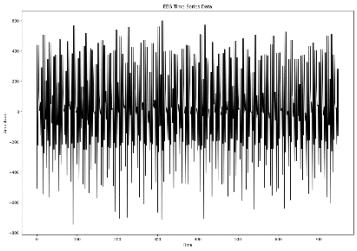
Introduction:

The project titled **"AI for EEG Emotion Recognition to Enhance Mental Well-being"** focuses on developing a smart system that detects and interprets human emotions from EEG (Electroencephalography) signals using machine learning algorithms. The primary objective is to improve mental well-being by identifying emotional states such as stress, anxiety, and calmness in real-time. The prototype comprises EEG signal acquisition, noise filtering, feature extraction, and emotion classification into positive, negative, or neutral categories. It leverages algorithms like Support Vector Machine (SVM), KNN ,DT , Random Forest (RF), and to ensure high accuracy and performance. The system has been evaluated using publicly available datasets and has demonstrated strong results in emotion detection. This working model has potential applications in healthcare, education, wearable technology, and personal wellness, and is currently available at the institution for further research and development.









Outcome and Impact

Result:

The project successfully developed and tested an EEG-based Emotion Recognition System powered by AI. Key results and findings include:

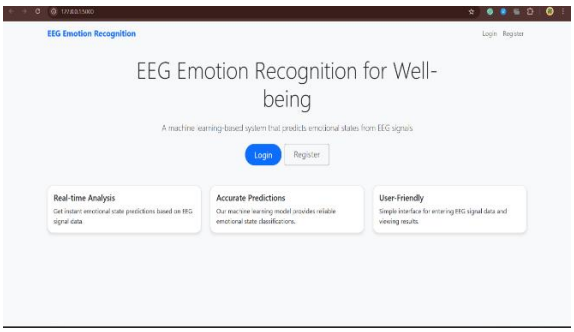
- **High Classification Accuracy:**
  The Random Forest (RF) achieved the highest accuracy of 98.59%, outperforming other models like Decision Tree, KNN and SVM.
- **Robust Emotion Detection:**
  The system accurately classified emotional states into **positive, negative, and neutral** categories based on EEG signals.
- **Effective Preprocessing and Feature Extraction:**
  Noise and artifacts were successfully removed from EEG signals, and key emotional features (e.g., time-frequency representations, spectral power densities) were extracted for high-quality input into classifiers.
- **Model Evaluation:**
  Performance metrics such as **Precision, Recall, F1-Score,** and **Accuracy** were used to validate each classifier.
- **Prototype Implementation:**
  A fully functional prototype was built, demonstrating real-time emotion classification with a user-friendly interface, ready for further enhancements and potential commercialization.

These outcomes indicate the system's strong potential for real-world applications in mental health monitoring, wearable tech, and human-computer interaction.

Sample Outputs

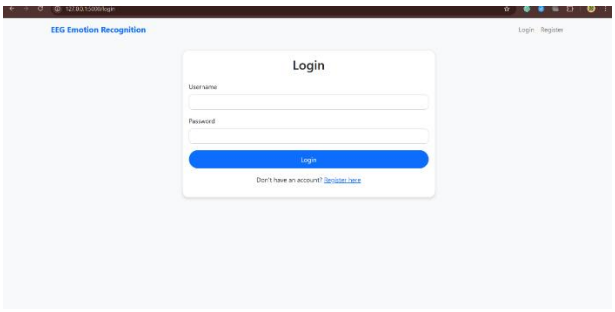
1.Home page

The home page serves as the main entry point to the EEG Emotion Recognition system. It provides users with options to register a new account or log in to an existing one, ensuring secure and personalized access to the platform's features focused on emotional well-being monitoring.



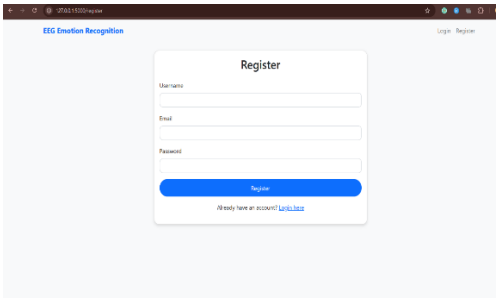
2.Login page

The login page provides secure access to the system by authenticating users through their registered username and password. It ensures that only authorized individuals can access personalized features and data within the EEG emotion recognition platform.



3.Registration page

The registration page allows new users to create an account by entering a username, email, and password. This ensures secure access to the EEG Emotion Recognition system and enables personalized tracking of emotional states.

