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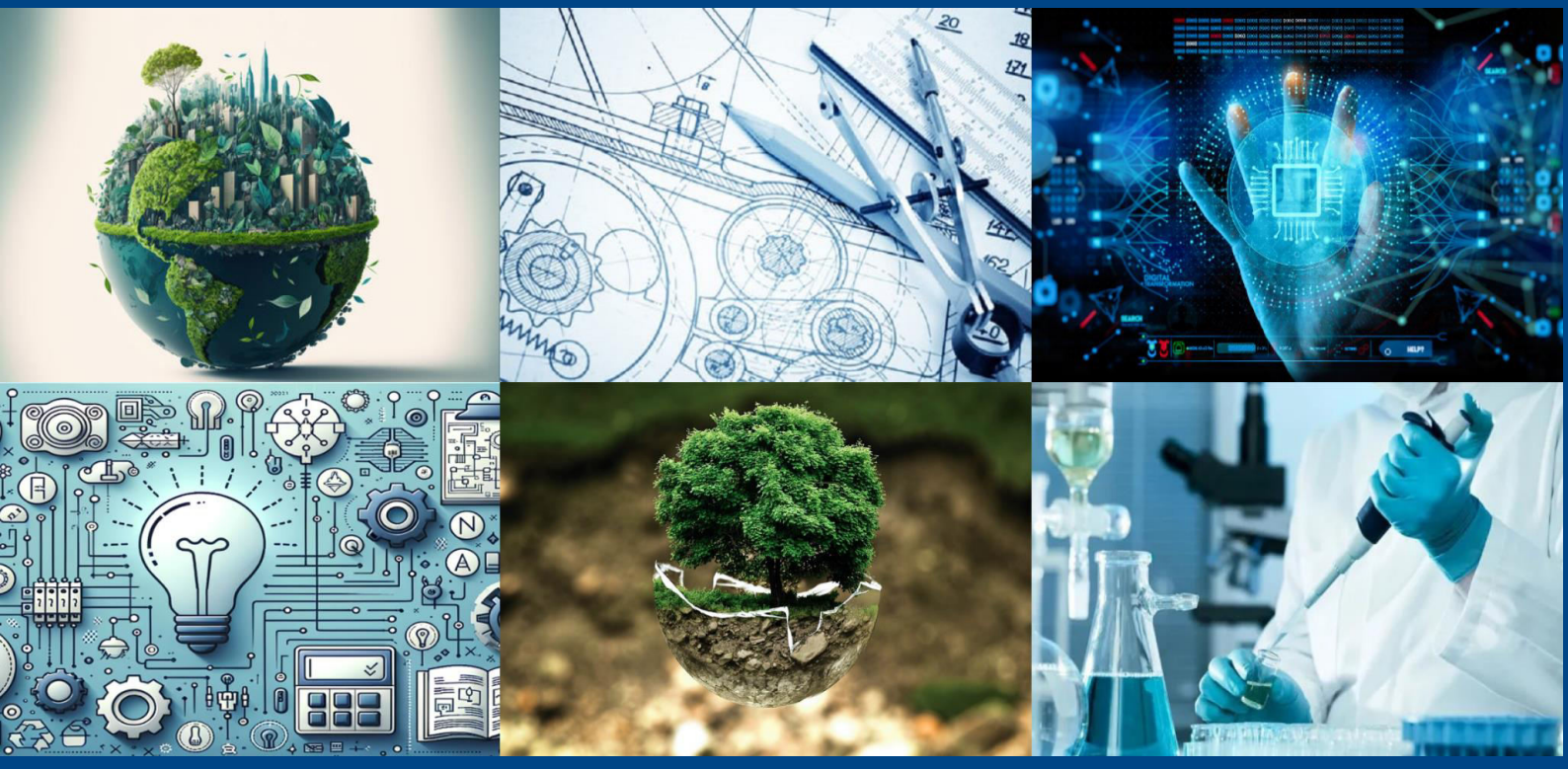

