EARLY PREDICTION OF CVA USING AI

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Brain stroke, deep learning, CNN, image detection, numerical data, feature selection.

Introduction:

Stroke, or cerebrovascular accident (CVA), is a major cause of death and long-term disability globally, caused by disrupted blood flow to the brain—either through ischemic blockage or haemorrhagic rupture. Key risk factors include hypertension, diabetes, high cholesterol, and genetic predisposition. Early detection is essential to reducing complications and mortality. AI has shown great potential in enhancing stroke diagnosis. Bhattacharya et al. introduced a visual saliency detection method using spatiotemporal decomposition, useful for highlighting ischemic regions in brain scans. Chan et al. proposed a privacy-preserving crowd monitoring method, suggesting AI can analyse patient data securely for stroke prediction. Fradi et al.'s mid-level descriptor approach for crowd behaviour analysis can aid in identifying subtle patterns in MRI scans. Weiner and Collins demonstrated a sample-based detection method, applicable in detecting stroke-related features. Wenhua et al. used multi-scale texture analysis with soft classification, relevant for distinguishing ischemic from normal brain tissue. Xinyu et al.'s texture-based learning for crowd density can improve MRI analysis accuracy. Yan et al. focused on anomaly detection in videos, a concept transferable to identifying stroke-related anomalies in brain imaging.This project leverages such AI techniques to automate stroke detection, integrating numerical and imaging data for early, accurate, and privacy-preserving prediction, ultimately improving patient outcomes.

Objectives:

1. Develop a Comprehensive Detection Model: Integrate both numerical and image data into a single, cohesive model for stroke detection.
2. Optimize Deep Learning Models: Enhance model accuracy with CNN architectures tailored for stroke detection in imaging data.
3. Implement Feature Selection: Identify key predictors in numerical data, improving model focus and performance.
4. Ensure High Accuracy and Precision: Aim for a high accuracy rate in both detection and prediction of stroke cases.

Methodology:

1. **Data Collection:**

- **MRI Brain Images:** Acquire labelled MRI scans from public datasets like the Brain MRI Images for Stroke Detection.
- **Numerical Data:** Collect patient-related numerical data (e.g., age, medical history) from medical datasets or records.

2. **Data Preprocessing:**

- **Image Processing:**
    - Resize images to a fixed size.
    - Apply augmentation (rotation, flipping, zoom) to increase diversity.
    - Normalize pixel values and convert to grayscale if needed.
- **Numerical Processing:**
    - Handle missing values via imputation (mean, median, etc.).
    - Normalize numerical features.
    - Engineer relevant features (age, cholesterol, blood pressure).

3. **Model Development:**

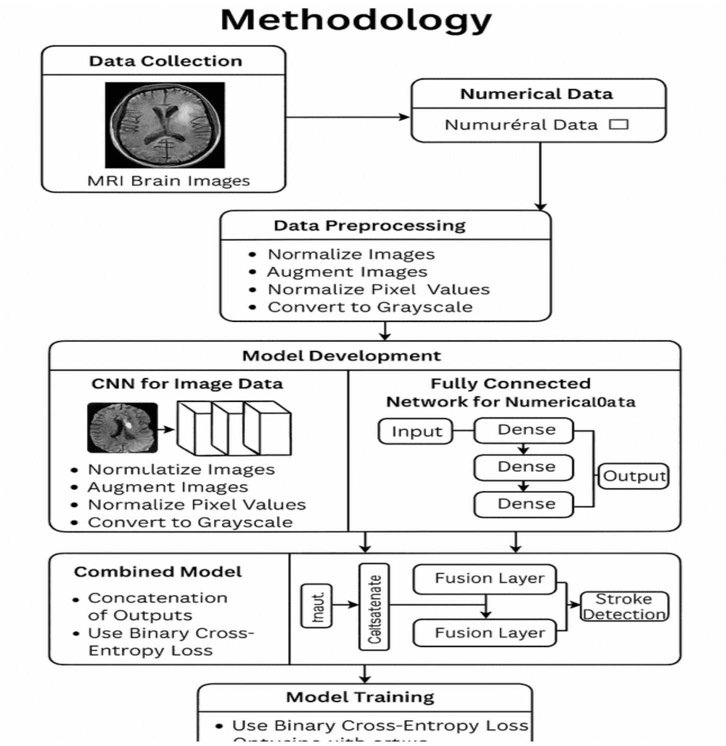
- **Deep Learning Approach:**

- Use a **CNN** to process image data with convolutional, pooling, and dense layers.
- Use a **Fully Connected Network** for numerical data with ReLU-activated dense layers.

- **Combined Model:**
  - Concatenate outputs from CNN and the numerical network.
  - Use a fusion layer followed by a final classification output for stroke prediction.

4. **Model Training:**

- Use **binary cross-entropy loss** for the classification task.
- Optimize using the **Adam optimizer** for efficient training.

