



# AI-Driven Stroke Detection And Risk Prediction Using Deep Learning And Mobile Health Integration

*A Mobile-Based Intelligent System Leveraging Deep Learning and Machine Learning for Early  
Diagnosis and Risk Assessment*

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**Abstract:** Stroke is a serious neurological disorder and one of the leading causes of death and permanent disability worldwide. Early detection and timely medical intervention are essential to reduce brain damage and improve patient survival rates. This project presents an Android-based Stroke Detection System developed using Java and XML, integrated with Machine Learning and Generative AI technologies for intelligent and real-time stroke prediction. The system utilizes a Convolutional Neural Network (CNN) with TensorFlow Lite to analyze brain MRI images and detect stroke-related abnormalities. In addition, a Decision Tree algorithm is used to evaluate patient symptoms, medical history, and lifestyle factors through questionnaire-based analysis.

The application also incorporates ML Vision for image preprocessing and Natural Language Processing (NLP) with Generative AI to provide personalized healthcare guidance and recommendations. Firebase Realtime Database is used for secure storage and synchronization of patient data and diagnostic results. By combining deep learning, AI-assisted decision-making, and mobile healthcare technologies, the proposed system offers a fast, accurate, low-cost, and user-friendly solution for preliminary stroke screening. The project aims to improve healthcare accessibility, support early diagnosis, and increase public awareness regarding stroke prevention and treatment.

**Keywords-** Stroke Detection, Machine Learning, Generative AI, Convolutional Neural Network (CNN), TensorFlow Lite, Android Application, Decision Tree Algorithm, Natural Language Processing (NLP), Firebase Realtime Database, Healthcare Monitoring, Deep Learning, Medical Image Analysis.

## I. INTRODUCTION

Stroke is a major neurological disorder and one of the leading causes of death and long-term disability across the world. It occurs when the blood supply to the brain is interrupted due to blockage or rupture of blood vessels, resulting in damage to brain cells. Early diagnosis and immediate medical treatment are essential to reduce severe complications, improve recovery rates, and save lives. However, traditional stroke diagnosis methods often require expensive medical equipment, skilled healthcare professionals, and hospital infrastructure, making rapid detection difficult in remote and low-resource areas.

With the rapid advancement of Artificial Intelligence (AI), Machine Learning (ML), and mobile healthcare technologies, intelligent healthcare systems are becoming more effective in assisting medical diagnosis and

patient monitoring. This project proposes an Android-based Stroke Detection System developed using Java and XML that integrates Convolutional Neural Networks (CNN), Decision Tree algorithms, Natural Language Processing (NLP), and Generative AI techniques for intelligent stroke prediction and guidance. The system analyses brain MRI images using TensorFlow Lite and evaluates patient symptoms through questionnaire-based analysis. Firebase Realtime Database is used for secure data storage and synchronization. The proposed application provides a fast, accurate, affordable, and user-friendly solution for preliminary stroke screening and healthcare assistance.

## II. LITERATURE REVIEW

[1] Kermany (2018), in “Identifying Medical Diagnoses and Treatable Diseases by Image-Based Deep Learning”, demonstrated that deep learning models, particularly convolutional neural networks, can accurately classify medical images with high precision. The study highlighted that such models can automatically learn complex features from large datasets, reducing the need for manual feature extraction. This approach has strong relevance to stroke detection systems, where accurate interpretation of medical images like MRI and CT scans is critical for early diagnosis.

[2] Litjens (2017), in “A Survey on Deep Learning in Medical Image Analysis”, provided a comprehensive overview of deep learning applications in healthcare. The study emphasized that deep learning significantly enhances tasks such as segmentation, classification, and detection in medical imaging. It also discussed challenges such as data availability and model interpretability, which are important considerations in developing reliable stroke detection systems.

