

**MINI PROJECT :**

# **EARLY ALZHEIMER DISEASE DETECTION AND CLASSIFICATION**

by

Kunal(2021IMT-58)

Sidhant Kappor(2021IMT-100)

Sontake Swapnil Santosh(2021IMT-101)

Vishal Kumar(2021IMT-114)

Supervised by - Dr. Sunil Kumar



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# INTRODUCTION



ALZHEIMER'S  
AWARENESS



- Alzheimer's disease is a progressive neurological disorder that affects cognitive functions, primarily memory.
- The disease is characterized by the abnormal accumulation of two proteins in the brain: beta-amyloid plaques and tau protein tangles. These deposits lead to the degeneration and eventual death of nerve cells, causing a gradual decline in cognitive function.
- Common symptoms : memory loss, confusion, and change in behavior.
- While there's no cure, early diagnosis and interventions can help manage symptoms and improve quality of life.

## IMPORTANCE OF EARLY DETECTION

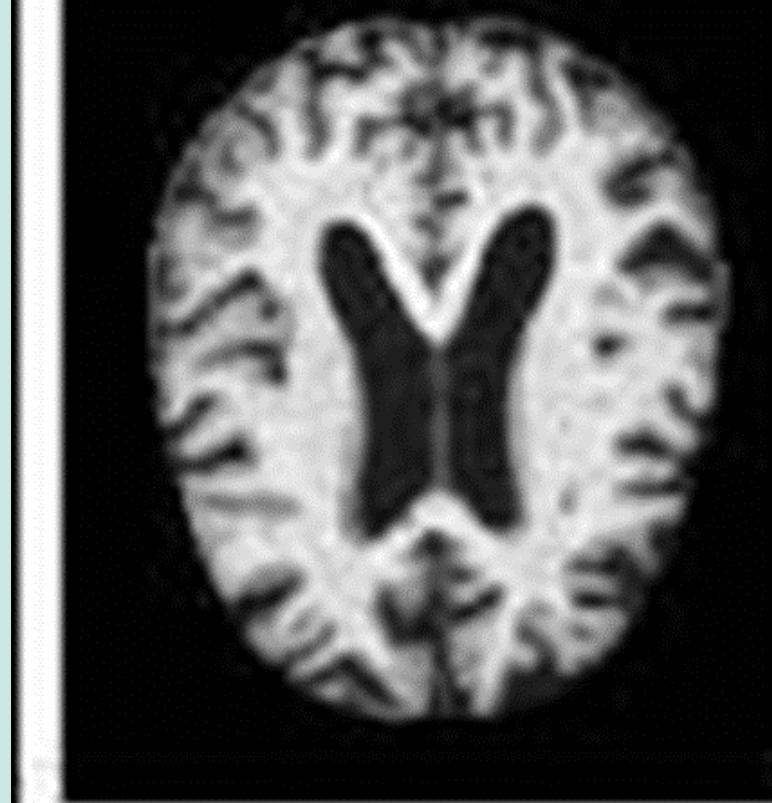
- Timely interventions, personalized care, improved quality of life.
- Efficient resource allocation, and advancing research.
- Effective treatments, better symptom management, and informed decision-making.
- Leads to healthcare systems, and research initiatives

## WHY ALZHEIMER'S DISEASE CLASSIFICATION IS CRUCIAL ?

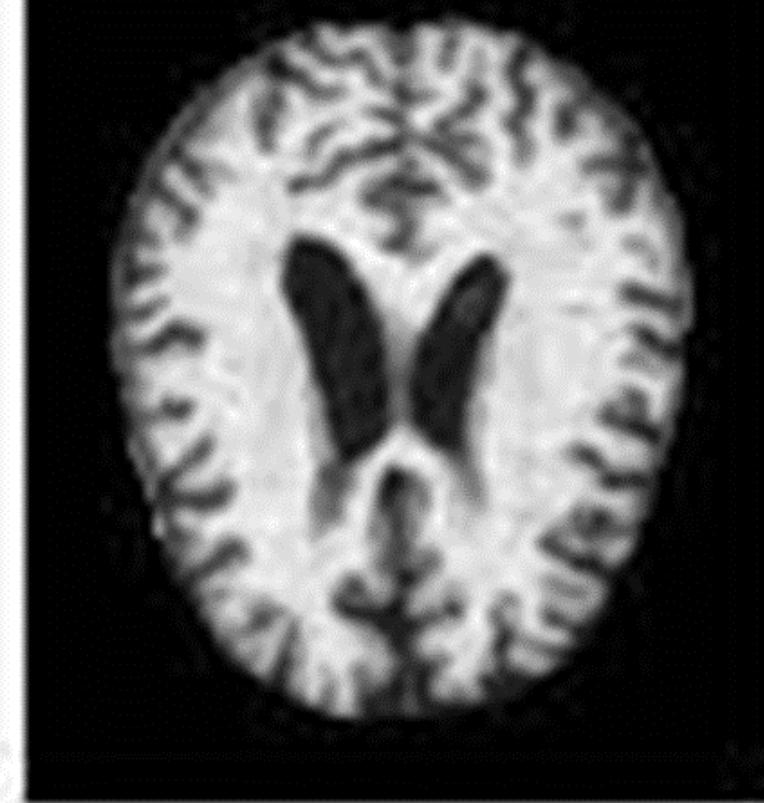
- **Timely Intervention:** Early detection enables effective treatment and management.
- **Personalized Care:** Tailored approaches improve treatment outcomes.
- **Quality of Life:** Accurate classification enhances symptom control.
- **Research and Trials:** Proper classification speeds up therapy development.
- **Patient-Caregiver Support:** Informed decisions for care planning.
- **Resource Allocation:** Efficient use of healthcare resources.

