CHAPTER – 1

INTRODUCTION

1.1 INTRODUCTION TO PROJECT

Alzheimer's disease is a type of brain disease, just as coronary artery disease is a type of heart disease. It is also a degenerative disease, meaning that is also a degenerative disease, meaning that it becomes worse with time. Alzheimer's disease is thought to begin 20 years or more before symptoms arise with small changes in the brain that are unnoticeable to the person affected. Only after years of brain changes do individuals experience noticeable symptoms, such as memory loss and language problems. Symptoms occur because nerve cells (neurons) in parts of the brain involved in thinking, learning and memory (cognitive function) have been damaged or destroyed. Individuals typically live with Alzheimer's symptoms for years. Over time, symptoms tend to increase and start interfering with individual's ability to perform everyday activities. At this point, the individual is said to have dementia due to Alzheimer's disease or Alzheimer's dementia. As the disease progresses, neurons in other parts of thebrain are damaged or destroyed. Activities that used to be core to the individual's identity, such as planning family events or participating in sports, may no longer be possible. Eventually, neurons in parts of the brain that enable a person to carry out basic bodily functions, such as walking and swallowing are affected. People in the final stages of Alzheimer's disease are bed-bound and require around - the- clock care. Alzheimer's disease is ultimately fatal. Alzheimer's is a neurological illness that occurs when brain cells are destroyed. Alzheimer patients suffer from confusion, difficulties in adapting to one's environment, problems related to speech and language skills, low motivation and problems. It is important to diagnose Alzheimer's illness early. Studies on Alzheimer illness have been conducted in the literature. In their study, Lee et al. used deep learning methods for the diagnosis of Alzheimer's disease. They stated that when they used a single data method separately, they obtained an accuracy rate of 75%, and the second method they used achieved an accuracy rate of 81% .

Goo et al. applied more than one method in their study. They obtained accuracy values of 87.62% with CNN architectures, 85.61% with 2D SIFT method, 86.31% with 2D Kaze method, 85.26% with 3D SIFT method, and 83.15% with 3D Kaze method. Zhao et al.

stated that they obtained 92% accuracy by using SVM method in their study using 15 healthy and 15 patient data. Ortiz et al. stated that using the deep learning methods, they increased the accuracy rate up to 90% in the diagnosis of the disease. Moradi et al. stated that they achieved 90.2% accuracy using SVM and cross-validated. They used 10 folders for cross-validated. They stated that the results of their study played a major role in the diagnosis of the illness. Salvatore et al. stated that they used a machine learning method that they optimized in their study for the diagnosis of Alzheimer disease and obtained the highest accuracy rate of 76%. Lu et al. used the multiscale deep neural network structure to diagnose Alzheimer's illness.

STATEMENT OF THE PROBLEM

Once –healthy neurons stop functioning, lose connections with other neurons and die, the damage initially appears to take place in the hippocampus. As more neurons die, additional parts of the brain are affected and begin to shrink, by the final stage of Alzheimer's damage is widespread and a brain tissue has shrunk significantly. So this disease have some disadvantages like initially they did the research for finding the drug for this disease then the focusing turned on analysis and prediction of the disease. The diagnosis at MCI stage will help the person to focus on healthy approach of life and good planning to take care of memory loss.

So, these diseases have some disadvantages like initially they did the research for finding the drug for this disease then the focusing turned on analysis and prediction of the disease.

BRIEF DESCRIPTION OF THE PROJECT

- Alzheimer's disease is a neurological condition in which the death of brain cells causes memory loss and cognitive decline Alzheimer's disease is a condition that affects the brain. The symptoms are mild at first and become more severe over time.It is named after Dr. Alois Alzheimer, who first described the condition in 1906.
- There is no treatment to cure Alzheimer's disease. The diagnosis at MCI stage will help the person to focus on healthy approach of life, and good planning to take care of approach of life, and good planning to take care of.
- The objective of the AD Detect and prevent project is to develop an integrated and seamless solution for people with Alzheimer's disease. It proposes to identify Alzheimer's disease based on image processing using functional MRI images.

Methodology

REASON FOR CHOOSING WATERFALL MODEL FOR DEVELOPMENT PROCESS

- Clear project objectives.
- Stable project requirements.
- Progress of system is measurable.
- Strict sign-off requirements
- Helps you to be perfect.
- Logic of software development is clearly understood.
- Production of a formal specification.
- Better resource allocation.
- Improves quality, the emphasis on requirements and design before writing a single line of code ensures minimal wastage of time and effort and reduces the risk of schedule slippage.

Less human resources required as once one phase is finished those people can start working on to the next phase.

The proposed system consists of the following 5 steps :

STAGE 1 : INPUT IMAGE

Take as input, MRI scan of a patient. Generally input to CNN are image pixel values. CNN extracts the features in the input image and learns some weight over the epochs.

STAGE 2 : GRAYSCALING

Convert the image to grayscale .The complete pixel turns to gray, no other color will be seen.

STAGE 3: CONVERT GRAY SCALING TO ARRAY

Here, Numpy is used to convert the gray scale image into array format.

STAGE 4 : MODEL INPUT

Input the array values to the model as per requirement .

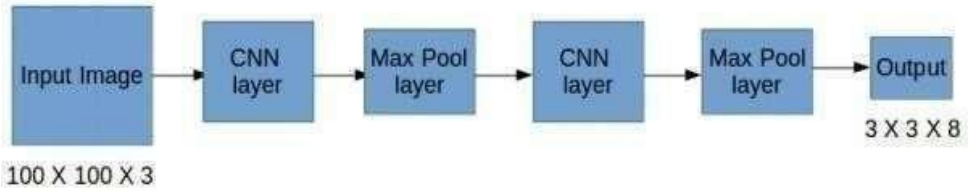


Figure :1.1 Trained model

STAGE 5 : PREDICT THE DATA

Use the trained classifier to predict the output for the patient's MRI scan. Given data is checked here, whether it is predicting properly or not.

Significance and Relevance of Work

Alzheimer's disease (AD) is most common type of dementia, is an incurable, progressive neurological brain disease beginning with mild memory loss, possibly leading to loss of the ability to carry on a conversation and respond to environments. It can severely affect the person's ability to carry out daily activities.

Early detection of Alzheimer's disease can help with proper treatment and prevent brain tissue damage. Several statistical and machine learning models have been exploited for Alzheimer's disease diagnosis.

SOFTWARE AND HARDWARE SPECIFICATION

System Requirement Specification is a fundamental document, which forms the foundation of the software development process. It not only lists the requirements of a system but also has a description of its major feature. An SRS is basically an organization's understanding (in writing) of a customer or potential client's system requirements and dependencies at a particular point in time (usually) prior to any actual design or development work. It's a two- way insurance policy that assures that both the client and the organization understand the other's requirements from that perspective at a given point in time. The SRS also functions as a blueprint for completing a project with as little cost growth as possible. The SRS is often referred to as the "parent" document because all subsequent project management documents, such as design specifications, statements of work, software architecture specifications, testing and validation plans, and documentation plans, are related to it. It is important to note that an SRS contains functional and non-functional requirements only.

It doesn't offer design suggestions, possible solutions to technology or business issues, or any other information other than what the development team understands the customer's system requirements.

HARDWARE REQUIREMENTS

- Processor: Intel Core i5 or above.
- RAM: 8GB or above.
- Standard Keyboard and Mouse.
- Hard Disk Space: 100GB.
- Camera for recording and capturing the frame.
- Stable Internet Connection (512kbps and above).

SOFTWARE REQUIREMENTS

1. Operating System: Windows 7 or above, Linux.
2. Python Compiler (Jupiter/PyCharm/IDLE).
3. Python Interpreter (IDLE)
4. The following Python Libraries to be installed:
    a) TensorFlow
    b) Tensor board
    c) Keras
    d) Joblib
    e) h5py
    f) opencv
    g) pillow

a) TensorFlow:

Tensor Flow is Google's Open Source Machine Learning Framework for dataflow programming across a range of tasks. Nodes in the graph represent mathematical operations, while the graph edges represent the multi-dimensional data arrays (tensors) communicated between them.

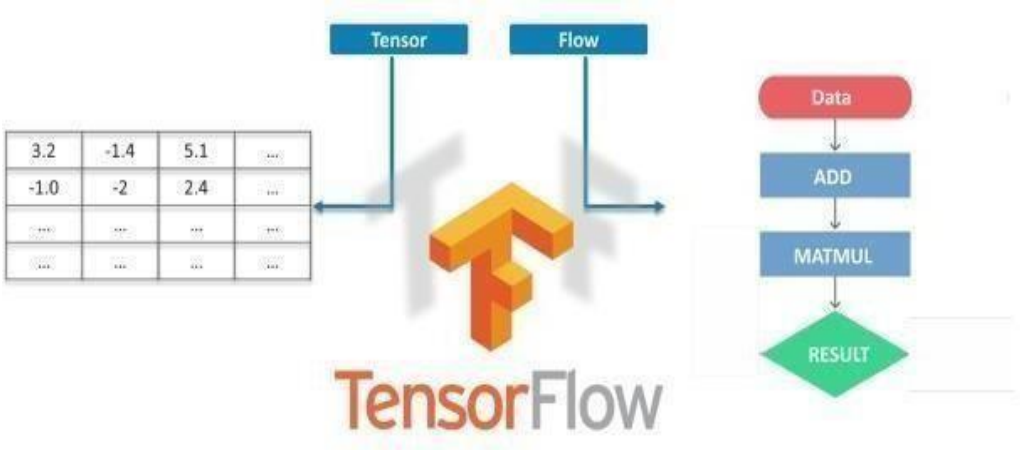


Figure 1.2 Tensor Flow

Tensors are just multidimensional arrays, an extension of 2-dimensional tables to data with a higher dimension. There are many features of TensorFlow which makes it appropriate for Deep Learning.

b) TensorBoard:

TensorBoard is a visualization toolkit for TensorFlow. It provides a suite of web applications that allow you to visualize your TensorFlow runs and graphs. TensorBoard can be used to track training progress, visualize model graphs, and inspect hyperparameters.

TensorBoard is a tool for providing the measurements and visualizations needed during the machine learning workflow. It is a visualization framework of TensorFlow for understanding and inspecting machine learning algorithm flow. TensorBoard enables tracking experiment metrics like loss and accuracy, visualizing the model graph, projecting embeddings to a lower dimensional space

c) Keras:

Keras is a deep learning API written in Python, running on top of the machine learning platform Tensor Flow. It was developed with a focus on enabling fast experimentation.