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Alzheimer's Disease Prediction using Deep Learning

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ABSTRACT : The early and accurate detection of Alzheimer's disease (AD) remains a critical challenge in the field of neurology. This aims to develop a robust predictive model for Alzheimer's disease by integrating Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) to analyze MRI scans. The dataset will include MRI scans categorized into four stages: non-demented, mild dementia, moderate dementia, and severe dementia. The primary goal is to enhance the early detection and classification of Alzheimer's disease through advanced machine learning techniques. This will involve leveraging CNNs to extract and interpret spatial features from MRI images, and RNNs to analyze temporal patterns and progression of dementia across sequential scans.The project will employ CNNs to effectively capture intricate patterns and structural anomalies within the MRI scans, which are crucial for identifying different stages of dementia. The proposed methodology will be validated using a dataset containing MRI scans from patients at varying stages of dementia, with performance metrics focusing on classification accuracy and precision.It is anticipated that the integration of CNNs and RNNs will significantly improve the accuracy of dementia stage classification, achieving a precision rate above 90%. This enhanced predictive capability will provide a valuable tool for clinicians, aiding in earlier and more accurate diagnosis of Alzheimer's disease. The successful implementation of this approach is expected to advance diagnostic practices by providing a sophisticated tool for early detection and monitoring of Alzheimer's disease. The results could lead to improved patient management and treatment outcomes, contributing to better overall care for individuals affected by dementia.

KEYWORDS: Alzheimer's Disease, MRI, Convolutional Neural Networks, Recurrent Neural Networks, Deep Learning, Dementia Classification.

I. INTRODUCTION

Alzheimer's Disease Prediction using Deep Learning is a specialized tool designed to predict the onset of Alzheimer's disease (AD) by analyzing medical imaging data, such as MRI scans. AD is a neurodegenerative disease characterized by progressive and permanent memory loss, leading to a decline in intellectual and social skills. According to the Centers for Disease Control and Prevention, Alzheimer's is the most common form of dementia, often beginning with mild memory loss and progressing to difficulties with orientation, language comprehension, judgment, and the ability to engage in conversation or respond to the environment. It significantly impacts a person's ability to perform daily activities, with prevalence increasing in individuals over 65 years of age.This project utilizes deep learning models like Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN) to classify stages of dementia, ranging from non- demented to very demented, based on MRI data. By extracting critical features from these scans, the model aims to assist healthcare professionals in the early detection of Alzheimer's disease, potentially improving patient care and enabling timely intervention strategies. The system highlights the role of deep learning in advancing diagnostic tools and supporting medical decision-making.

II. LITERATURE REVIEW

Alzheimer's Disease (AD) is a condition that affects the brain, causing memory loss, confusion, and problems with thinking and communication. It is the most common type of dementia and affects millions of older people around the world. As the disease gets worse, people may find it hard to do daily tasks, recognize loved ones, or care for themselves. In later stages, they become fully dependent on caregivers. AD usually affects people over 65, and the risk increases as they age.Although there is no cure for Alzheimer's, some treatments can help manage its symptoms.

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Medicines like donepezil, rivastigmine, and memantine can slow down memory loss, but their effects are temporary.Doctors often use MRI (Magnetic Resonance Imaging) scans to help diagnose Alzheimer's. These scans show changes in the brain, such as shrinking of the hippocampus and thinning of the brain's outer layer, which are signs of the disease. MRI scans are safe and can detect these changes even in the early stages.However, diagnosing Alzheimer's early can be difficult because its symptoms are similar to other brain conditions. Deep learning models, like Convolutional Neural Networks(CNNs), can help by analyzing MRI scans to find patterns linked to Alzheimer's [1]. CNNs can spot changes in the brain automatically, such as shrinking and thinning in certain \areas.When CNNs are combined with Recurrent Neural Networks (RNNs), they work even better. CNNs study the details in each MRI scan, while RNNs track changes over time, helping to understand how the disease develops [2]. Other techniques, like support vector machines (SVM), can also improve accuracy [3].There are still challenges in using these models. For example, they need high-quality MRI images and a lot of labeled data to work well. Sometimes, models work well on training data but not on new data. To solve these problems, methods like transfer learning, data augmentation, and making the models easier to understand are being used [4].Researchers are also exploring new ways to improve Alzheimer's diagnosis. For example, hybrid models that combine CNNs with attention mechanisms or graph-based methods can capture more details. In the future, combining MRI scans with other data, like genetic or cognitive information, could make diagnoses even more accurate [5].