# DIFFERENT STAGES OF ALZHEIMER'S

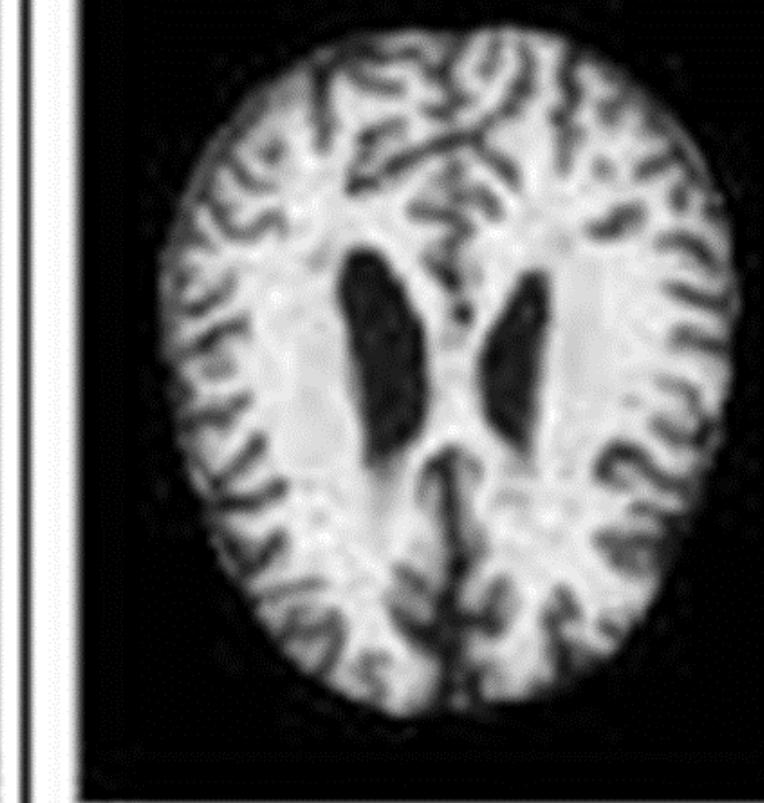
- Non-Demented: Individuals with no signs of dementia.
- Mild Demented: Individuals with mild cognitive impairment.
- Moderate Demented: Individuals with moderate cognitive impairment.
- Very Mild Demented: Individuals with very mild cognitive impairment