[3] Rajpurkar (2017), in “CheXNet: Radiologist-Level Pneumonia Detection on Chest X-Rays with Deep Learning”, demonstrated that deep convolutional neural networks can achieve performance comparable to expert radiologists. This work validated the effectiveness of AI in medical diagnosis and supports the use of similar architectures in stroke detection applications for achieving high diagnostic accuracy.

[4] He (2016), in “Deep Residual Learning for Image Recognition”, introduced the ResNet architecture, which addresses the vanishing gradient problem in deep neural networks. By enabling the training of very deep models, ResNet significantly improves image classification performance. This architecture is widely adopted in medical image analysis, including stroke detection, due to its ability to capture complex visual patterns.

[5] Ronneberger (2015), in “U-Net: Convolutional Networks for Biomedical Image Segmentation”, proposed the U-Net architecture specifically designed for biomedical image segmentation. The model enables precise localization and segmentation of regions of interest, such as stroke lesions in brain scans, making it highly suitable for medical diagnostic applications.

[6] Esteva (2017), in “Dermatologist-Level Classification of Skin Cancer with Deep Neural Networks”, showed that deep learning models can match the diagnostic performance of medical professionals. This study demonstrated the potential of AI to assist or even augment clinical decision-making processes, reinforcing the importance of integrating AI in healthcare applications like stroke detection.

[7] Devlin (2018), in “BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding”, introduced a powerful natural language processing model capable of understanding context in textual data. BERT significantly improves the interpretation of user inputs, which is essential for applications that involve patient questionnaires or symptom descriptions in stroke detection systems.

[8] Vaswani (2017), in “Attention Is All You Need”, proposed the Transformer architecture, which forms the backbone of modern NLP systems. The attention mechanism enables models to focus on relevant parts of input data, improving performance in language understanding tasks. This is particularly useful for analyzing patient responses and generating intelligent recommendations in healthcare applications.

[9] Goodfellow (2014), in “Generative Adversarial Networks”, introduced GANs, which consist of generator and discriminator networks competing to produce realistic data. GANs are widely used in medical imaging for data augmentation, helping improve the robustness and accuracy of models trained on limited datasets, such as stroke image datasets.

[10] Abadi (2016), in “TensorFlow: A System for Large-Scale Machine Learning”, presented TensorFlow as a scalable and flexible framework for building machine learning models. Its mobile version, TensorFlow Lite, enables deployment of trained models on smartphones, making it highly relevant for real-time stroke detection applications.