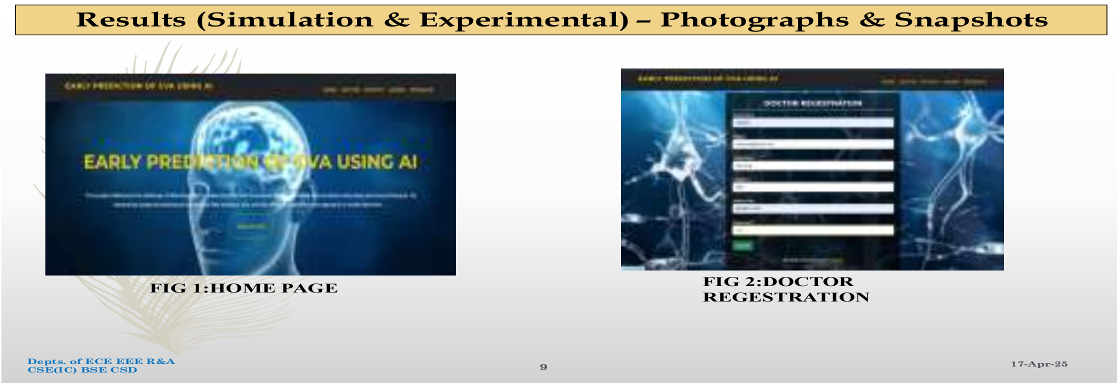


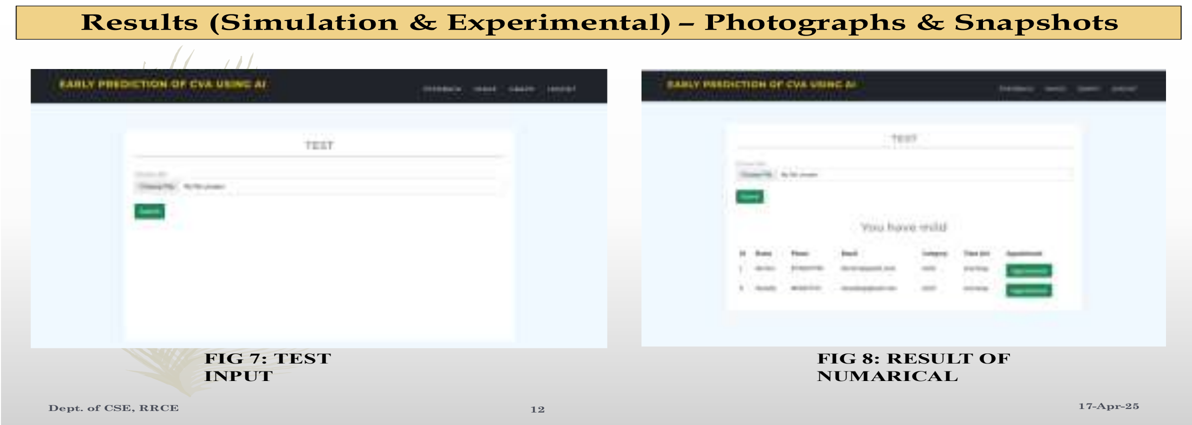
Result and Conclusion:

Result

- The system includes three main features: a **Login page** for secure access, a **Registration page** for new users, and a **Brain Stroke Detection module** that allows medical image uploads for analysis using AI.

- In the **numerical data prediction module**, users input parameters like age, heart rate, and ECG rate to predict stroke risk. However, unrealistic values (e.g., heart rate of 817 or ECG of 37,000) highlight the need for proper input validation.
- The **MRI-based stroke detection system** applies grayscale conversion, edge detection, and sharpening to classify scans. It achieved 99.99% accuracy for normal brains, 98.51% for ischemic strokes, and 98.98% for haemorrhagic strokes, showing strong performance in stroke type classification.





Results (Simulation & Experimental) – Photographs & Snapshots

FIG 11: IMG INPUT

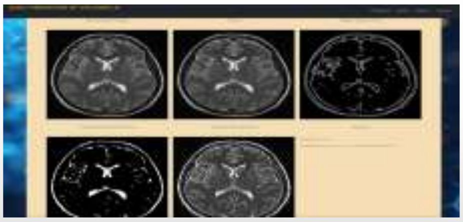


FIG 12: PATIENT IN NORMAL CONDITION

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Results (Simulation & Experimental) – Photographs & Snapshots

FIG 13: PATIENT IN ISCHEMIC CONDITION

FIG 14: PATIENT IN HEMORRHAGIC CONDITION

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Results (Simulation & Experimental) – Photographs & Snapshots

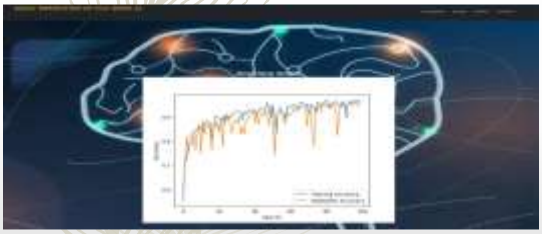

FIG 15:PATIENT ACCURCY GRAPH

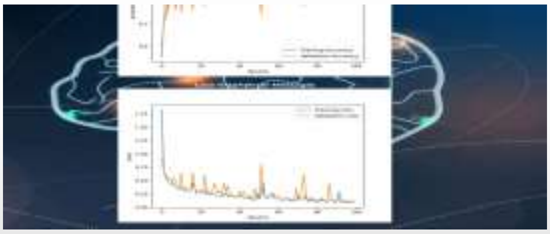

FIG 16:PATIENT LOSS GRAPH

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Conclusion:

This project developed a hybrid AI system combining CNNs for MRI analysis and machine learning for numerical data to enhance stroke prediction. By integrating imaging and clinical parameters, the system offers improved diagnostic accuracy.The approach involved data collection, preprocessing, feature extraction, and model training. Results show that AI-driven tools can significantly aid early stroke detection, support clinical decision-making, and improve patient outcomes.

Future Scope:

- **Real-time Stroke Detection** by integrating with hospital systems and IoT-enabled medical devices for continuous monitoring.
- **Larger & Diverse Datasets** to train models for better generalization across age groups, ethnicities, and comorbidities.
- **Multi-class Classification** to detect other neurological disorders beyond stroke, such as tumors or traumatic brain injuries.
- **Integration with EHRs (Electronic Health Records)** to provide deeper context during prediction.
- **3D MRI Support** for improved spatial analysis of brain structures using volumetric data.
- **Explainable AI (XAI)** to help doctors understand the reasoning behind each prediction.