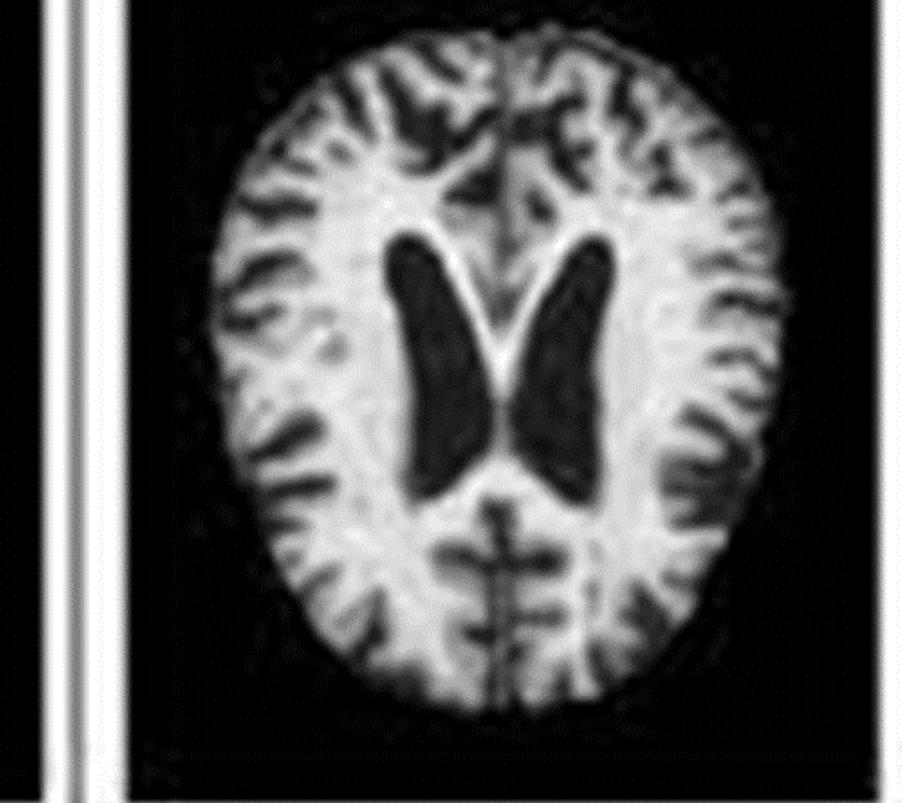
Non-Demented



Mild-Demented



Moderate-Demented



Very-Mild Demented

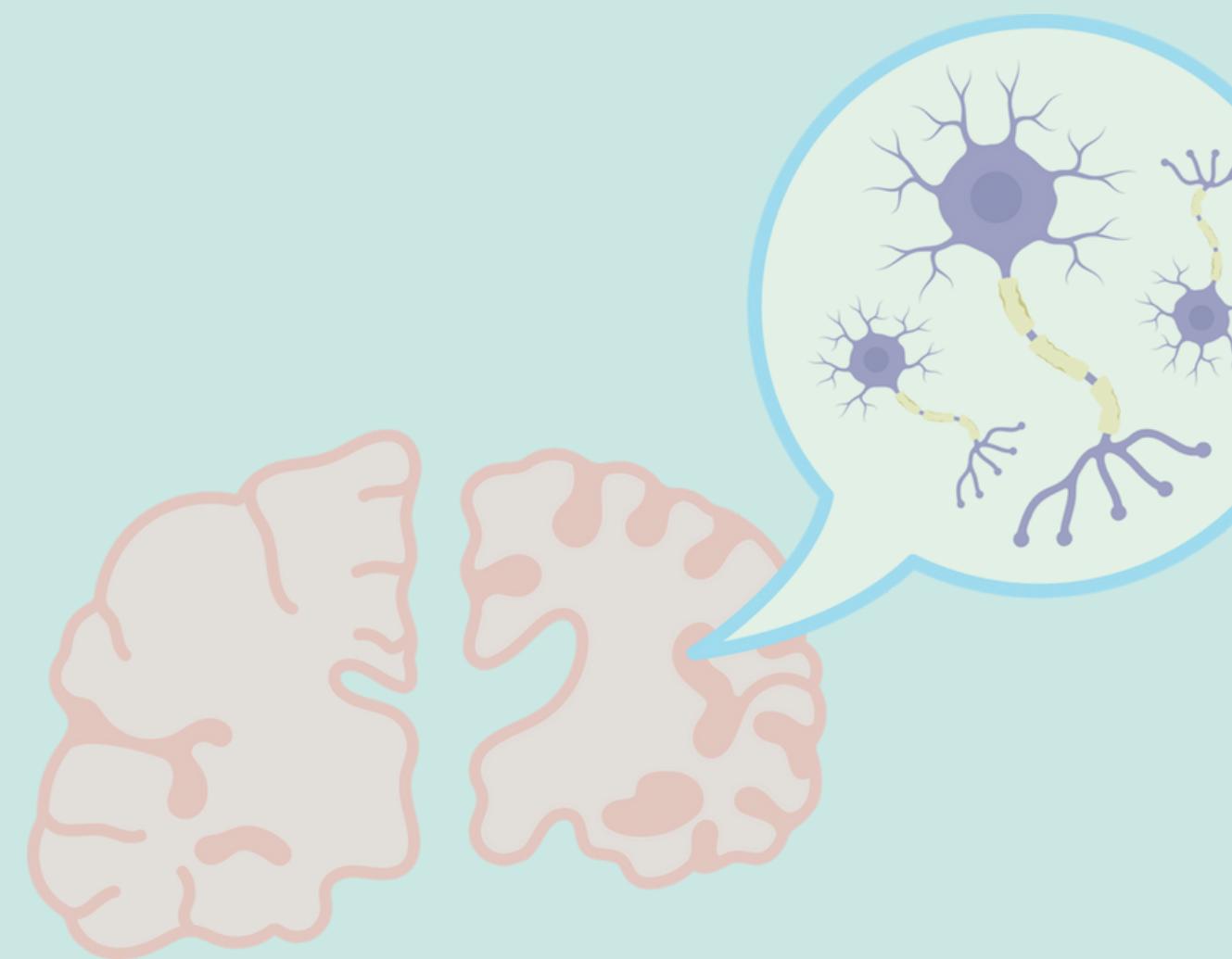
# PROBLEM STATEMENT

## Classifying Alzheimer Disease Stages from MRI Scan Images

- Alzheimer's disease, a progressive neurological disorder affecting millions globally, necessitates early detection and precise classification.
- The project's primary goal is to leverage advanced deep learning techniques to automatically classify distinct stages of Alzheimer's disease.
- Through the analysis of MRI scan images, the project aspires to contribute to the medical field by enhancing diagnostic accuracy and treatment planning

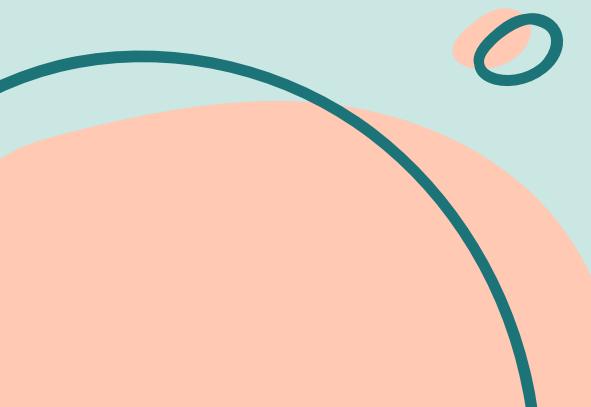
# OBJECTIVE

**Develop and evaluate a CNN-based model for Alzheimer's detection using brain MRI images, assessing its performance in accuracy, sensitivity, and specificity, and comparing results with state-of-the-art methods.**