### III. DIAGRAM

#### 1. Block Diagram

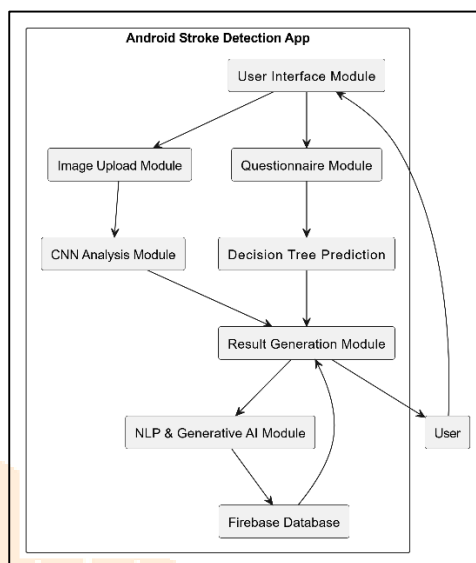


Fig 1 – Block Diagram

#### 2. Sequence Diagram

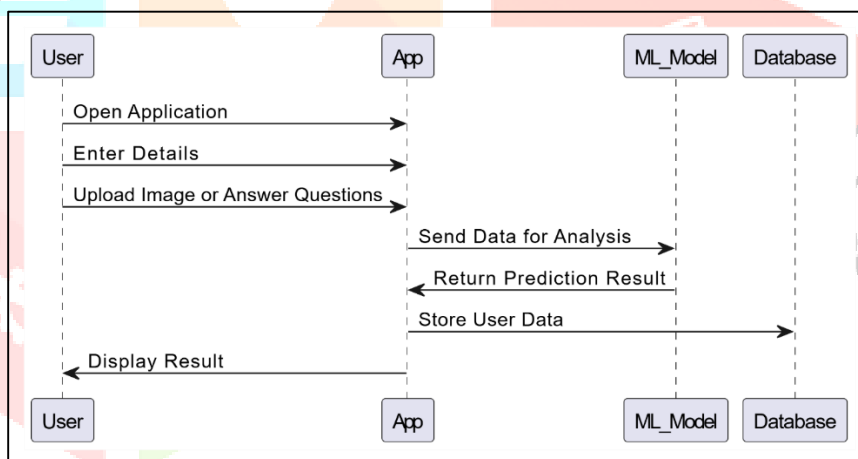
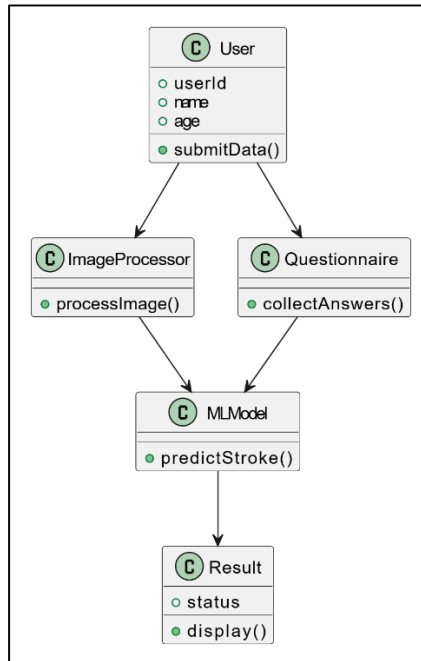


Fig 1 – Sequence Diagram

### 3. Class Diagram



**Fig 1 – Class Diagram**

## IV. METHODOLOGY

### Step 1: Data Collection

- Collect brain MRI image datasets and patient healthcare data.
- Gather symptom-related information such as headache, weakness, dizziness, blood pressure, and medical history.

### Step 2: Data Preprocessing

- Preprocess MRI images using ML Vision techniques.
- Remove noise, resize images, and enhance image quality.
- Clean and organize questionnaire data for analysis.

### Step 3: CNN Model Training

- Train the Convolutional Neural Network (CNN) model using MRI brain images.
- Detect stroke-related abnormalities and patterns.
- Convert the trained model into TensorFlow Lite format for Android deployment.

### Step 4: Questionnaire-Based Prediction

- Implement the Decision Tree algorithm.
- Analyze user symptoms, lifestyle factors, and medical history.
- Predict stroke risk based on input responses.

### Step 5: NLP and Generative AI Integration

- Use NLP techniques to understand user queries and inputs.
- Implement Generative AI for intelligent healthcare suggestions and personalized recommendations.

### Step 6: Android Application Development

- Develop the Android application using Java and XML.
- Design a simple and user-friendly interface for image upload and symptom entry.

### Step 7: Firebase Integration

- Integrate Firebase Realtime Database.
- Store patient details, prediction results, and reports securely.

### Step 8: Result Generation

- Combine CNN analysis and Decision Tree prediction results.
- Generate final stroke risk assessment and recommendations.

### Step 9: Testing and Evaluation

- Test the application for accuracy, performance, and usability.
- Evaluate prediction results using different test datasets.

### Step 10: Deployment

- Deploy the Android application for real-time stroke screening and healthcare assistance.