The Keras functional API is useful for creating complex models, such as multi-input/multi- output models, directed acyclic graphs (DAGs), and models with shared layers. The functional API uses the same layers as the Sequential model but provides more flexibility in putting them together.

d) Joblib:

Joblib is a Python library for running computationally intensive tasks in parallel. It provides a set of functions for performing operations in parallel on large data sets and for caching the results of computationally expensive functions.

Joblib is a popular library for machine learning, as it can be used to speed up the training and prediction of machine learning models. It can also be used to cache the results of expensive computations, so that they do not need to be repeated.

Joblib is a set of tools to provide lightweight pipelining in Python. It provides utilities for saving and loading Python objects that make use of NumPy data structures, efficiently parallelizing CPU-bound computations using threads and/or processes, and making it easy to launch parallel computations from IPython notebooks.

e) h5py:

Joblib and h5py are two different libraries that serve different purposes. Joblib is used to accelerate the model training process by enabling multiprocessing across several machines or cores on a single machine . On the other hand, h5py is a Pythonic interface to the HDF5 binary data format. It lets you store huge amounts of numerical data and easily manipulate that data from NumPy .

The h5py library is a Python interface to the HDF5 binary data format. HDF5 is a popular format for storing large amounts of data, and h5py makes it easy to read, write, and manipulate HDF5 files from Python.

f) OpenCV:

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. Being a BSD-licensed product, OpenCV makes it easy for businesses to utilize and modify the code.

The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms. These algorithms can be used to detect and recognize faces, identify objects, classify human actions in videos, track camera movements, track moving objects, extract 3D models of objects, produce 3D point clouds from stereo cameras, stitch images together to produce a high resolution image of an entire scene, find similar images from an image database, remove red eyes from images taken using flash, follow eye movements, recognize scenery and establish markers to overlay it with augmented reality, etc.

Figure :1.3 OpenCV Logo

OpenCV has more than 47 thousand people of user community and estimated number of downloads exceeding 18 million. The library is used extensively in companies, research groups and by governmental bodies. Along with well- established companies like Google, Yahoo, Microsoft, Intel, IBM, Sony, Honda, Toyota that employ the library, there are many startups such as Applied Minds, VideoSurf, and Zeitera, that make extensive use of OpenCV. OpenCV leans mostly towards real-time vision applications and takes advantage of MMX and SSE instructions when available. A full- featured CUDA and OpenCL interfaces are being actively developed right now. There are over 500 algorithms and about 10 times as many functions that compose or support those algorithms. OpenCV is written natively in C++ and has a templated interface thatworks seamlessly with STL containers. The library is cross-platform. It focuses mainly on real-time image processing. If the library finds Intel's Integrated Performance Primitives on the system, it will use these commercial optimized routines to accelerate it. OpenCV is NOT a piece of software that you run and process images. You need to write code. Also, OpenCV is not some executable file that you double click and it'll start working. It is pure code, library files and DLL files. When you write your own code, you "link" to these library files to access the OpenCV functions.

g) Pillow:

Pillow is a popular Python module that provides a rich set of tools and functions for image processing and manipulation. It is an open-source library that builds upon the capabilities of the Python Imaging Library (PIL) and offers an easy-to-use interface for working with images in various formats.

One of the key strengths of Pillow is its extensive support for image file formats. It can read and write a wide range of image file formats, including popular formats like JPEG, PNG, GIF, BMP, TIFF, and more. This versatility allows developers to work with images from different sources and convert between formats effortlessly.

Pillow provides a comprehensive set of functions for image manipulation. It offers operations like resizing, cropping, rotating, flipping, and adjusting image properties such as brightness, contrast, and color balance. These operations enable developers to preprocess and transform images as needed for various applications, such as computer vision, web development, and data analysis.

1.2 FUNCTIONAL AND NON-FUNCTIONAL REQUIREMENTS

FUNCTIONAL REQUIREMENTS

Functional Requirement defines a function of a software system and how the system must behave when presented with specific inputs or conditions. These may include calculations, data manipulation and processing and other specific functionality. In this system following are the functional requirements:

- Collect the MRI Images.
- Train the Model.
- Predict the results.

NON-FUNCTIONAL REQUIREMENTS

Non-functional requirements are the requirements which are not directly concerned with the specific function delivered by the system. They specify the criteria that can be used to judge the operation of a system rather than specific behaviors. They may relate to emergent system properties such as reliability, response time and store occupancy. Nonfunctional requirements arise through the user needs, because of budget constraints, organizational policies, and the need for interoperability with other software and hardware systems or because of external factors such as:

1. Product Requirements
2. Organizational Requirements
3. User Requirements
4. Basic Operational Requirements.

PRODUCT REQUIREMENTS

- **Portability:** Since the software is developed in python it can be executed on anyplatform with minor or no modifications.

- **Correctness:** It followed a well-defined set of procedures and rules to compute and also rigorous testing is performed to confirm the correctness of data.

- **Ease of Use:** The front end is designed in such a way that it provides an interface whichallows the user to interact in an easy manner.

- **Modularity:** The complete product is broken up into many modules and well-definedinterfaces are developed to explore the benefit of flexibility of the product.

- **Robustness:** This software is being developed in such a way that the overall performance is optimized and the user can expect the results within a limited time with almost relevancy and correctness. python itself possesses the feature of robustness, which implies the failure of the system is negligible.

Non-functional requirements are also called the qualities of a system. These qualities can be divided into execution quality & evolution quality. Execution qualities are security & usability of the system which are observed during run time, whereas evolution quality involves testability, maintainability, extensibility or scalability.

ORGANIZATIONAL REQUIREMENTS

Process Standards: IEEE standards are used to develop the application which is the standard used by the most of the standard software developers all over the world.

Design Methods: Design is one of the important stages in the software engineering process. This stage is the first step in moving from problem to the solution domain. In other words, starting with what is needed design takes us to work how to satisfy the needs.

The design of the system is perhaps the most critical factor affecting the quality of the softwareand has a major impact on the later phases, particularly testing and maintenance. We have to design the product with the standards which has been understood by the developers of the team.

USER REQUIREMENTS

The user must be able to visualize Graphical User Interface Window.

BASIC OPERATIONAL REQUIREMENTS

The customers are those that perform the eight primary functions of systems engineering, with special emphasis on the operator as the key customer. Operational requirements will define the basic need and, at a minimum, will be related to these following points:

Mission profile or scenario: It describes about the procedures used to accomplish mission objective. It also finds out the effectiveness or efficiency of the system.

Performance and related parameters: It point out the critical system parameters to accomplish the mission.

Utilization environments: It gives a brief outline of system usage. Finds out appropriate environments for effective system operation.

Operational life cycle: It defines the system lifetime.

CHAPTER - 2

LITERATURE SURVEY

A literature survey or a literature review in a project report shows the various analyses and research made in the field of interest and the results already published, taking into account the various parameters of the project and the extent of the project. Literature survey is mainly carried out in order to analyze the background of the current project which helps to find out flaws in the existing system & guides on which unsolved problems we can work out. So, the following topics not only illustrate the background of the project but also uncover the problems and flaws which motivated to propose solutions and work on this project.

A literature survey is a text of a scholarly paper, which includes the current knowledge including substantive findings, as well as theoretical and methodological contributions to a particular topic. Literature reviews use secondary sources, and do not report new or original experimental work. Most often associated with academic-oriented literature, such as a thesis, dissertation or a peer-reviewed journal article, a literature review usually precedes the methodology and results sectional though this is not always the case. Literature reviews are also common in are search proposal or prospectus (the document that is approved before a student formally begins a dissertation or thesis). Its main goals are to situate the current study within the body of literature and to provide context for the particular reader.

Literature survey is mainly carried out in order to analyze the background of the current project which helps to find out flaws in the existing system & guides on which unsolved problems we can work out. So, the following topics not only illustrate the background of theproject but also uncover the problems and flaws which motivated to propose solutions and work on this project. A variety of research has been done on power aware scheduling. Following section explores different references that discuss about several topics related to power aware scheduling.

Literature reviews are a basis for researching nearly every academic field. A literature survey includes the following.

- Existing theories about the topic which are accepted universally.
- Books written on the topic, both generic and specific.
- Research done in the field usually in the order of oldest to latest.
- Challenges being faced and on-going work, if available.

Literature survey describes about the existing work on the given project. It deals with the problem associated with the existing system and also gives user a clear knowledge on how to deal with the existing problems and how to provide solution to the existing problems.

Objectives of Literature Survey

- Learning the definitions of the concepts.
- Access to latest approaches, methods and theories.
- Discovering research topics based on the existing research.

[1] Ali H. Al-nuaimi et.al "Changes in the EEG Amplitude as a Biomarker for Early Detection of Alzheimer's Disease",2016 30th Annual International Conference of the IEEE Engineering in Medicine and Biology society (EMBC).

Advantage:

This study provides a novel framework for constructing robust biomarkers that can be usedto detect AD with high performance (sensitivity and specificity closed to 100%) by exploiting the combined strengths of different biomarkers. The resulting EEG biomarkers may be used in clinical studies performed in patients with AD in response to the need for a gate keeper screening tests of large groups of the aging population.

Limitation:

The main limitation of this study was the size of the cross-sectional dataset of AD patients and old subjects. In addition, specificity and association with established biomarkers such as CSF tau or PET amyloid imaging should be investigated. For future work, we will evaluate our method with larger size longitudinal EEG datasets, from different settings, that contain normal, MCI and AD subjects.

[2] Imene Garali et.al "Region-Based Brain Selection and Classification on PET Images for Alzheimer's Disease Computer Aided Diagnosis",2015 IEEE International Conference on Image Processing (ICIP).

Advantage:

In this work, a machine learning based approach for detection of Alzheimer's disease is proposed. The OASIS dataset was used for experiments. The texture, area and shape features from hippocampus region of MRI scan are extracted. The textual features from OASIS were also extracted. These features were used to train the neural network with errorback propagation for classification. The proposed system has an average accuracy of 86.8 %.

Limitation:

The overall accuracy found was 86.8%. The accuracy is less as compared to other system.

[3] Machine Learning Framework for Implementing Alzheimer's Disease by Sivakani R and Gufran Ahmad Ansari.

Advantage:

The contribution of this paper is pre-processing the dataset, feature selection, the featureextraction and classification.