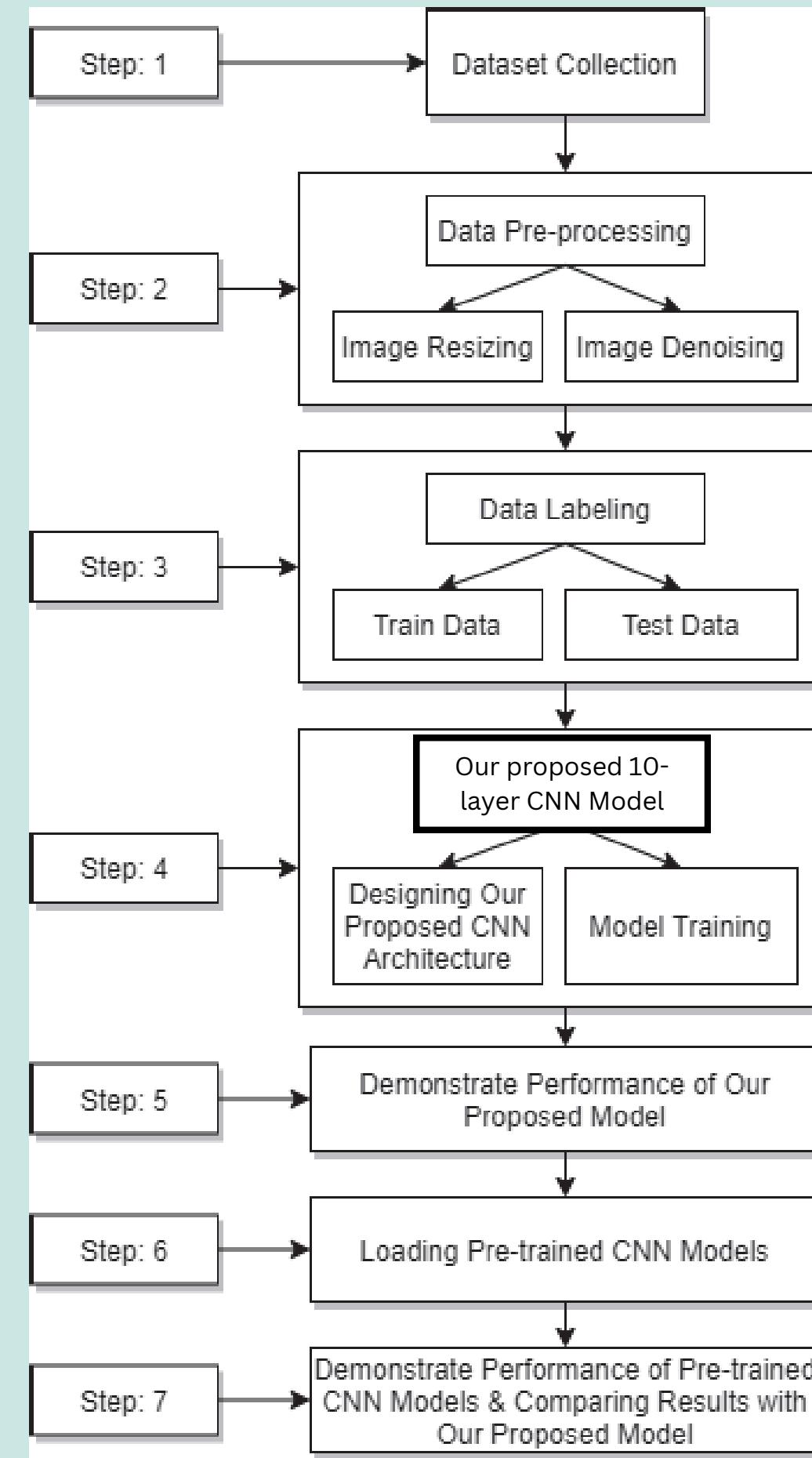


# BASE RESEARCH PAPER

- Base research paper: Emtiaz Hussain, Mahmudul Hasan, Syed Zafrul Hassan, Tanzina Hassan Azmi, Md Anisur Rahman, and Mohammad Zavid Parvez. Deep learning based binary classification for alzheimer's disease detection using brain mri images. In 2020 15th IEEE Conference on Industrial Electronics and Applications (ICIEA). IEEE, 2020.



# FLOWCHART



# DATA COLLECTION

## Data set collection summary / statistics

- **TOTAL NUMBER OF IMAGES: 6400**
- **IMAGE SIZE: 128X128 PIXELS (EACH IMAGE IS SQUARE)**
- **NUMBER OF CLASSES: (MILDDEMENTED, MODERATEDEMENTED, NONDEMENTED, AND VERYMILDDEMENTED)**
- **CLASS DISTRIBUTION: THE DISTRIBUTION OF IMAGES AMONG DIFFERENT CLASSES IN BOTH THE TRAINING AND TESTING SETS.**

# DATA PREPROCESSING

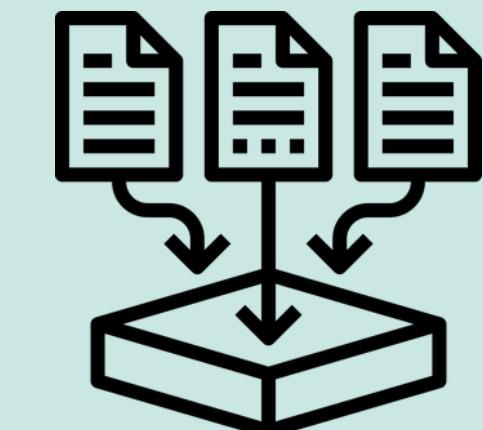
- 1) IMAGE RESIZING
- 2) IMAGE-TO-ARRAY CONVERSION
- 3) LABEL GENERATION
- 4) DATA SPLITTING
- 5) DATA SHUFFLING

### Training Data:

Mild Demented: 717 images  
Moderate Demented: 52 images  
Non Demented: 2560 images  
Very Mild Demented: 1792 images