III. SYSTEM ARCHITECTURE

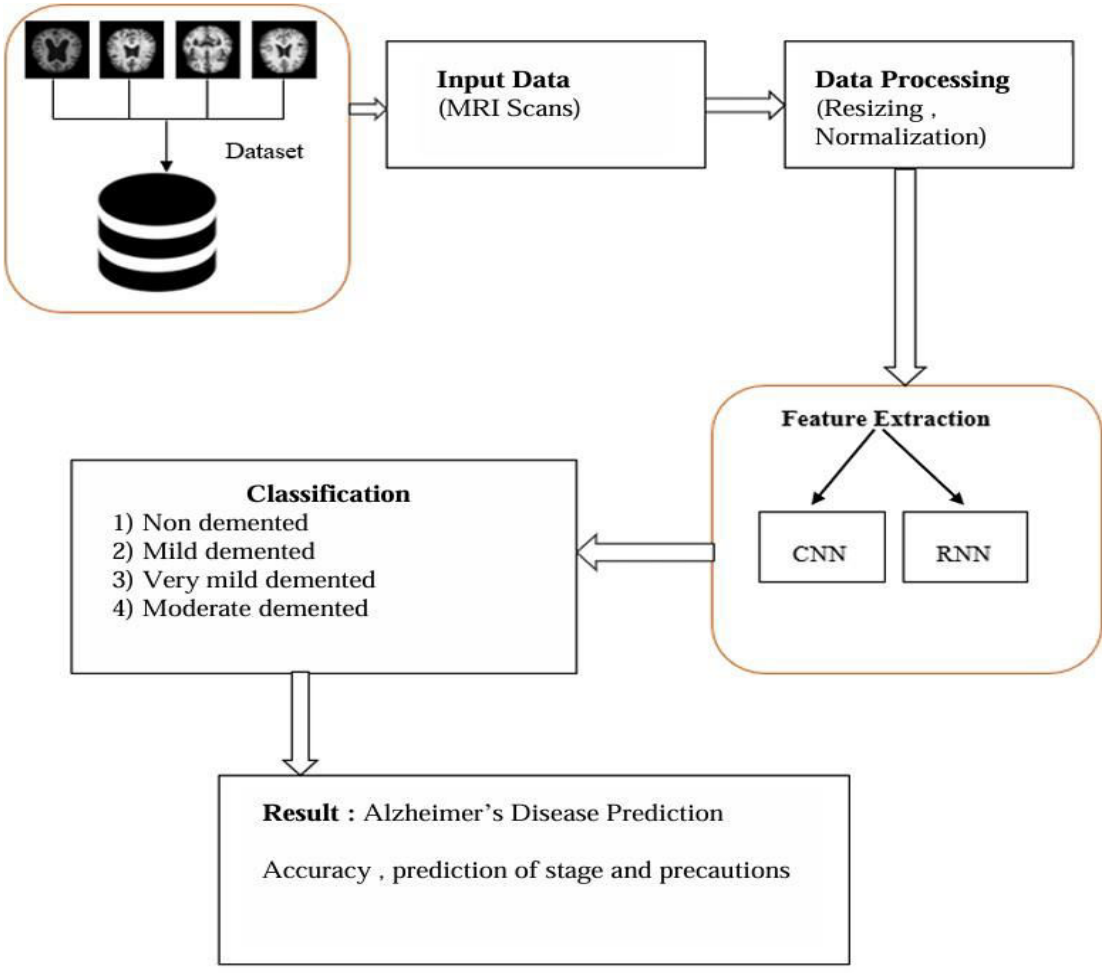

Fig.1.1 System Architecture

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1) Input Data (MRI Scans) : The process starts with MRI scans of the brain.
2) Data Processing : The MRI images are resized and normalized to prepare them for analysis.
3) Feature Extraction : This step uses Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN) to extract important features from the MRI images.
4) Classification : The extracted features are then classified into different categories: Non- Demented, Very Demented, Moderate Demented, or Mild Demented.
5) Output : The final output includes the accuracy of the diagnosis, the predicted class of dementia, and any recommended precautions.

IV. METHODOLOGY

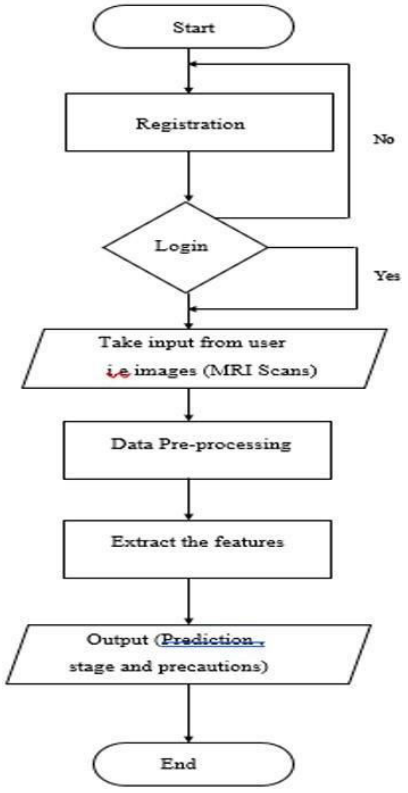

Fig.1.2 System flow diagram Step 1: Collecting MRI Scans

- **Source of Data:** MRI images are collected from trusted sources like the Alzheimer's Disease Neuroimaging Initiative (ADNI).
- **Categories:** The scans are divided into four stages of dementia:
    1. Non-demented (healthy brain)
    2. Very Mild Dementia (early-stage signs)
    3. Mild Dementia (more noticeable symptoms)
    4. Moderate Dementia (advanced stage requiring care)

Step 2: Pre processing the Data
Before using the data, the MRI scans must be cleaned and standardized:

- **Remove Poor-Quality Scans:**
  Eliminate images that are blurry, incomplete, or corrupted.

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- **Resize Images:**
  All scans are resized to the same dimensions (e.g., 224x224 pixels) for consistency.

- **Normalize Pixel Values:**
  Pixel intensities are adjusted to a uniform scale, usually between 0 and 1, to make the images easier for AI to process.
- **Data Augmentation:**
  To create a more diverse dataset, the following modifications are applied:
  1. Rotating images.
  2. Flipping horizontally or vertically.
  3. Zooming in slightly.

These techniques help the model learn from a broader variety of scenarios, improving accuracy.

Step 3: Building the AI Models

Two advanced machine learning models are used together to achieve high accuracy:

- **Convolutional Neural Network (CNN):**
  1. **Purpose:** Finds important features in the scans, like patterns, shapes, or textures that might indicate dementia.
  2. **Pretrained Models:** We use ResNet or VGGNet to enhance performance. These models are already trained on large image datasets, so they know how to recognize complex features.
- **Recurrent Neural Network (RNN) with LSTM:**
  1. **Purpose:** Analyzes the sequence and relationships of the features extracted by the CNN.
  2. **Why LSTM?** LSTM (Long Short-Term Memory) layers are ideal for identifying patterns and trends, such as the progression of dementia over time or across features.