Limitation:

They used EM algorithm for feature extraction and best first algorithm for feature selection but a better algorithm can be used to improve the performance.

[4] Devi Srawinda and Alhadi Bustaman proposed an Advanced Local Binary Pattern(ALBP) method.

Advantage:

ALBP method was introduced as 2D and 3D features extraction descriptors. This proposed work gives better performance and accuracy compared to the previous LBP method.

Limitations:

The average accuracy achieved for whole brain and hippocampus data was between 80%and 100%. The extracted feature vector has high dimensionality, requires high computation for processing and can be improvised using parallel computing for feature extraction from large brain datasets of MRI.

[5] Saraswathi et.al proposed an Alzheimer's Disease detection method using combination of three machine learning algorithms.

Advantage:

The classification is done using Extreme Learning Machine (ELM) and the Advanced Particle Swarm Optimization (PSO) algorithm optimizes the classification results.

Limitations:

The proposed approach can differentiate between very mild AD and normal cases more accurately. Better algorithm can be used for classifying.

[6] Classification of Alzheimer's disease in MRI based on Dictionary learning and heavy tailed modelling by Perla Mayo, Robin Holmes and Alin Achim.

Advantage:

This model presents aid in the task of classification of structural MRI scans. The classifications performed using a Support Vector Machine

Limitations:

The accuracy of this approach is 86%. They have used OMP to obtain the space coefficientvectors for the patches, however an algorithm that could offer a better estimation and lead to higher accuracy can be used.

[7] Yang Han and Xing-Ming Zhao proposed a feature selection-based approach known as Hybrid Forward Sequential Selection for detection of Alzheimer's Disease.

Advantages:

In this approach the features were ranked, and top-k features are selected. The SupportVector Machine was used as the classifier.

Limitations:

This study shows that proposed approach outperforms other features selection methods, improves accuracy of diagnosis and reduces computational coast.

[8] Vander Lee SJ , Teunissen CE ,Pool R, Shipley MJ, Teumer A, Chouraki V "Circulating metabolites and general cognitive ability and dementia" 2018.

Advantages:

General cognitive ability was higher in participants with higher education and was inversely associated with increasing age and the presence of APOE ε4 allele. Increased HDL-C was associated with higher general cognitive ability whereas fasting glucose levels were associated with lower cognitive ability.

Limitations:

The accuracy of this approach is 86%. They have used OMP to obtain the space coefficient vectors for the patches, however an algorithm that could offer a better estimation and lead to higher accuracy can be used.

[9] K.R Kruthika , Rajeswari , HD Maheshappa , "Multistage classifier –based approach for Alzheimer 's disease prediction and retrieval" ,Informatics in medicine unlocked 2019.

Advantages:

The study by using all available imaging and non-imaging clinical data for optimized knowledge extraction and distillation. Secondly, our teacher network only utilized the patients with complete multi-modal data. The patients missing some modalities of data were excluded.

Limitations:

There are some problems for discriminating MCI and NC states versus AD. the fault alarm rate for the AD class was smaller than the other classes - NC and MCI. This means that advanced biomarkers and biochemical information are needed to combine structural MRI biomarkers for better performance of the diagnosis between MCI and NC classes.

[10] M. RANGINI, Dr. G, WISELIN JIJI "Detection of Alzheimer's Disease Through Automated Hippocampal Segmentation", 2013 International Multi Conference on Automation, Computing, Communication, Control and Compressed Sensing(iMAC4s).

Advantages:

In the work proposed by Lauga Sorensen et.al[13], the hypothesis that the

hippocampal texture is associated with early cognitive loss was tested. They used three independent datasets from Australian Imaging Biomarkers and Lifestyle flagship study of ageing(AIBL), ADNI and metro polit 1953 for training the classifier. In this study it was found that hippocampal texture is a better bio-marker as compared to reduction in hippocampal volume for predicting MCI-to-AD conversion for ADNI dataset. The hippocampal texture was found to have superior differentiation capability between stable MCI and MCI-to-AD conversion than volumetric changes in the hippocampus region. The findings in their research supported the hypothesis that textural information of hippocampus region is more sensitive as compared to volume and can be used to detect AD in early stage.

Limitations:

The main limitation of this study was the size of the cross-sectional dataset of AD patients and old subjects. In addition, specificity and association with established biomarkers such as CSF tau or PET amyloid imaging should be investigated. For future work, we will evaluate our method with larger size longitudinal EEG datasets, from different settings, that contain normal, MCI and AD subjects.

[11] Ruoxuan Cuia , Manhau liu "RNN –based Oasis longitudinal analysis for diagnosis of Alzheimer 's disease", Informatics in Medicine unlocked,2019.

Advantages:

Experiments are conducted to test the proposed classification algorithm based on combination of convolutional and recurrent neural networks for longitudinal analysis of structural MR images. The image sets used in this study and the corresponding image processing steps are illustrated in Section 2. There are MR images of 830 subjects including 198 AD, 167 pMCI, 236 sMCI and 229 NC subjects from ADNI.

Limitations:

In this paper, we have proposed a new classification framework based on combination of CNN and RNN to perform the longitudinal analysis of structural MR images for AD diagnosis. CNN model was proposed to extract the spatial features of each time point and generates single-time classification result, while RNN based on cascaded BGRU

CHAPTER – 3

SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

Classification for Alzheimer's Disease based on SVM using a spatial texture feature of cortional thickness .

Diagnosis of Alzheimer's Disease using Machine learning

Moving from detection to pre-detection of Alzheimer's Disease from MRI data.

Classification of Patients with Alzheimer's Disease and Healthy Subjects from MRI Brain ImagesUsing the Existence Probability of Tissue Types.

3.2 LIMITATIONS OF THE EXISTING SYSTEM

- Lack of integrity.
- Lack of accuracy
- Lack of availability and continuity of service.
- High cost.
- Time consuming

3.3 PROPOSED SYSTEM

Diagnosis of the disease is done but that too at the later stage only. Thus if the disease is predicted earlier stage , the progression or the symptoms of the disease can be slow down Image processing is process of extracting the region of Interest from the image using different image segmentation technique.

We propose the image processing technique to process the MRI of brain from axial and coronal plane. Similarly ,the image segmentation is used to highlight the affected region in brain.

[The diagnosis region in brain MRI include hippocampus and volume of brain]
Here, we use CNN , since it is used for image classification and recognition because of its high accuracy. Where alternative approach has been discussed ,that is fast ,costs less and more reliable.

3.4 ADVANTAGES OF THE PROPOSED SYSTEM

1. **Rule Out Reversible and Treatable Causes of Dementia**

   There are multiple conditions besides Alzheimer's that can share some of the same characteristics, some of which are treatable and even reversible. And often, the earlier they're identified and treated, the better the outcome. These can include vitamin B12 deficiency, normal pressure hydrocephalus, delirium, thyroid problems, and depression.

2. **More Opportunities to Participate in Clinical Trials**

   Many clinical trials are only open to people in the early stages of Alzheimer's. Some require that the person with the dementia be able to agree to participate and demonstrate an understanding of the clinical trial. Several medications being tested target those who are in the early stages. An early diagnosis allows you to be eligible for more clinical trials, and to be more likely to benefit from the clinical trial drug or treatment approach.

3. **Medications Are Often More Effective in Early Alzheimer's**

   In general, the medications that are already approved by the United States Food and Drug Administration are more likely to be helpful early in the disease process. This is because their effectiveness is quite limited and often seems to result in maintaining the person's current functioning, and thus, slowing the disease process, rather than reversing the symptoms. Some people do respond quite well and report an improvement when on medications, while others show little to no benefit.

4. **Qualify for Disability if You're Still Working**

   If you have early onset Alzheimer's and are still working, you might be able to qualify for disability benefits if you become unable to work.

5. **Improve Safety**

   An early diagnosis can provide you with time to identify and address safety concerns. These can include driving, errors in medication administration, wandering, and risks in the home.

3.5 FEASIBILITY STUDY

Depending on the results of the initial investigation the survey is now expanded to a more detailed feasibility study. ―FEASIBILTY STUDY is a test of system proposal according to its workability, impact of the organization, ability to meet needs and effective use of the resources. The steps involved in the feasibility analysis are:

- Form a project team and appoint a project leader.
- Enumerate potential proposed system.
- Define and identify characteristics of proposed system.
- Determine and evaluate performance and cost effective of each proposed system.
- Weight system performance and cost data.
- Select the best proposed system.
- Prepare and report final project directive to management

Three key considerations involved in the feasibility analysis are:

1. ECONOMICAL FEASIBILITY
2. TECHNICAL FEASIBILITY
3. SOCIAL FEASIBILITY

1. ECONOMICAL FEASIBILITY

This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited. The expenditures must be justified. Thus the developedsystem as well within the budget and this was achieved because most of the technologies usedare freely available. Only the customized products had to be purchased.

2. TECHNICAL FEASIBILITY

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technicalresources. This will lead to high demands on the available technical resources. This will lead to high demands being placed on the client. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

3. SOCIAL FEASIBILITY

The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity. The level of acceptance by theusers solely depends on the methods that are employed to educate the user about the system and to make him familiar with it. His level of confidence must be raised so that he is also ableto make some constructive criticism, which is welcomed, as he is the final user of the system.