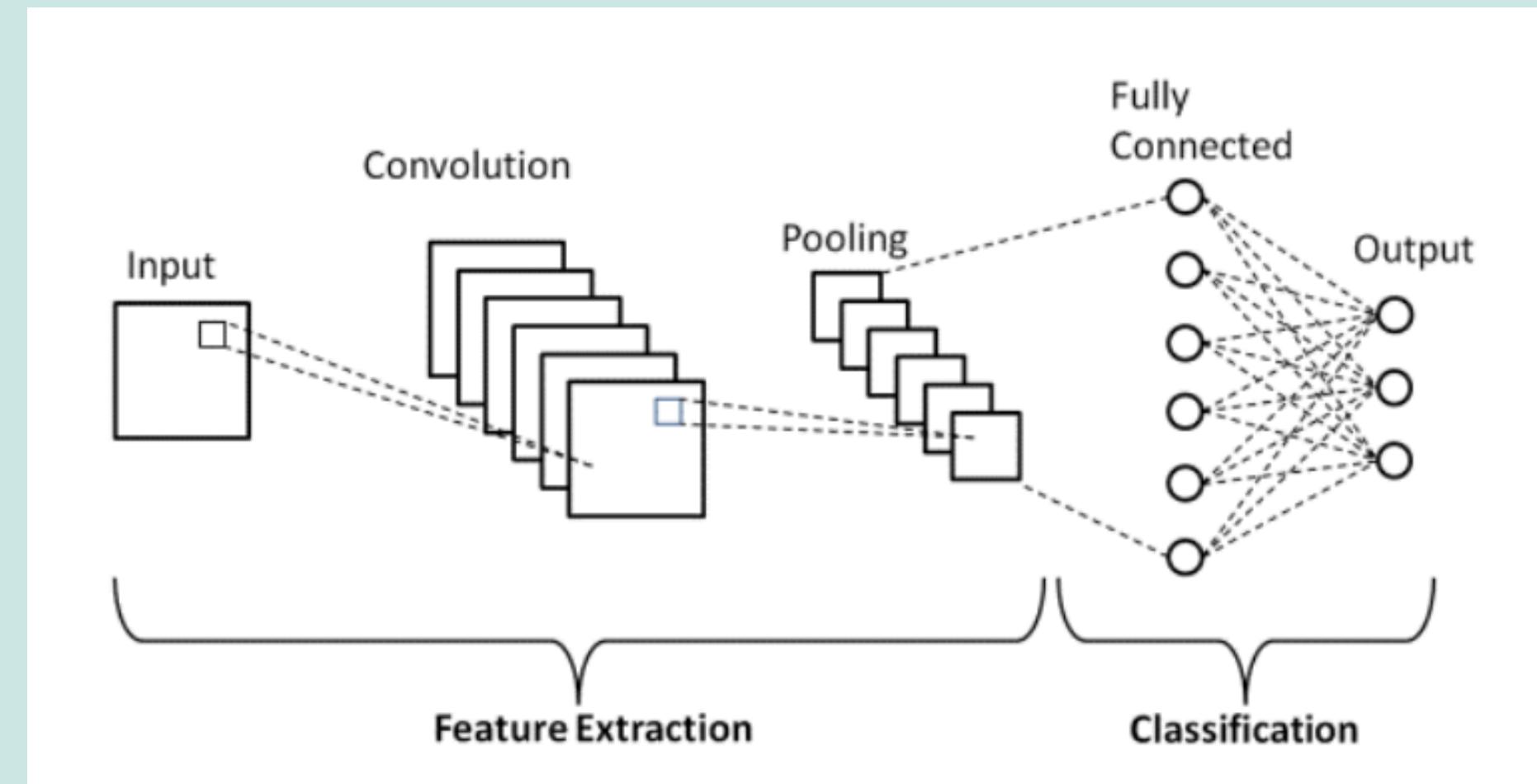
### Test Data:

Mild Demented: 179 images  
Moderate Demented: 12 images  
Non Demented: 640 images  
Very Mild Demented: 448 images  
Total Images: 6400



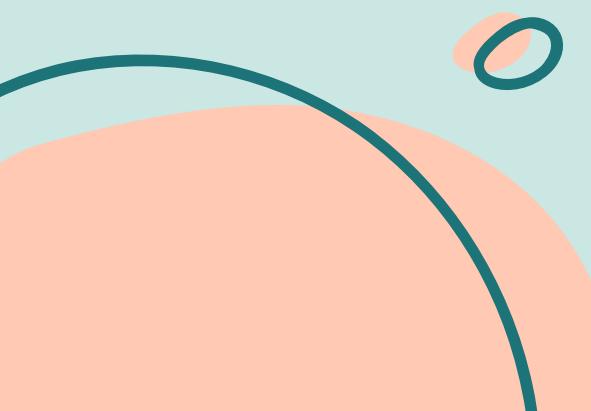
# Model Architecture : Sequential

The **Sequential** architecture is a type of neural network design in which layers are stacked sequentially, one after the other. Each layer in a **Sequential** model receives input from the previous layer and passes its output to the next layer. This linear stack of layers forms the backbone of the neural network, with data flowing through the layers in a single direction, from input to output.



# Why Sequential?

- **Simplicity:** Sequential models are easy to understand and implement due to their linear structure.
- **Flexibility:** They offer customization options for designing neural network architectures to suit specific tasks.
- **Ease of Training:** Suitable for training on small to medium-sized datasets efficiently.
- **Interpretability:** Linear structure facilitates analysis of learned representations for better understanding.



# Our proposed 11-layer CNN Model : Training

- Our Proposed 11-layer CNN model:
- In this section, we discuss our proposed 11-layer CNN model for the detection and classification of Alzheimer's disease using brain MRI images. Our 11-layer CNN model has five steps:
- Convolutional layer selection: In our proposed CNN model, we used Conv2D. We have used three conv2D layers in our model.
- Pooling layer selection: In this model, we have used Maxpooling2D. For every Conv2D layer, we have used a Maxpool2D layer. Therefore, we have used three Max-Pool2D layers.
- Flatten Layer: In our model, after using the pooling layer, we used a flatten layer to flatten the whole network.
- Dense Layer: After the flatten layer, we have used two dense layers. The dense layers are also known as fully connected layers.
- Activation Function: We have used Sigmoid function with another dense layer and ReLU function. ReLU is computationally efficient and has been shown to accelerate the convergence of gradient-based optimization algorithms during training.