Step 4: Training the System

- **Splitting the Data:**
  1. **Training Set (70%):** Used to teach the system.
  2. **Validation Set (20%):** Used to check how well the system is learning during training.
  3. **Test Set (10%):** Used to test the system on unseen data after training.
- **Training Process:**
  1. The CNN identifies features in the MRI scans.
  2. The RNN analyzes these features and predicts the dementia stage.
  3. The system compares its predictions with the correct answers and adjusts to improve accuracy.
- **Optimization Techniques:**
  1. **Adam Optimizer:** Helps the model learn efficiently.
  2. **Loss Function:** Measures the error (e.g., categorical cross-entropy) and guides improvements.

Step 5: Evaluating the Model

To ensure the system is accurate and reliable, we use the following evaluation metrics:

- **Accuracy Score:**
  1. The percentage of correct predictions made by the model.
- **F1 Score:**
  1. A balance between precision (how often it's correct) and recall (how well it detects all true cases).

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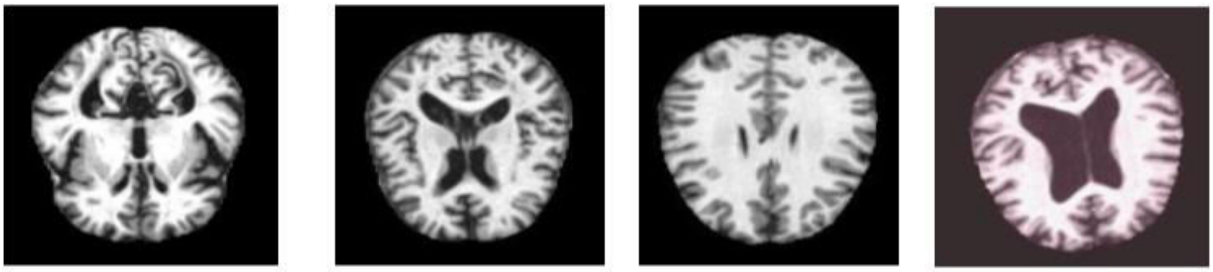
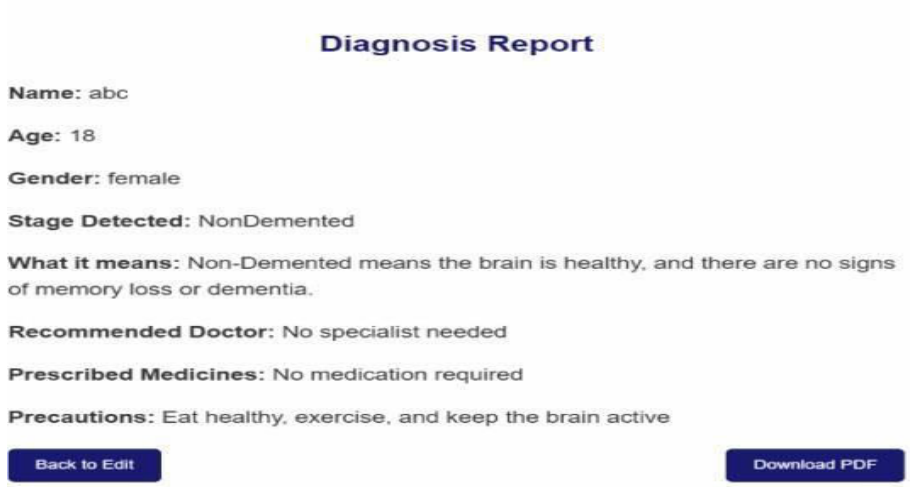
V. RESULT AND DECISION

Brain MRI Scan Images of Dataset :



Prediction :



Above image is the output. System will give similar output for each stage.

VI. CONCLUSION

The "Alzheimer's Disease Prediction Using Deep Learning" project seeks to create a predictive model capable of identifying the stages of Alzheimer's disease based on MRI scan data. By focusing on the stages ranging from non-demented to very demented, the deep learning model will provide an automated, scalable solution to support clinicians in diagnosing and managing Alzheimer's disease. This project emphasizes the potential of AI in healthcare, where early detection and stage classification can significantly improve treatment plans and enhance patient care outcomes.

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