CHAPTER - 4

SYSTEM DESIGN AND DEVELOPMENT

4.1 Architecture Design/System Architecture

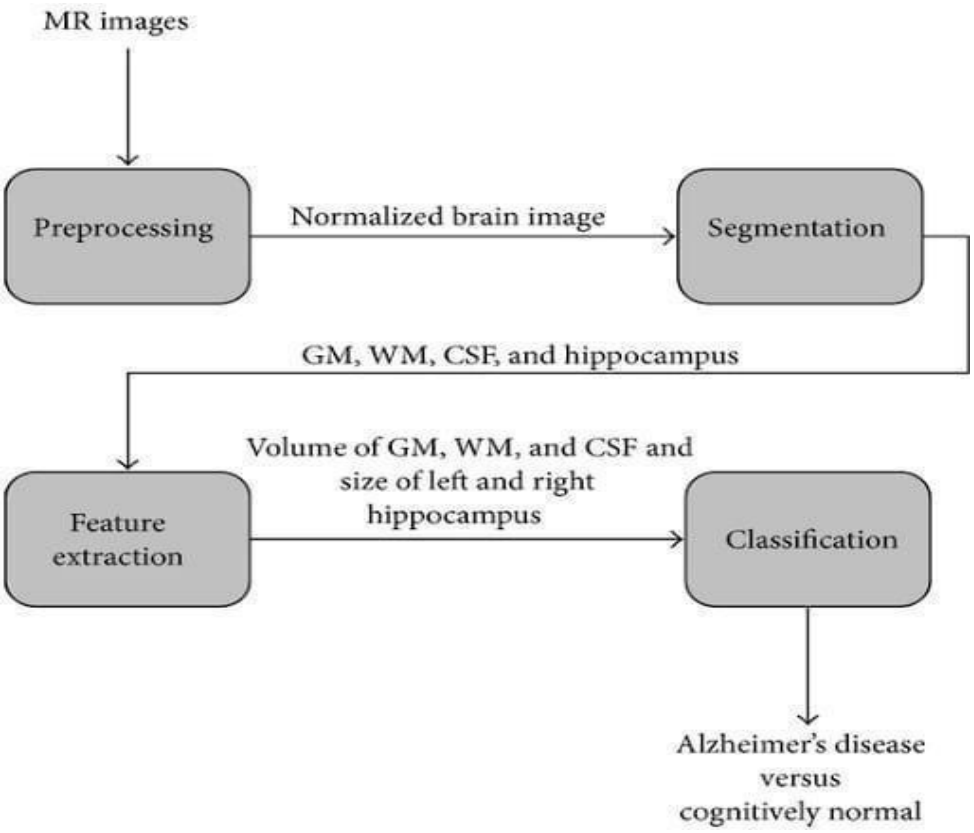


Figure 4.1: Design of disease prediction

System architecture is the conceptual design that defines the structure and behavior of a system. An architectural description is formal description of a system, organized in a way thatsupports reasoning about the structural properties of the system. It defines the system components or building and provides a plan from which products can be procured and systemdeveloped that will work together to implement the overall system.

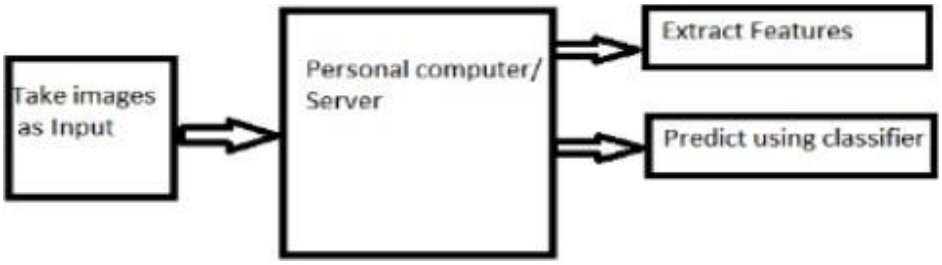


Figure 4.2 BLOCK DIAGRAM

The proposed approach is divided into two phases:

Training phase: A set of labelled MRI scans is preprocessed for ROI extraction and segmentation.

The training phase can be summarized as follows:

a) Extract features such as Texture, Shape and Area from the pre-processed MRI scans.
b) Train an ANN classifier using this feature set.

The output of the training phase is a trained classifier capable of predicting classification label based on features of MRI scan.

The performance of the trained classifier can be evaluated using measures like accuracy, sensitivity and specificity. using measures like accuracy, sensitivity and specificity.

Classification:

This phase can be summarized as follows:

a) Take as input, MRI scan of a patient.
b) Pre-process the MRI scan.
c) Extract the required features from the patient's MRI scan.
d) Use the trained classifier to predict the classification label for the patient's MRI scan

Dataset:

An MRI based dataset is considered from the Open Access Series of Imaging Studies (OASIS): the project aimed at making MRI data sets of the brain freely available to the scientific community. The

dataset consists of processed MR images. Additional information such as the patients age, gender, education, socio-economic status, Mini Mental State Examination (MMSE) score are also available with the scans.

ROI Extraction:

The hippocampus is the first region in the brain that gets affected during the Alzheimer's disease. Therefore, the proposed work focuses on the hippocampus region for detection of AD which will beextracted as the Region of Interest from the MRI scan. Masking based correlation technique will be used for extraction of ROI. In this technique, a mask with ROI extracted manually is run through the subject image and the hippocampus region from the subject image is extracted as ROI using maximum correlation value.

Feature Extraction:

The Texture, Shape and Area features will be extracted from the Hippocampus region of the Brain for detection of AD. The Gray Level Co-occurrence Matrix will be used to extract the texture features and the Shape, Area features will be extracted using seven moment invariants. The features available with the dataset such as age, gender, education, socio-economic status, Mini-Mental Examination Score will also be extracted. These extracted features will then be used to generate the feature vector.

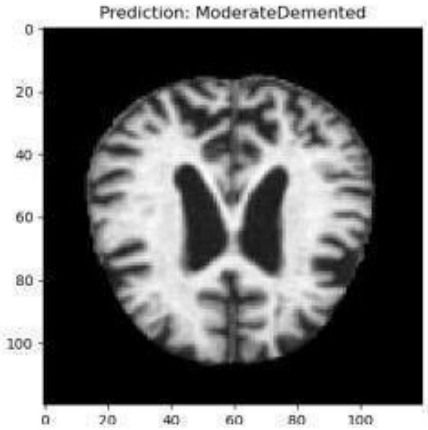
Classification phase:

It has following steps.

1. Preprocess MRI scan for ROI extraction.
2. Extract texture, shape and area features of the hippocampus region (ROI).
3. Feed the feature vector to the trained CNN for classification
4. Determine the appropriate label from the response of the CNN