| Model architecture layers                             |                      |         |
|---|----------------------|---------|
|   | OutputShape          | Param   |
| rescaling <sub>2</sub> (Rescaling)                    | (None, 180, 180, 3)  | 0       |
| conv2d <sub>3</sub> (Conv2D)                          | (None, 180, 180, 16) | 448     |
| max <sub>p</sub> ooling2d <sub>3</sub> (MaxPooling2D) | (None, 90, 90, 16)   | 0       |
| conv2d <sub>4</sub> (Conv2D)                          | (None, 90, 90, 32)   | 4640    |
| max <sub>p</sub> ooling2d <sub>4</sub> (MaxPooling2D) | (None, 45, 45, 32)   | 0       |
| conv2d <sub>5</sub> (Conv2D)                          | (None, 45, 45, 64)   | 18496   |
| max <sub>p</sub> ooling2d <sub>5</sub> (MaxPooling2D) | (None, 22, 22, 64)   | 0       |
| dropout (Dropout)                                     | (None, 22, 22, 64)   | 0       |
| flatten <sub>1</sub> (Flatten)                        | (None, 30976)        | 0       |
| dense <sub>2</sub> (Dense)                            | (None, 128)          | 3965056 |
| dense <sub>3</sub> (Dense)                            | (None, 4)            | 516     |

# Results

## 1. BEFORE DATA AUGMENTATION AND DROPOUT

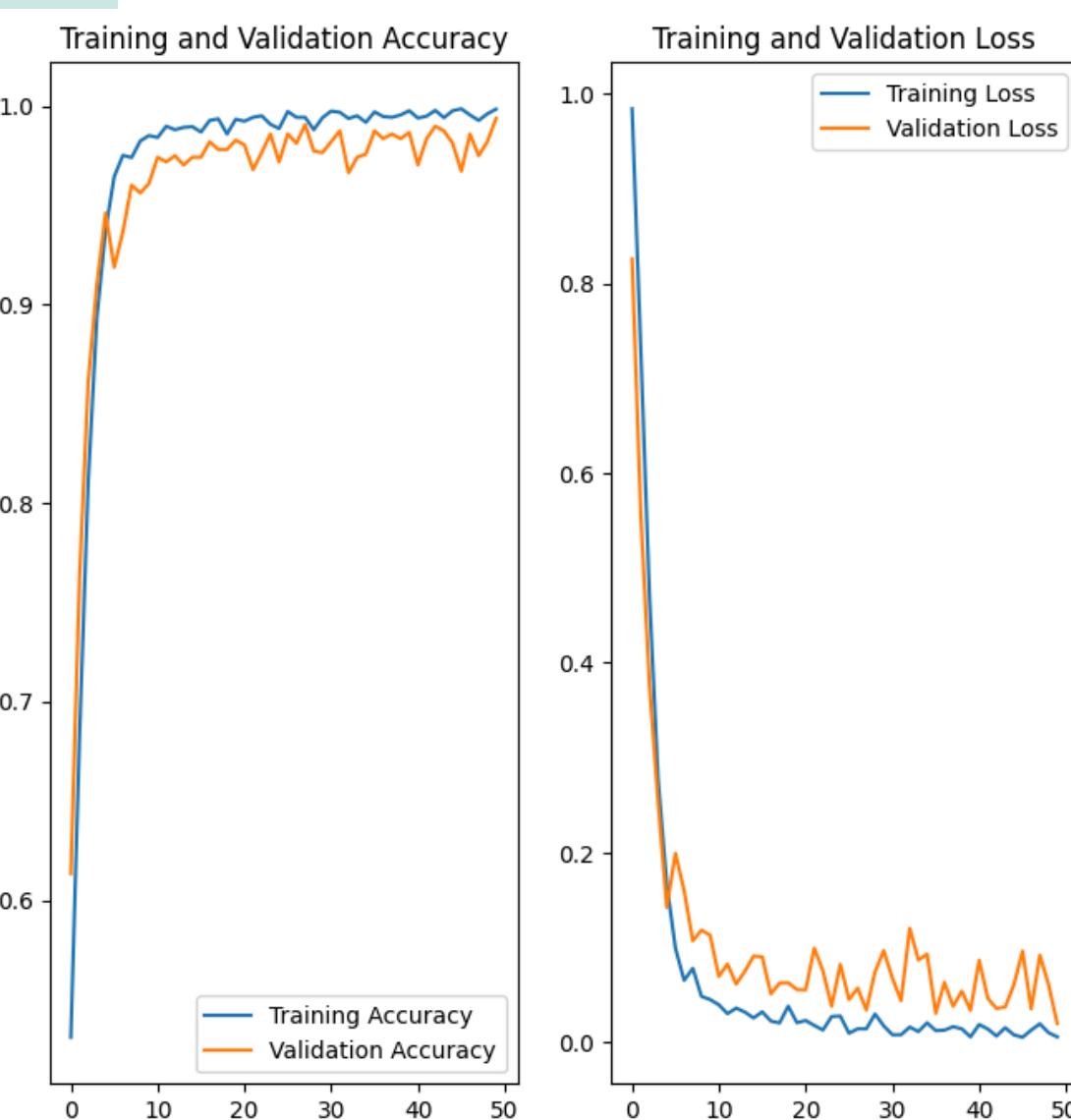
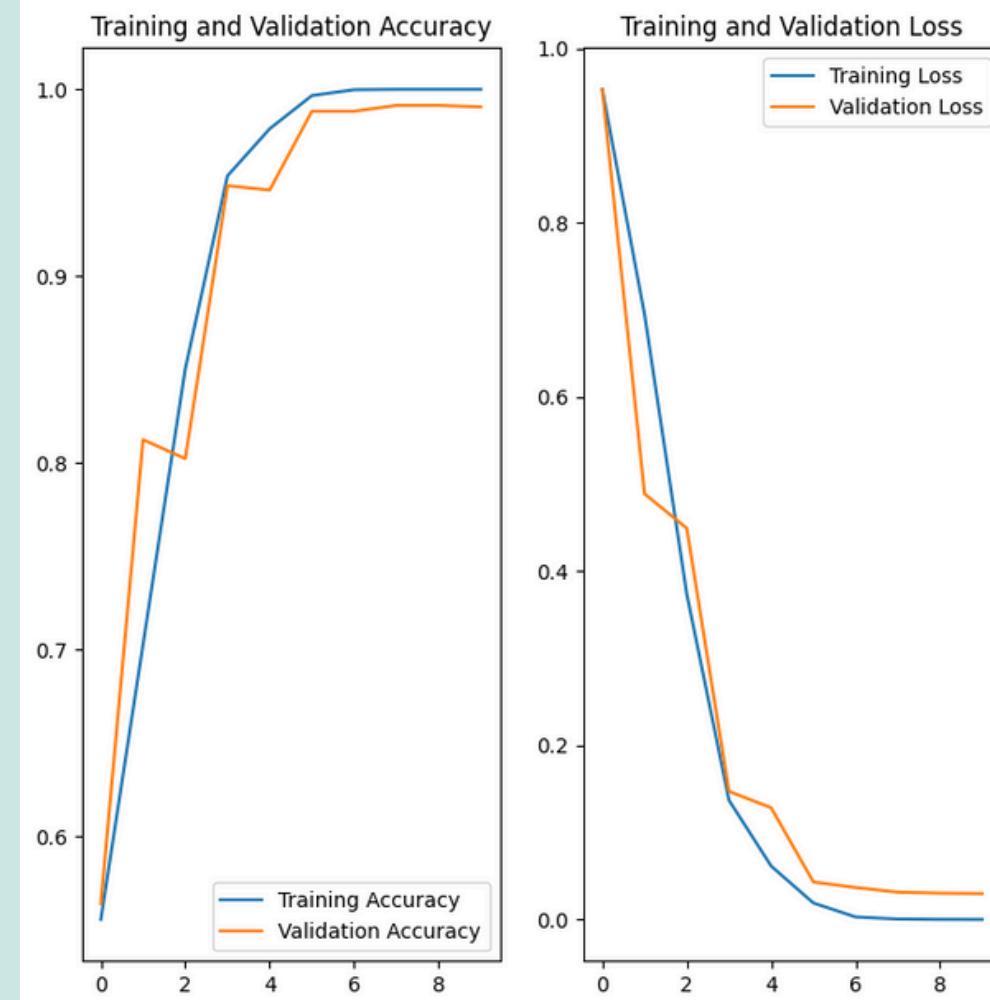
### LAYER