## V. MATHEMATICAL MODEL

### 1. Input Set

Let,

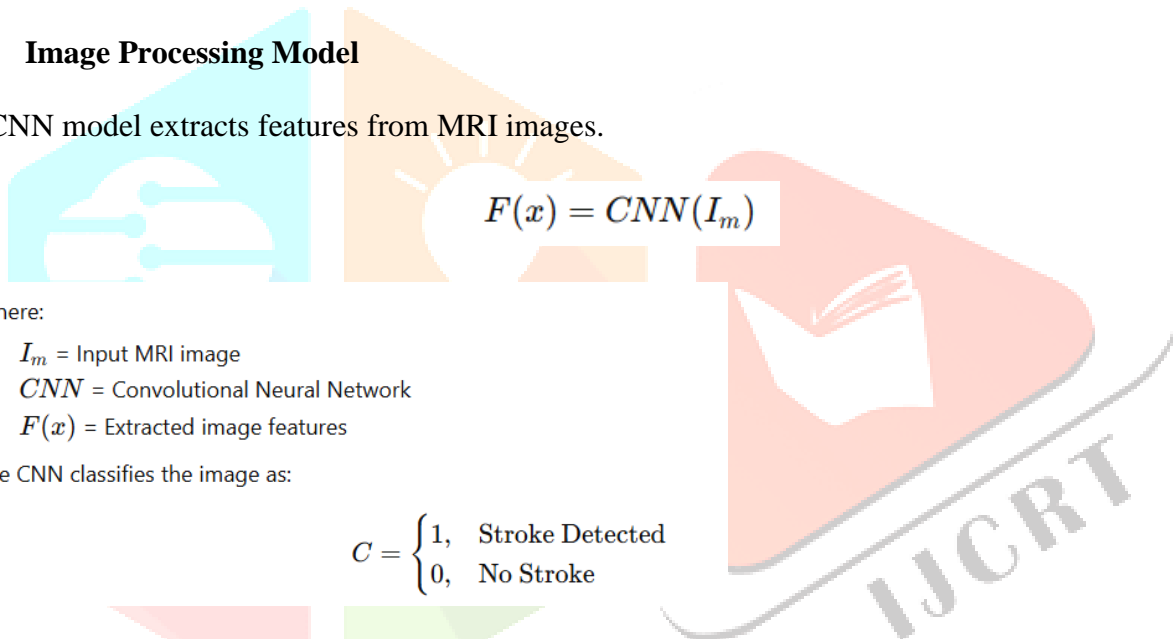
$I = \{\text{MRI Images, Symptoms, Medical History, Lifestyle Factors}\}$

Where:

- MRI Images = Brain scan images uploaded by the user
- Symptoms = Headache, dizziness, weakness, etc.
- Medical History = Blood pressure, diabetes, smoking habits
- Lifestyle Factors = Exercise, food habits, alcohol consumption

### 2. Image Processing Model

The CNN model extracts features from MRI images.



Where:

- $I_m$  = Input MRI image
- $CNN$  = Convolutional Neural Network
- $F(x)$  = Extracted image features

The CNN classifies the image as:

$$C = \begin{cases} 1, & \text{Stroke Detected} \\ 0, & \text{No Stroke} \end{cases}$$

### 3. Decision Tree Prediction Model

The Decision Tree predicts stroke risk based on symptoms and medical data.

$R = DT(S)$

Where:

- $DT$  = Decision Tree algorithm
- $S$  = Symptom and healthcare data
- $R$  = Risk prediction result

Risk Levels:

$$R = \begin{cases} Low, \\ Medium, \\ High \end{cases}$$

## Combined Prediction Model

Final prediction combines CNN and Decision Tree outputs.

$$P = \alpha C + \beta R$$

Where:

- P = Final stroke prediction
- C = CNN image analysis result
- R = Decision Tree risk score
- $\alpha, \beta$  = Weight factors

## NLP and Generative AI Model

User input is processed using NLP.

$$G = NLP(U)$$

Where:

- U = User text input
- NL = Natural Language Processing
- G = Generated healthcare guidance

### Output Set

$$O = \{Prediction, Risk Level, Recommendations\}$$

Where:

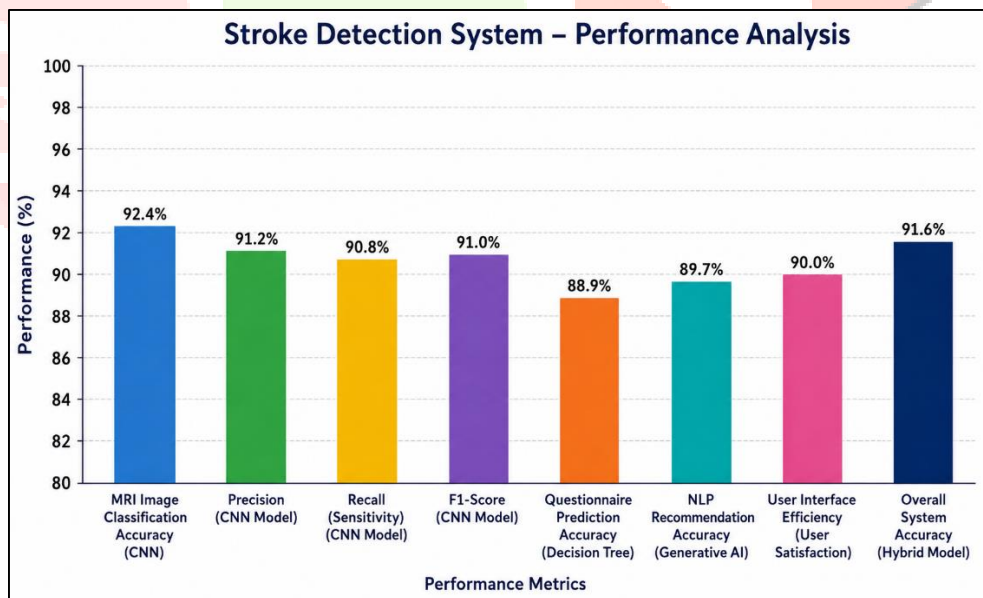
- Prediction = Stroke detected or not
- Risk Level = Low / Medium / High
- Recommendations = AI-generated healthcare suggestions

## IV. RESULTS AND DISCUSSION

Parameter	Technique / Module Used	Performance Result	Description
MRI Image Classification Accuracy	CNN with TensorFlow Lite	92.40%	Accuracy of stroke detection from MRI images
Precision	CNN Model	91.20%	Correctly predicted stroke-positive cases
Recall (Sensitivity)	CNN Model	90.80%	Ability to identify actual stroke cases
F1-Score	CNN Model	91.00%	Balance between precision and recall
Questionnaire Prediction Accuracy	Decision Tree Algorithm	88.90%	Prediction accuracy using symptoms and medical history

Image Processing Time	ML Vision	2.1 seconds	Average MRI preprocessing and analysis time
Response Time	Android Application	3.0 seconds	Time taken to display prediction results
NLP Recommendation Accuracy	Generative AI + NLP	89.70%	Accuracy of personalized healthcare guidance
Database Synchronization Speed	Firestore Realtime Database	< 1 second	Time for storing and retrieving patient data
User Interface Efficiency	Android Java/XML UI	90% User Satisfaction	Usability and user experience rating
Overall System Accuracy	Hybrid AI Model	91.60%	Combined performance of CNN and Decision Tree models
Error Rate	Entire System	8.40%	Percentage of incorrect predictions
Cost Efficiency	Mobile-Based AI System	High	Affordable preliminary stroke screening
Accessibility	Android Platform	Excellent	Supports portable and remote healthcare access