Project Modules

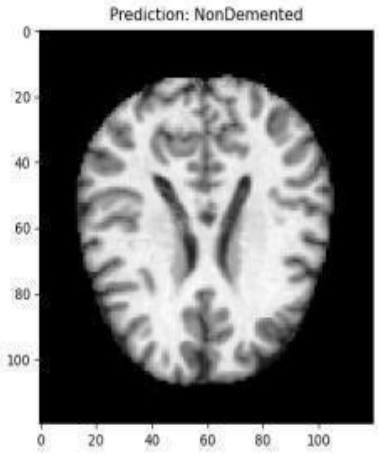
A) MODERATE DEMENTED



X= 101.250

Y= 41.3251

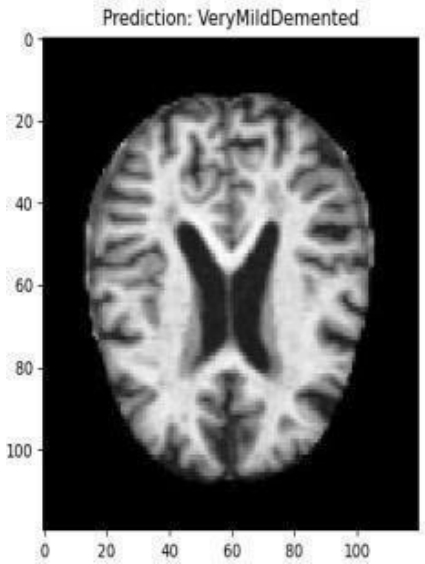
B) NON DEMENTED



X= 110.451

Y= 40.3544

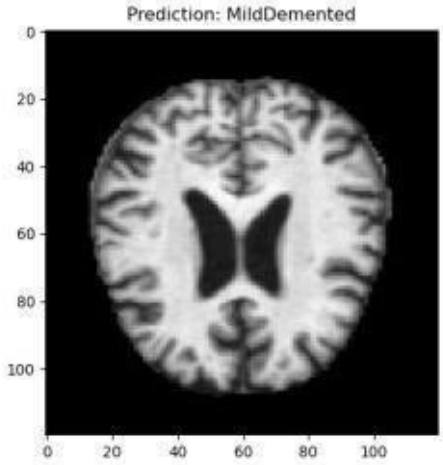
C) Very Mild Demented



X= 109.175

Y=45.738

D) Mild Demented



X= 105.23

Y=43.2541

DATAFLOW DIAGRAM

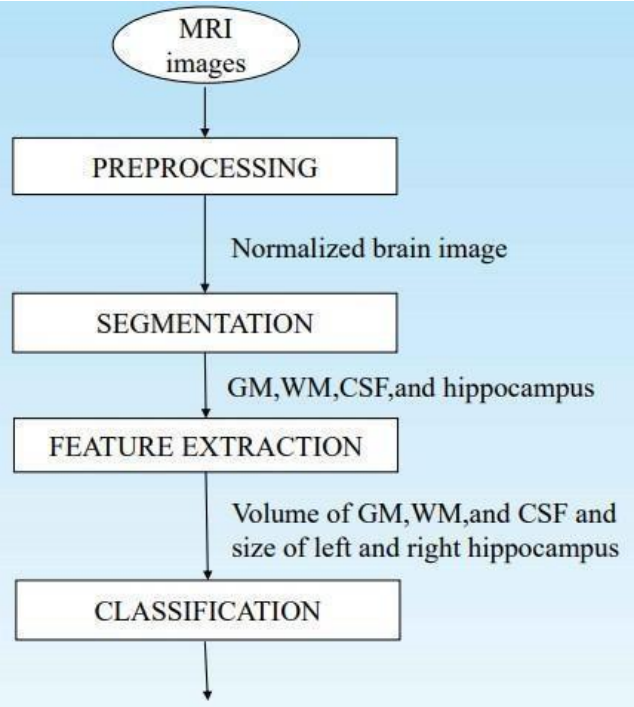


Figure 4.3 DATAFLOW DIAGRAM

USE CASE DIAGRAM

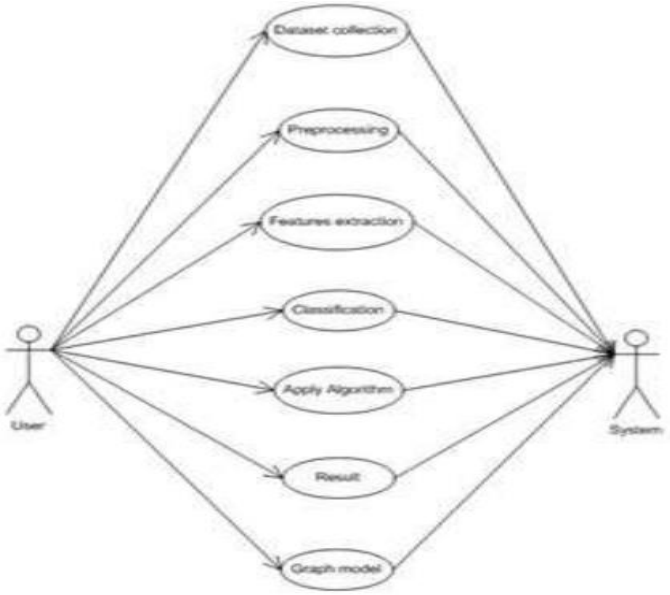


Figure 4.4 USE CASE DIAGRAM

CLASS DIAGRAM

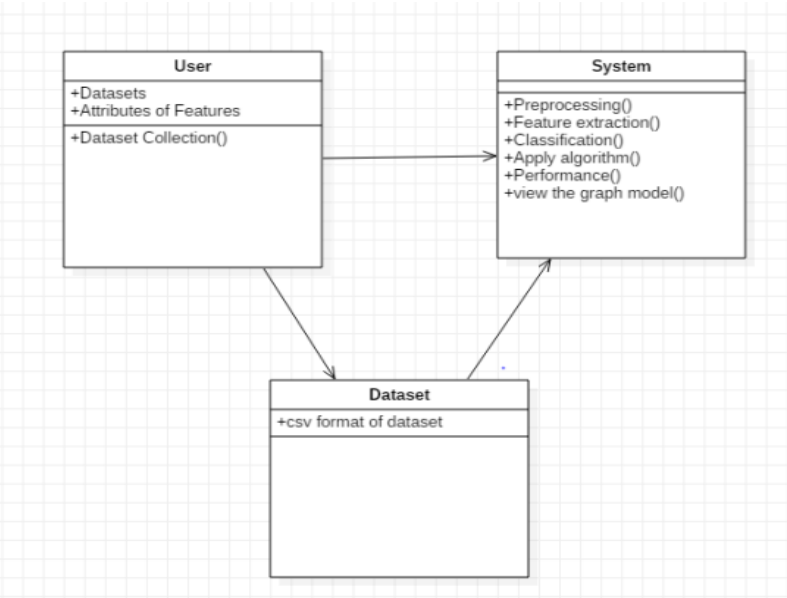


Figure 4.5 CLASS DIAGRAM

ACTIVITY DIAGRAM

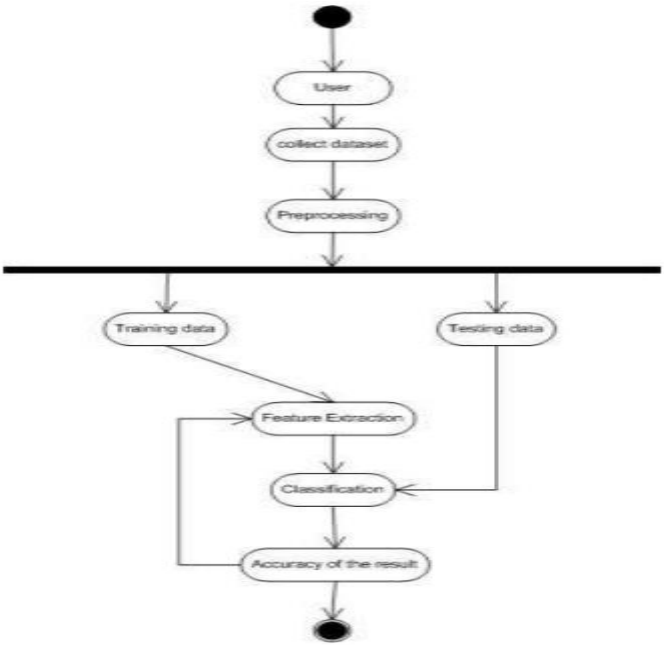


Figure 4.6 ACTIVITY DIAGRAM

ALGORITHM

CNN ALGORITHM

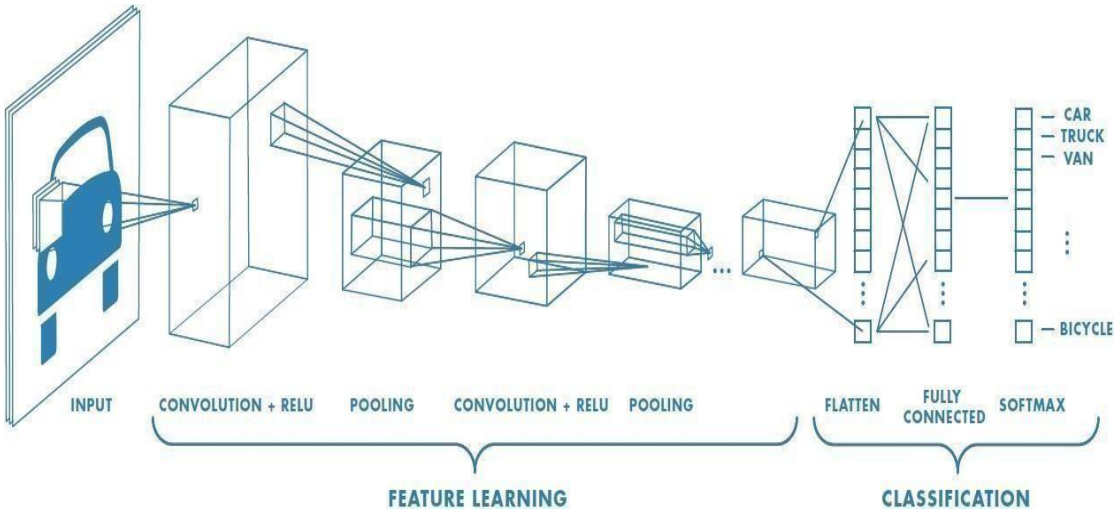


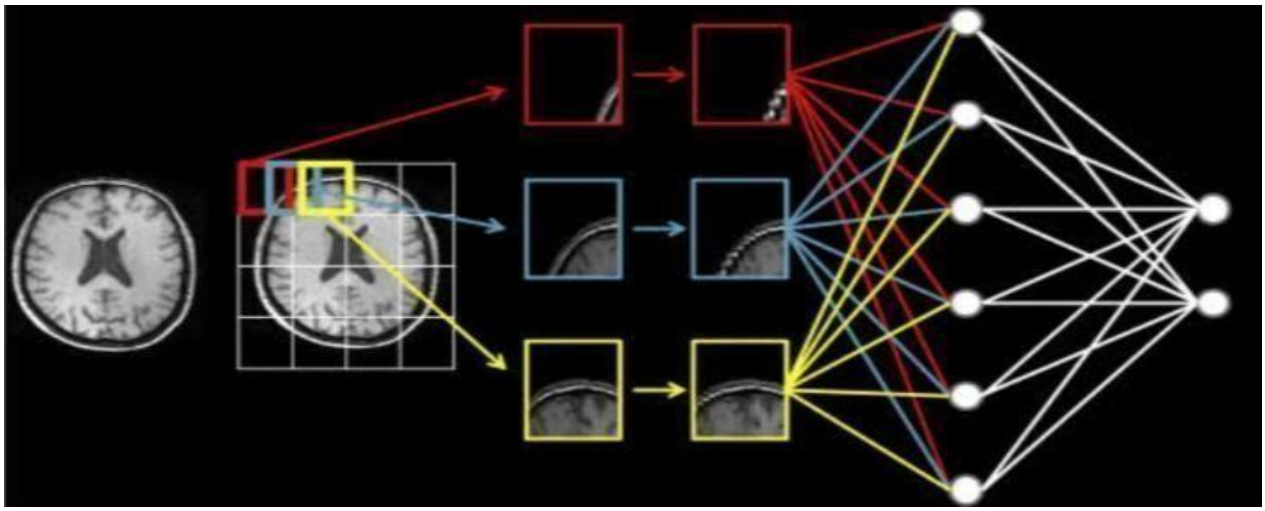
Figure 4.7 External view of CNN

CNN works by extracting features from the images. Any CNN consists of the following:

1. The input layer which is a grayscale image
2. The Output layer which is a binary or multi-class labels
3. Hidden layers consisting of convolution layers, ReLU (rectified linear unit) layers,Pooling layers, and a fully connected Neural Network

It is very important to understand that ANN or Artificial Neural Networks, made up ofmultiple neurons is not capable of extracting features from the image. This is where a combination of convolution and pooling layers comes into the picture. Similarly, the convolution and pooling layers can't perform classification hence we need a fully Connected Neural Network.

The role of CNN is to reduce the images into a form that is easier to process, without losingfeatures critical towards a good prediction. This is important when we need to make the algorithm scalable to massive datasets.

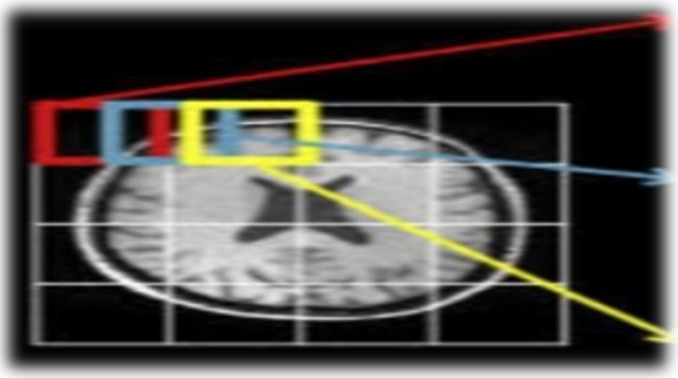


1	2	3	4	5
INPUT IMAGE	CONVOLUTION LAYER	POOLING LAYE	CONNECTED LAYER	OUTPUT

Figure 4.8: FUNCTIONS OF CNN

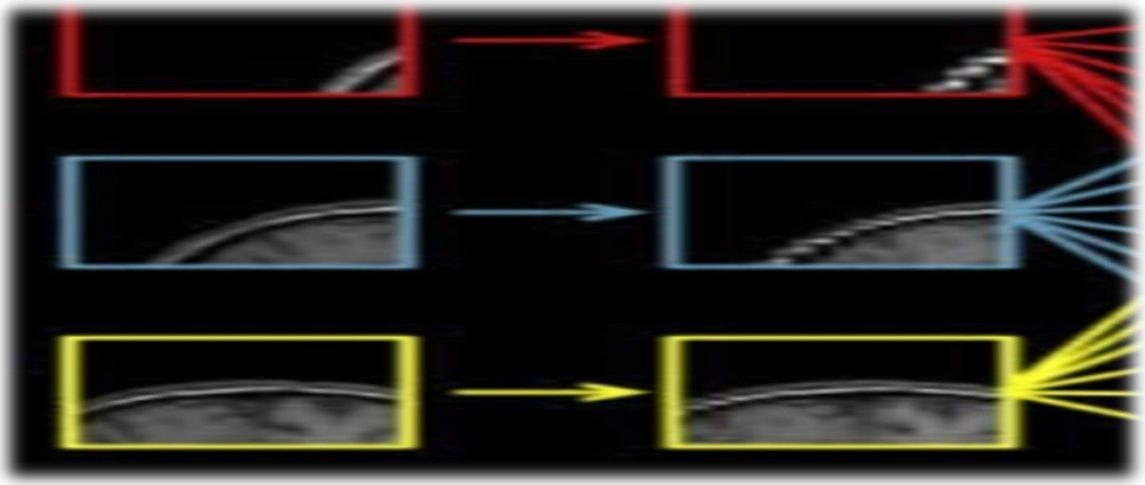
FUNCTIONS OF EACH LAYER

CONVOLUTION LAYER : converts images into an array and converts negativenumbers into zeros .