- **ACCURACY:** THE MODEL ACHIEVES AN ACCURACY OF AROUND 98.54% ON THE TRAINING DATA AND 98.34% ON THE VALIDATION DATA AFTER 10 EPOCHS.
- **LOSS:** BOTH TRAINING AND VALIDATION LOSS DECREASE STEADILY OVER EPOCHS, INDICATING GOOD CONVERGENCE.

## 2. AFTER DATA AUGMENTATION AND DROPOUT

### LAYER

- **ACCURACY:** THE MODEL ACHIEVES AN ACCURACY OF AROUND 99.84% ON THE TRAINING DATA AND 99.37% ON THE VALIDATION DATA AFTER 50 EPOCHS.
- **LOSS:** BOTH TRAINING AND VALIDATION LOSS DECREASE STEADILY OVER EPOCHS, INDICATING GOOD CONVERGENCE.



## CONCLUSION

- In conclusion, the model created for this experiment showed promise in MRI imagebased Alzheimer's disease stage prediction. A convolutional neural network (CNN) comprising three convolutional layers, max-pooling layers, dropout regularization, and fully connected layers made up the model architecture. A dataset of MRI pictures of Alzheimer's patients in various stages of the illness was used to train and assess the model. The model yielded training accuracy of 99.84% and validation accuracy of 99.37% after 50 epochs of training. These findings suggest that the model has made good progress on generalizing to new data.

## FUTURE SCOPE

- Future iterations of the app can incorporate multi-modal data fusion by integrating diverse sources of patient information, such as genetic data, biomarkers, and cognitive assessments. This holistic approach may provide a more comprehensive understanding of disease progression and enhance the accuracy of predictions.
- Enhancement by the implementation of a robust image validation filter to ensure the accuracy and validity of input images. By incorporating this filter, the model's reliability in classifying genuine brain MRI scans could be significantly enhanced, reinforcing the system's precision and clinical utility.
- Integration of Multimodal Data
- Pretrained models and transfer learning
- Advanced Architectures
- Improved interpretability and explainability
- Clinical Validation and Deployment
- tailored medicine
- Longitudinal Analysis
- Ethical and Regulatory Considerations

# Website Deployment

**Real-Time Predictions:** Following the upload of an image, the app processes it using the ensemble model to produce real-time predictions for the stage of Alzheimer's disease. A percentage indicating the degree of confidence in the outcome is included with the predictions.

**Resources for Education:** The app offers educational material on Alzheimer's disease to help users comprehend the disease's stages and its effects on different people. Users are given useful information that they might use for early identification and action.

**Contact and Feedback:** Users can communicate with the app by sending questions and comments using the contact form that is already there. This promotes participation and gives users a way to get more information or give input.