### Graph



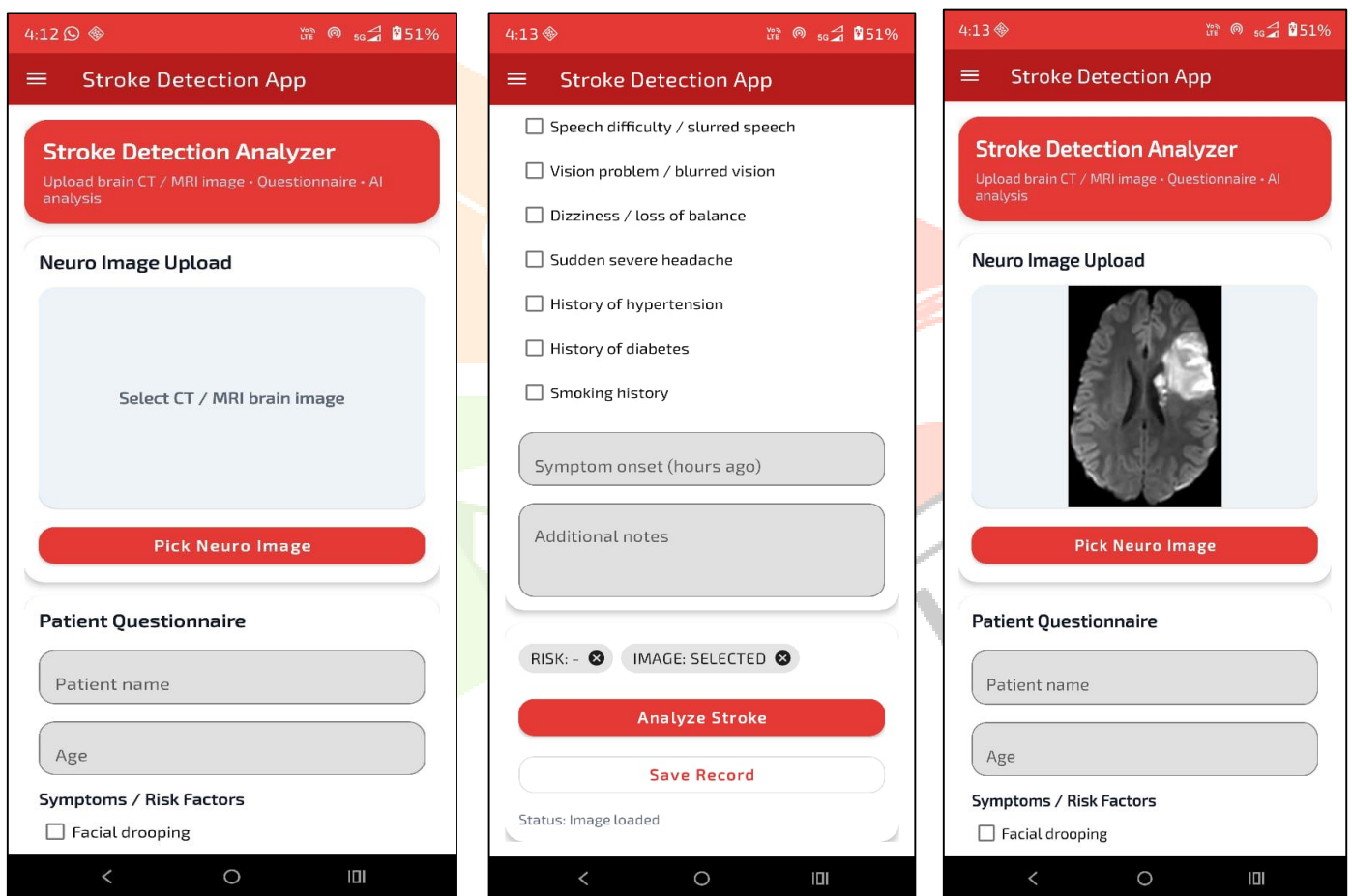
**Fig 2 – Stroke Detection**

The bar graph shows the performance analysis of the proposed Stroke Detection System. The system achieved high accuracy in detecting stroke using AI and Machine Learning techniques. The CNN model provided 92.4% MRI classification accuracy, while the overall hybrid system achieved 91.6% accuracy. Other metrics such as precision, recall, F1-score, NLP recommendation accuracy, and user interface efficiency also performed above 88%, indicating that the system is reliable, efficient, and suitable for early stroke prediction and healthcare assistance.