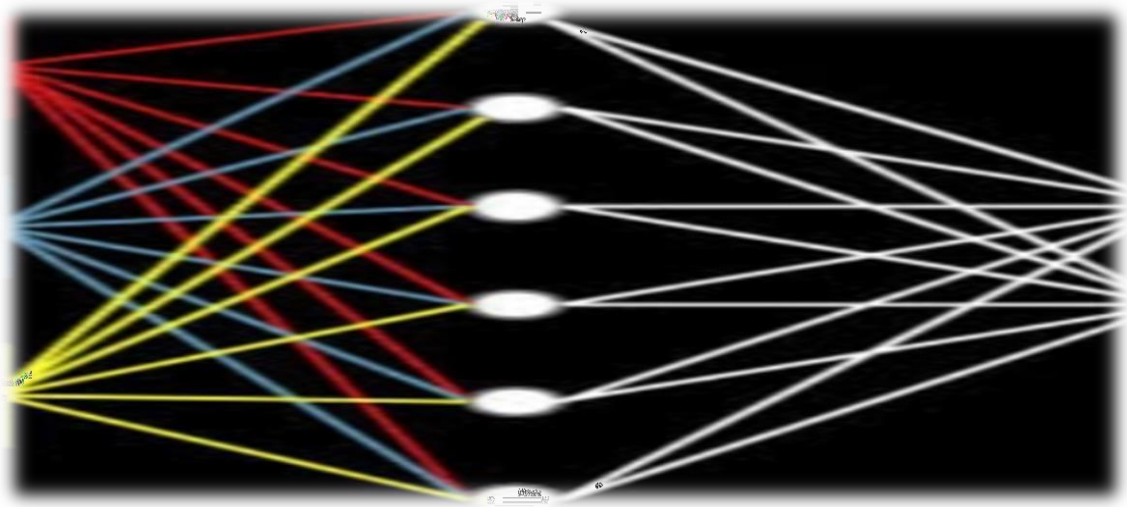
Convolution Layer

POOLING LAYER : Reduces the Image Size and Image segmentation takes place andperform operation on infected area.



Pooling Layer

FULLY CONNECTED LAYER : combines the extracted features and represents anew model.



Fully Connected Layer

In short think of CNN algorithm that can take an input image, assign importance (learnable weights and biases) to various aspects/objects in the image, and be able to differentiate one from the other.

CHAPTER - 5

CODING

PSEUDOCODE

CREATE THE MODEL

```
from tensorflow import keras
from tensorflow.keras import
layersimport os
def createModel(train_data=None):
if os.path.exists('./model/model.h5') and train_data is None:
try:
print( name )
model = keras.models.load_model('./model/model.h5')
print("returned")
return model
except Exception
as e:
print("error")
elif train_data is not None:
model=keras.Sequential([keras.Input(shape=train_data.shape[1:]),
layers.Conv2D(64,kernel_size=(3,3),activation="relu"),
layers.MaxPooling2D(pool_size=(2,2)),layers.Conv2D(64,kernel_size=(3,3),
activation="relu"),layers.MaxPooling2D(pool_size=(2, 2)),
layers.Flatten(),
layers.Dense(128,activation="relu"),
layers.Dropout(0.5),
layers.Dense(4, activation="softmax")])
return model
```

TRAINING THE MODEL

```
import numpy as np
from tensorflow import keras
import matplotlib.pyplot as plt
import os
import cv2
import random
import sklearn.model_selection as model_selection
import datetime
from model import createModel
from contextlib import redirect_stdout
categories = ["NonDemented", "MildDemented", "ModerateDemented",
"VeryMildDemented"]
SIZE = 120
def getData():
rawdata = []
data = []
dir = "./data/"
for category in categories:
path = os.path.join(dir, category)
class_num=categories.index(category)
for img in os.listdir(path):
try:
rawdata = cv2.imread(os.path.join(path, img), cv2.IMREAD_GRAYSCALE)
new_data = cv2.resize(rawdata, (SIZE, SIZE))
data.append([new_data, class_num])
except Exception as e: pass random.shuffle(data)
img_data = []
img_labels = []
for features, label in data:
img_data.append(features)
img_labels.append(label)
img_data = np.array(img_data).reshape(-1, SIZE, SIZE, 1)
img_data = img_data / 255.0
```

```
img_labels=np.array(img_labels)
return img_data, img_labels data,
labels = getData()
train_data,test_data,train_labels,test_labels=model_selection.train_test_split(data,
labels, test_size=0.20)
train_data,val_data,train_labels,val_label=model_selection.train_test_split(train_da
ta,
train_labels, test_size=0.10)
print(len(train_data), " ", len(train_labels), len(test_data), " ", len(test_labels))
model = createModel(train_data)
checkpoint = keras.callbacks.ModelCheckpoint(filepath='./model/model.h5',
save_best_only=True, monitor='val_loss', mode='min')
opt = keras.optimizers.Adam(learning_rate=0.001)
model.compile(optimizer=opt,
loss="sparse_categorical_crossentropy",metrics=["accuracy"], )
history=model.fit(train_data,train_labels,epochs=10,validation_data=(val_data,val
_labels))
model.save('./model/model.h5')
test_loss, test_acc = model.evaluate(test_data, test_labels)
print("Model Accuracy: ", test_acc, "Model Loss: ", test_loss)
plt.plot(history.history['accuracy'])
plt.plot(history.history['val_accuracy'])
plt.title('Modelaccuracy')
plt.ylabel('accuracy')
plt.xlabel('epoch')
plt.legend(['train', 'test'], loc='upper left')
plt.show()
# summarize history for loss
plt.plot(history.history['loss'])
plt.plot(history.history['val_l
oss']) plt.title('Model loss')
plt.ylabel('loss')
plt.xlabel('epoch')
plt.legend(['train', 'test'], loc='upper left')
plt.show()
```

PREDICT THE STAGE

```
import tensorflow as tf
from tensorflow import
kerasimport cv2
import matplotlib.pyplot as plt
import numpy as np
SIZE = 120
model = keras.models.load_model('model/model.h5')
categories=["NonDemented","MildDemented",
"ModerateDemented","VeryMildDemented"]
nimage = cv2.imread("26 (22).jpg", cv2.IMREAD_GRAYSCALE)
image = cv2.resize(nimage,(SIZE,SIZE))
image = image/255.0
prediction = model.predict(np.array(image).reshape(-1,SIZE,SIZE,1))
pclass = np.argmax(prediction)
plt.imshow(image,cmap="gray")
pValue = "Prediction: {0}".format(categories[int(pclass)])
plt.title(pValue)
realvalue="RealValue1"
plt.figtext(0,0,realvalue)
plt.show()
```

CHAPTER-7

SOFTWARE TESTING

INTRODUCTION

This chapter gives the outline of all testing methods that are carried out to get a bug free system. Quality can be achieved by testing the product using different techniques at different phases of the project development. The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components subassemblies and/or a finished product. It is the process of exercising software with the intent of ensuring that the Software system meets its requirements and user expectations and does not fail in an unacceptable manner. There are various types of test. Each test type addresses a specific testing requirement.

METHODS OF TESTING

UNIT TESTING

Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program inputs produce valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application .it is done after the completion of an individual unit before integration. This is a structural testing, that relies on knowledge of its construction and is invasive. Unit tests perform basic tests at component level and test a specific business process, application, and/orsystem configuration. Unit tests ensure that each unique path of a business process performs accurately to the documented specifications and contains clearly defined inputs and expected results.

Unit testing is usually conducted as part of a combined code and unit test phase of the software lifecycle, although it is not uncommon for coding and unit testing to be conducted astwo distinct phases.

Test strategy and approach

Field testing will be performed manually and functional tests will be written in detail.

Test objectives

- All field entries must work properly.
- Pages must be activated from the identified link.
- The entry screen, messages and responses must not be delayed.

Features to be tested

- Verify that the entries are of the correct format
- No duplicate entries should be allowed
- All links should take the user to the correct page

INTEGRATION TESTING

Integration tests are designed to test integrated software components to determine if they actually run as one program. Testing is event driven and is more concerned with the basic outcome of screens or fields. Integration tests demonstrate that although the components were individually satisfaction, as shown by successfully unit testing, the combination of components is correct and consistent. Integration testing is specifically aimed at exposing the problems that arise from the combination of components.

MANUAL TESTING:

Valid Input : Identified classes of valid input must be accepted

Invalid Input : Identified classes of invalid input must be rejected.

USER ACCEPTANCE TESTING

User Acceptance Testing is a critical phase of any project and requires significant participation by the end user. It also ensures that the system meets the functional requirements.

Test Results: All the test cases mentioned above passed successfully. No defects encountered.