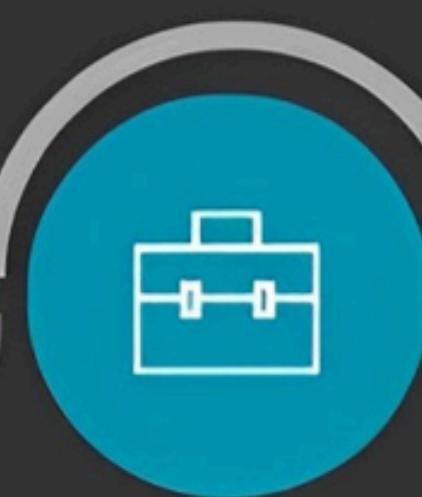
# DEPLOYMENT FLOWCHART

## CREATING SPACE



First we need to create a new space on huggingface

## CLONING



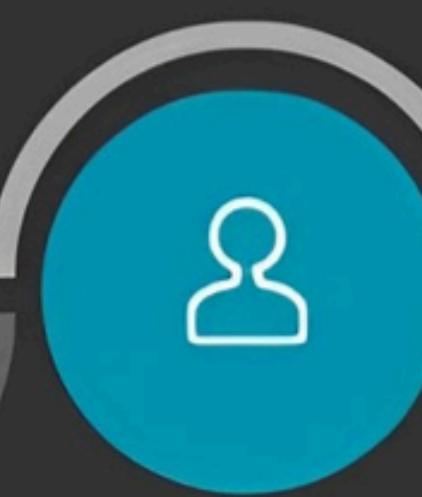
After that we need to clone the git repository on local machine.

## PUSHING



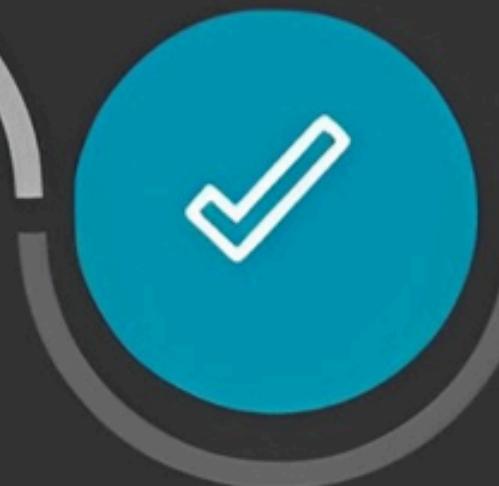
Now, it's time to add the app file and all its dependencies

## COMMIT



After pushing code made necessary changes and committed them.

## APP IS UP !



Now, our web app is live and running on huggingface space for the end user.

# Web Page Screenshot

Hi, Good Morning! 🙌

## Welcome To Alzheimer Disease Detection Web App

Alzheimer's disease is a progressive brain disorder that causes memory loss, cognitive decline, and changes in behavior.

[Learn More >](#)

For any querries or suggestions!

Insert image for classification:

Drag and drop file here  
Limit 200MB per file • PNG, JPG, JPEG

Browse files

Description:

We have devided the alzheimers disease into four stages namely:

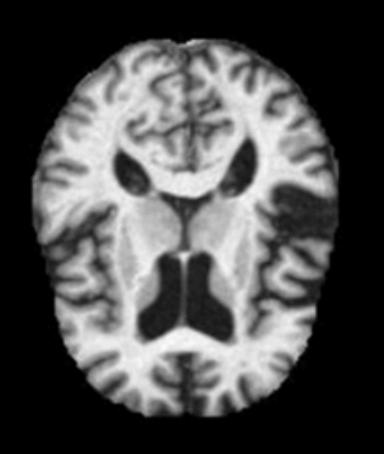
- Non-Demented: Individuals with no signs of dementia.
- Mild Demented: Individuals with mild cognitive impairment.
- Moderate Demented: Individuals with moderate cognitive impairment.
- Very Mild Demented: Individuals with very mild cognitive impairment." We are aiming at providing the early detection of the disease using this web application, which will help the early diagnosis.



# WEB PAGE SCREENSHOTS

## PREDICTED CLASS ALONG WITH ASSURITY OVER MRI

**Input Image**



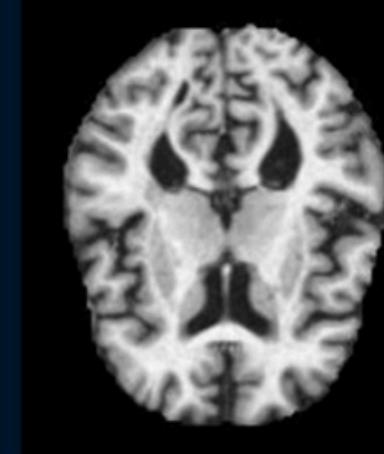
Uploaded Image

**Output**

**Predicted class:** VeryMildDemented

**With:** 85% assurity

**Input Image**



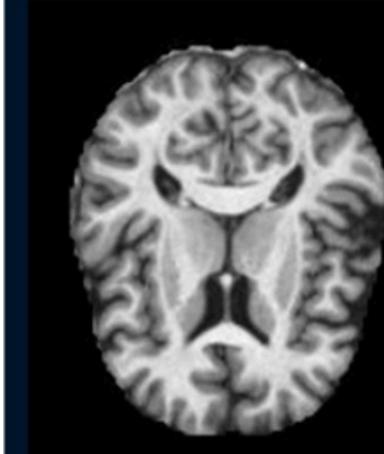
Uploaded Image

**Output**

**Predicted class:** NonDemented

**With:** 90% assurity

**Input Image**



Uploaded Image

**Output**

**Predicted class:** VeryMildDemented

**With:** 96% assurity

# WEB PAGE SCREENSHOTS

## PREDICTED CLASS ALONG WITH ASSURITY OVER MRI

### Input Image



Uploaded Image

### Output

#### Predicted class:

MildDemented

#### With:

33% assurity

LOW ACCURACY OVER  
RANDOM IMAGES

Hi, Good Morning! 🌞

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Alzheimer's disease is a progressive brain disorder that causes memory loss, cognitive decline, and changes in behavior.

[Learn More >](#)

#### Description:

We have devided the alzheimers disease into four stages namely:

- Non-Demented: Individuals with no signs of dementia.





Thankyou