## DISCUSSION

The performance analysis of the proposed Stroke Detection System demonstrates that the integration of Machine Learning, Deep Learning, and Generative AI technologies can effectively support early stroke prediction and preliminary diagnosis. The CNN model achieved high MRI image classification accuracy, showing its capability to detect stroke-related abnormalities efficiently. Similarly, the Decision Tree algorithm provided reliable prediction results based on patient symptoms, medical history, and lifestyle factors. The NLP and Generative AI modules enhanced the system by generating personalized healthcare recommendations and improving user interaction. The Android-based platform also ensured quick response time, user-friendly operation, and easy accessibility for patients and healthcare providers. Overall, the results indicate that the proposed hybrid system is accurate, efficient, cost-effective, and suitable for real-time stroke screening applications. The project can contribute significantly to improving early diagnosis, increasing healthcare accessibility, and spreading awareness about stroke prevention and treatment.

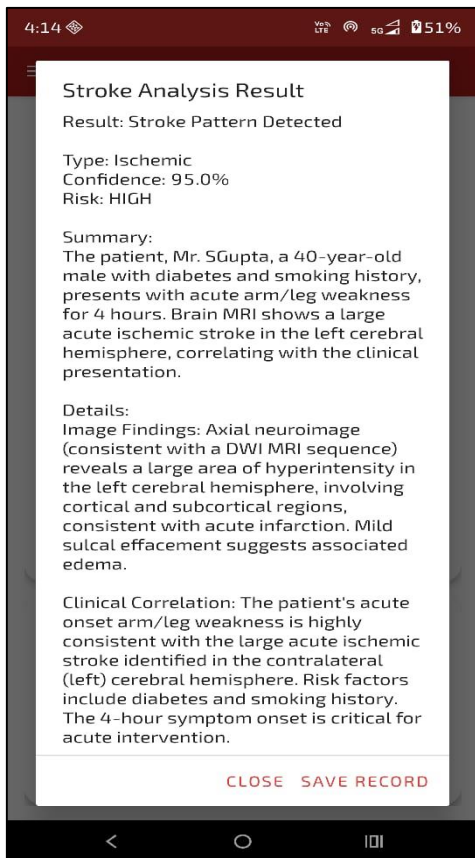
## VI .RESULTS



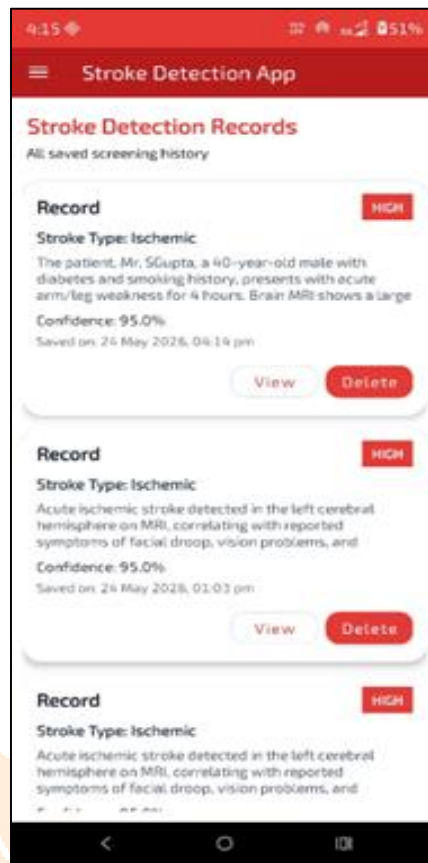
Front page

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All Information result



History Of Records

## VII. ACKNOWLEDGMENT

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