Test Cases:

Registration Test:

Name of Test	Registration Test
Input	Email: abc@gmail.com Password: 1234
Expected Output	Registration Successful
Actual Output	Registration Successful
Result	Successful

Table 7.1.1: Registration Test

Login Test:

Test Case	1
Name of Test	Login Test
Input	Username: abc@gmail.com Password: 1234
Expected Output	Login Successful
Actual Output	Login Successful
Result	Successful

Table 7.1.2: Login Test(successful)

Test Case	2
Name of Test	Login Test
Input	Username: xyz@gmail.com Password: abc@21
Expected Output	Login Failed
Actual Output	Login Failed
Result	Failed

Table 7.1.3: Login Test (Failure)

Input Image Format Testing:

Test Case	1
Name of Test	Input Image Format Test
Input	MRI image of Hippocampus region in the format of .png, .jpg
Expected Output	Should Accept the input image and predict the stage.
Actual Output	The image will be accepted and the stage will be predicted.
Result	Successful

Table 7.1.4: Input Image format testing (successful)

Test Case	2
Name of Test	Input Image Format Test
Input	Other images in the format of pdf, docs etc.
Expected Output	Should Accept the input image and predict the stage.
Actual Output	The image will not be accepted.
Result	Failed

Table 7.1.5: Input Image format testing (Failure)

CHAPTER-7

CONCLUSION AND FUTURE ENHANCEMENT

CONCLUSION

The purpose of early detection of Alzheimer's disease is achieved. The implementation is done using image processing method for the identification of disease. The Disease will classify the patient stage of disease as MILD DEMENTED MODERATE DEMENTED, NON DEMENTED, VERY MILD DEMENTED. The method is having simple methodology and low time complexity of the image. This overcomes the problem of earlier detection with no damage cause to brain. This will boost the research in the area of medical imaging. It can also be done by giving multiimages has Input and getting accurate output and predicting stages at a time

It can also be done using different methods we can predict healthy UNAFFECTED ALZHEIMER DISEASE and AFFECTED ALZHEIMER DISEASE .

FUTURE ENHANCEMENT

The classification accuracy can be further increased by providing more images in thedataset.

CHAPTER-8

BIBLIOGRAPHY

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[7] Yang Han and Xing-Ming Zhao proposed a feature selection-based approach known as Hybrid Forward Sequentail Selection for detection of Alzheimers's Disease.

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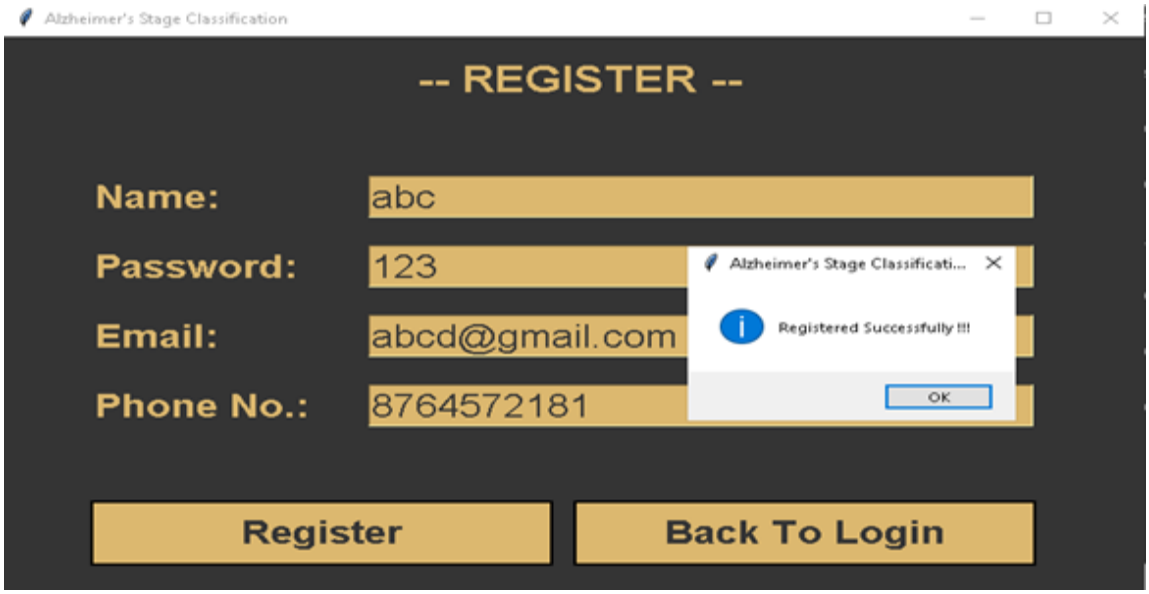
[11] Ruoxuan Cuia ,Manhau liu "RNN –based Oasis longitudinal analysis for diagnosis of Alzheimer 's disease", Informatics in Medicine unlocked,2019.

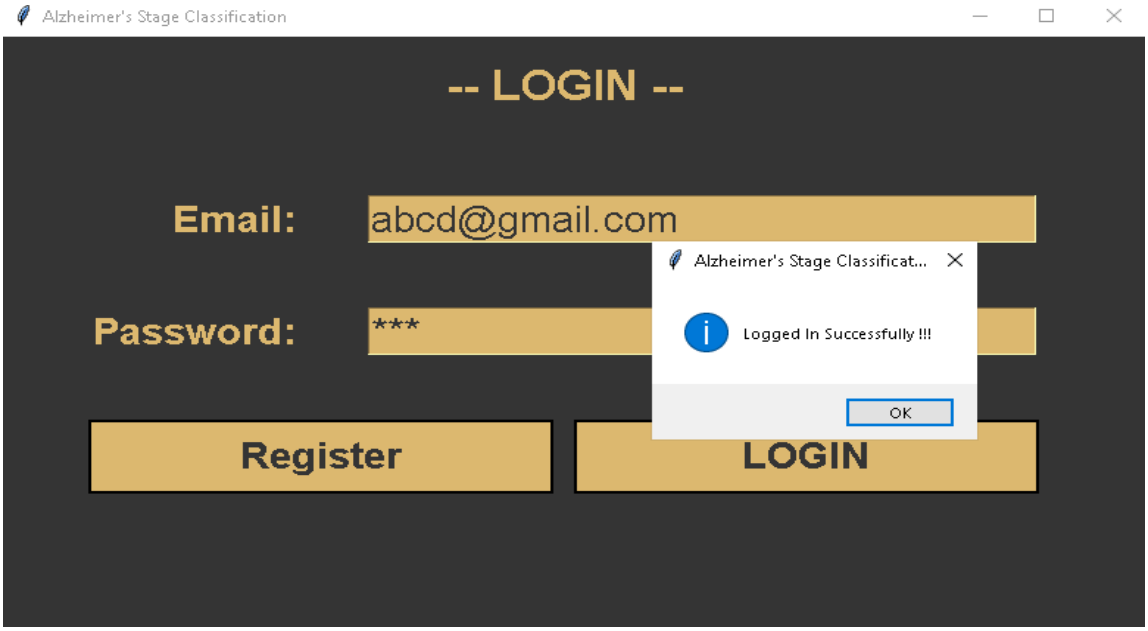
[12] Nation, D.A., Sweeney, M.D Montagne, A sagare, A P Dorazio, L M pachi "Blood –brainbarrier breakdown is an early biomarker of human cognitive dysfunction" 2019.