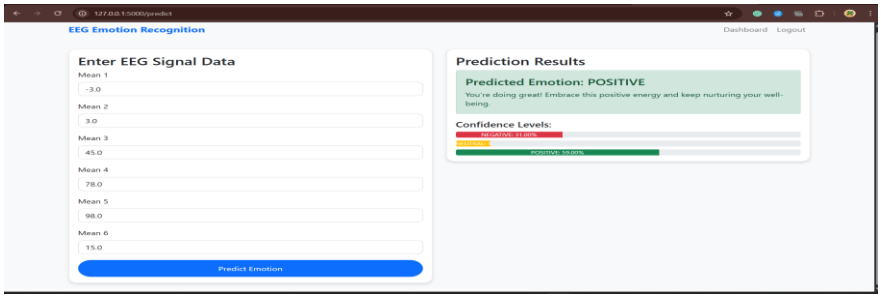


4.The Main page

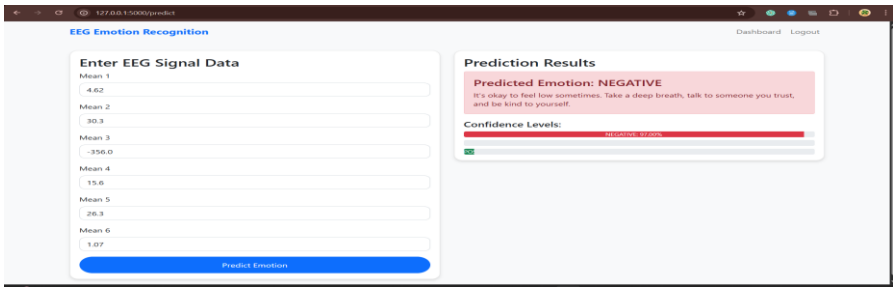
The main page is the central hub of the EEG Emotion Recognition system, where users can access core features after logging in. It provides a user-friendly interface to upload EEG

data, view emotion classification results (positive, negative, or neutral), and track emotional well-being over time.

a.Positive



b.Negative



c.Neutral

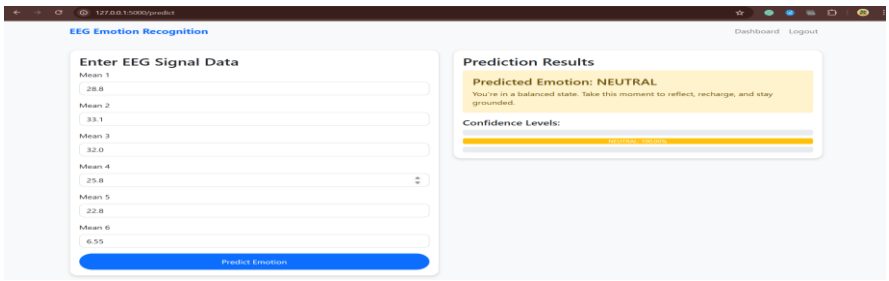
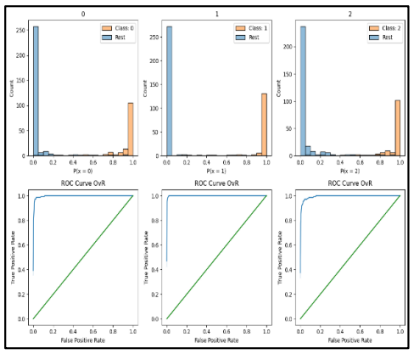
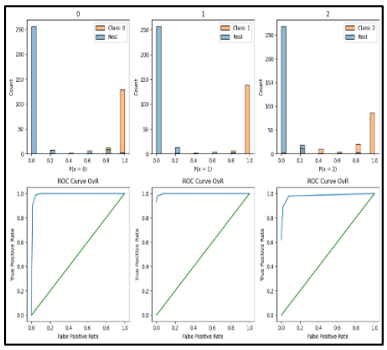


Table : Performance Metrics of Classifiers on Emotional State Prediction

Classifier	Accuracy	Precision	Recall	F1-Score
SVM	95.78	95.81	95.78	95.78
KNN	93.21	93.53	93.21	93.06
DT	96.02	96.09	96.02	96.03
RF	**98.59**	**98.60**	**98.59**	**98.59**





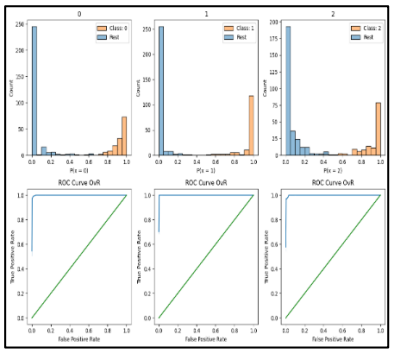


Fig 10(a): SVM **Fig 10(b) : KNN** **Fig 10(b) : RF**

ROC Curve in the "One vs Rest" approach lies in its ability to evaluate the performance of a multi-class classifier by illustrating the trade-off between true positive rate and false positive rate for each class individually.

Future Scope:

The project holds significant potential for both further development and commercialization. Key areas of future scope include:

- **Real-Time Implementation:**
  Enhancing the current prototype to support live EEG signal processing and real-time emotion detection for immediate feedback and intervention.
- **Integration with Wearable Devices:**
  Embedding the system into consumer-grade EEG headbands or smart wearables for continuous emotional monitoring in daily life.
- **Multi-Modal Emotion Analysis:**
  Combining EEG data with other physiological signals (like heart rate or facial recognition) to improve accuracy and reliability in complex emotional states.
- **Mobile & Web Application Development:**
  Creating mobile and web platforms that provide personalized mental health insights, tracking, and recommendations to users and mental health professionals.
- **Commercial Deployment:**
  Licensing the technology to healthcare providers, edtech companies, or mental wellness startups. The system can be marketed as a B2B solution or a direct-to-consumer wellness product.

- **Academic and Clinical Research:**
  Using the platform for in-depth cognitive and psychological studies or clinical trials to better understand the link between brain activity and emotional health.

With increasing global awareness around mental health, this system has the potential to evolve into a powerful tool for preventive care, digital therapy, and personalized well-being solutions.