APPENDIX

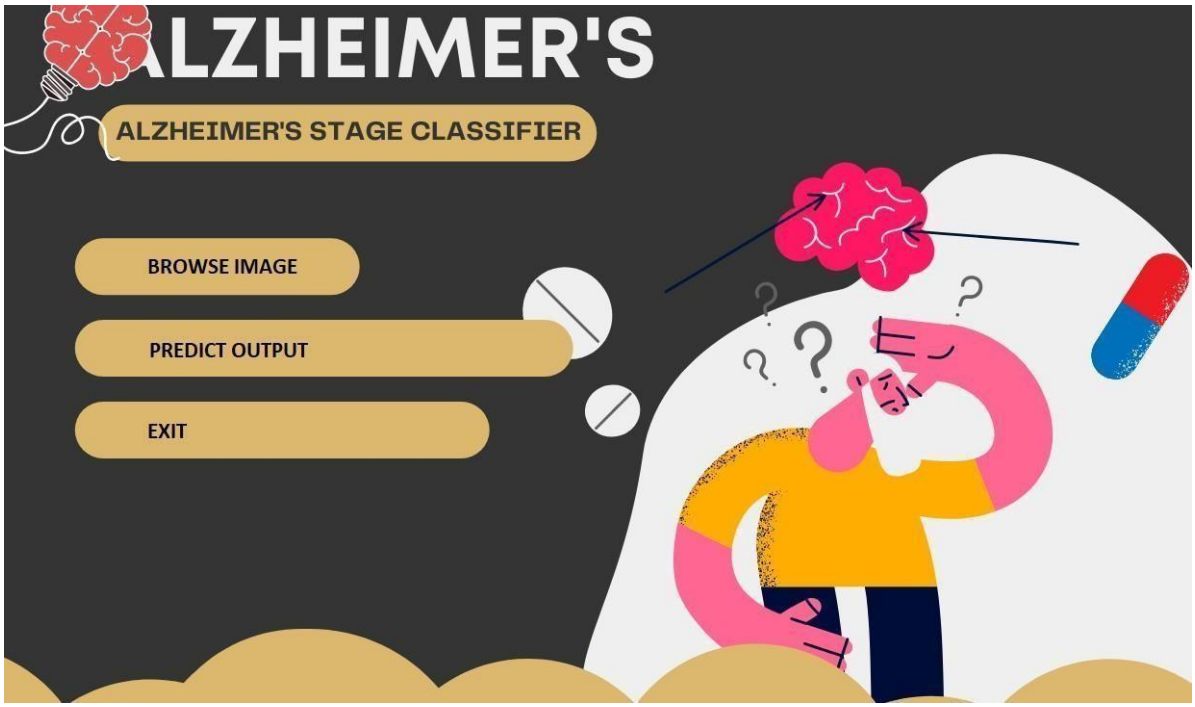
SNAPSHOTS



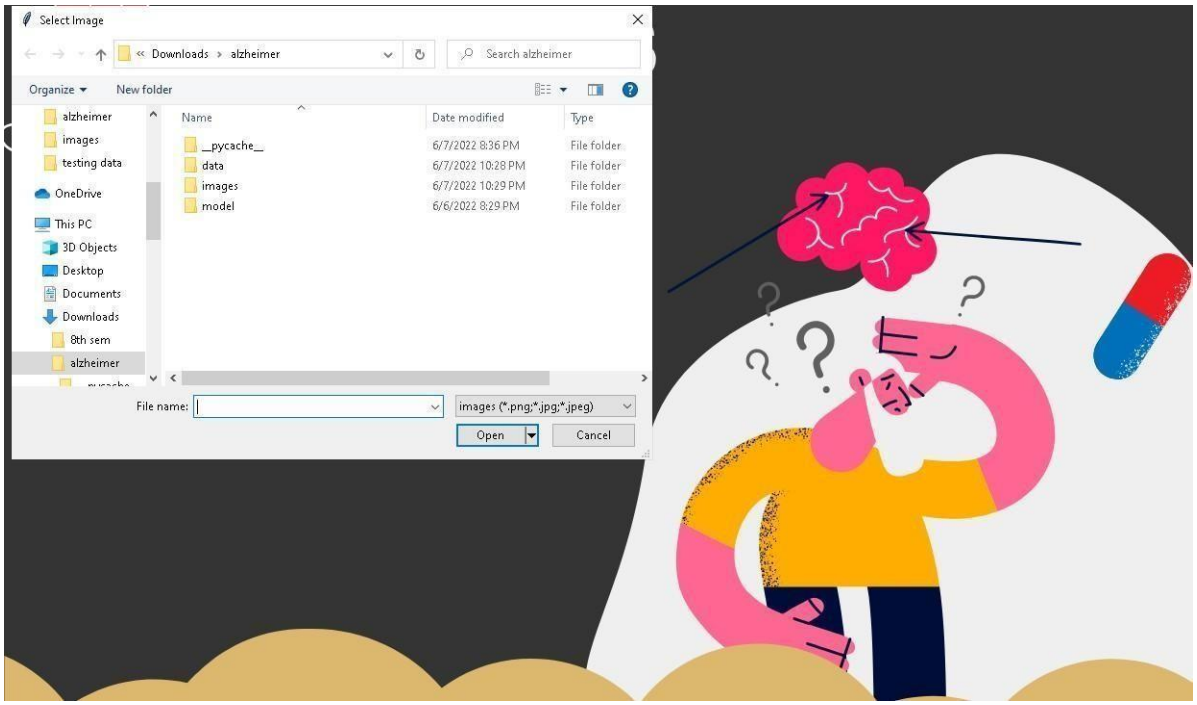
Register Page



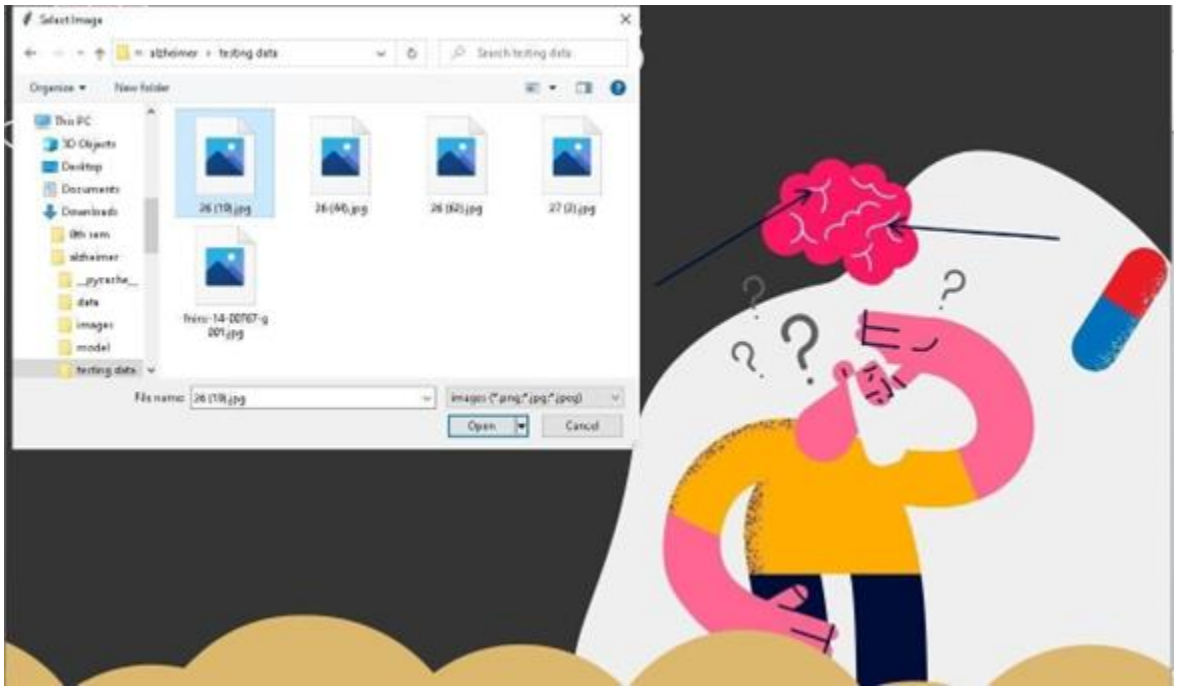
Login Page



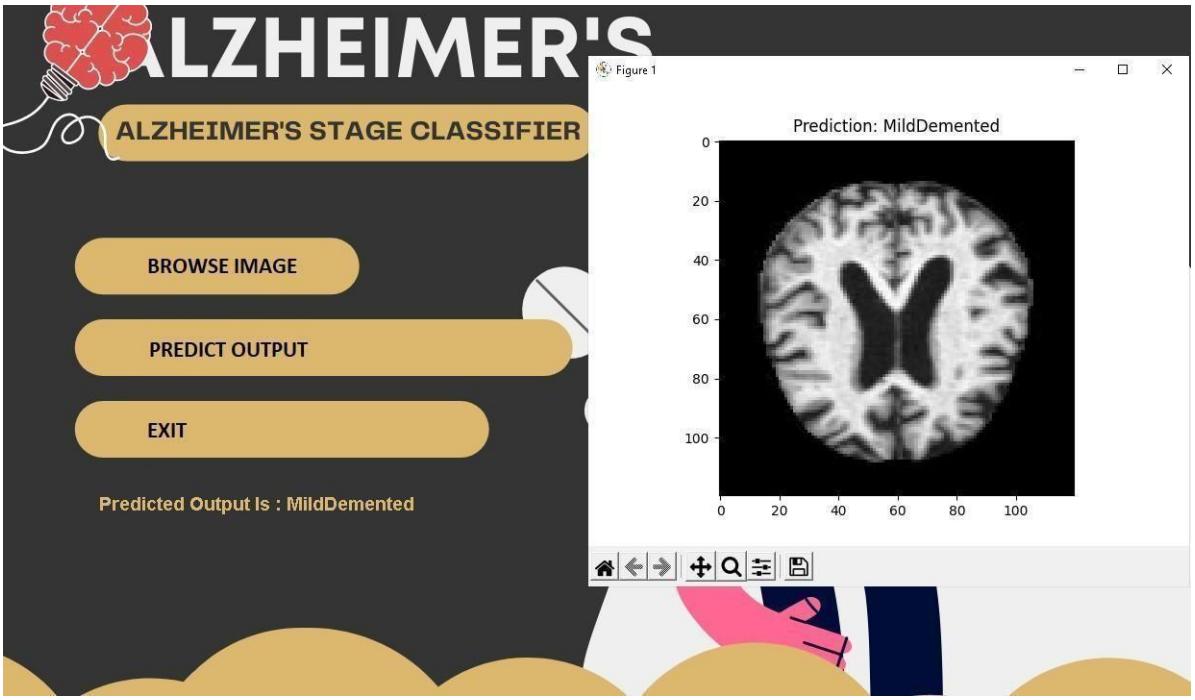
Home page



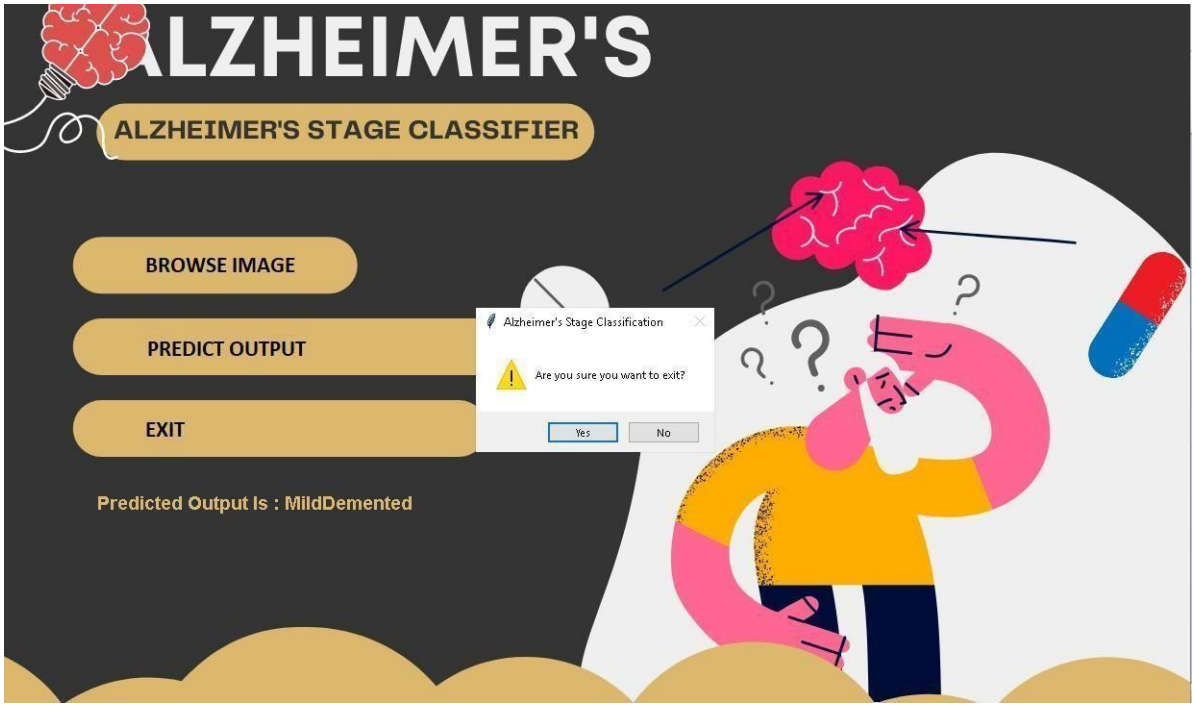
Browse page



Open an image page



Predict output page


ALZHEIMER'S
ALZHEIMER'S STAGE CLASSIFIER
BROWSE IMAGE
PREDICT OUTPUT
EXIT
Predicted Output Is : MildDemented
Alzheimer's Stage Classification
Are you sure you want to exit?
Yes
No

Exit page

LIST OF FIGURES

LIST OF TABLES

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