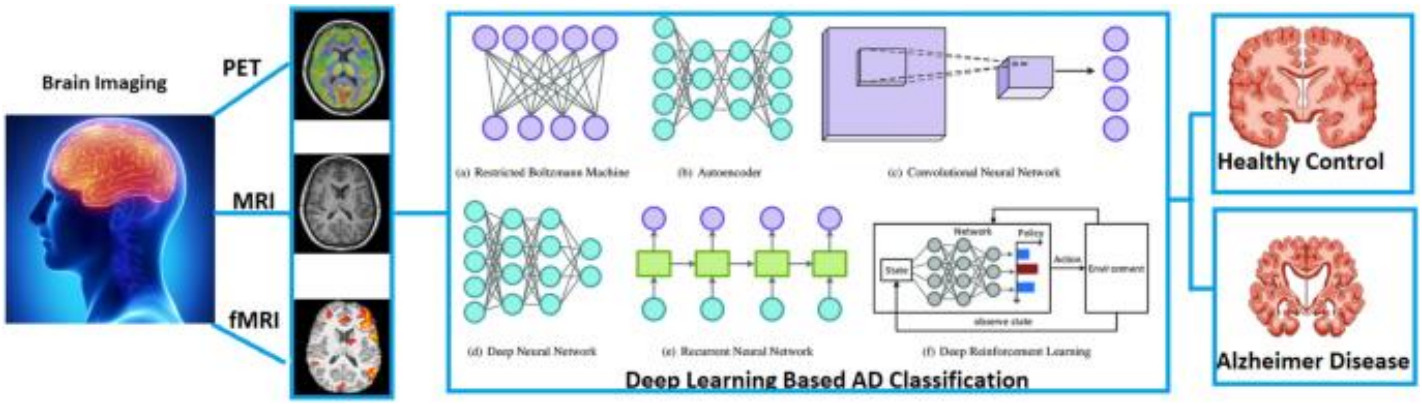
Unit Code : CIS013-3 (Research Methodologies And Emerging Technologies)

Utilizing Convolutional Neural Network With T1-Weighted MRI For Detecting Alzheimer's



Student Name: Santosh Tamang

Student University ID: 214700

Abstract

Alzheimer's Disease (AD) is the most common type of dementia, which is a progressive, which means it gets worse the more time goes by, disease beginning with mild memory loss and possibly leading to loss of ability to carry on daily activities. The requirement of a long clinical history and neuropsychological data including Magnetic Resonance Imaging (MRI) is a time requiring process. For the fast detection of Alzheimer's Disease detection a deep learning model, i.e., Convolutional Neural Network (CNN) is used. The study hopes to advance the diagnosis of Alzheimer's Disease by timely intervention. There are many studies done in utilizing Artificial Intelligence and computer vision in medical imaging. The study focuses on the utilization of CNN in t1-weighted MRI. The study aims to develop a mobile application capable of displaying the result obtained after the analysis of image. The application is being created to help the healthcare professional for timely intervention.

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1. Introduction

1.1 Background

Alzheimer's Disease (AD) is the most common type of dementia, which is a progressive, which means it gets worse the more time goes by, disease beginning with mild memory loss and possibly leading to loss of ability to carry on daily activities (Prevention, 2020). Alzheimer's disease is associated with the progressive accumulation of abnormal proteins in the brain, which lead to progressive synaptic, neuronal, and axonal damage (Kunz & de Silva, 2023). Early Alzheimer's Disease symptoms include loss of memory, linguistic and cognitive degradation, disoriented in time and place, change in mood or behavior and poor judgement (International, 2024). Scientists do not understand what causes Alzheimer's disease and believe there is not a single cause but rather several factors, i.e. age, family history, etc., that can affect each person differently (Prevention, 2020).

There is a lot of research taking place into new drug treatment for Alzheimer's Disease; however, there is currently no drug that can cure Alzheimer's Disease (Prevention, 2020). The currently available drugs, i.e. cholinesterase inhibitors and memantine, do not cure the progression of damage to the brain, it can still stabilize some symptoms for a limited period (Prevention, 2020). Early recognition allows medicine like cholinesterase inhibitors to effectively slow down the progression pf Alzheimer's Disease (Kunz & de Silva, 2023). Early recognition and intervention facilitate optimal care of Alzheimer's patients and delays the morbidity associated with this progressive illness (Y Chang & Silverman , n.d.). The early treatment of Alzheimer's Disease has substantial benefits, both in terms of personal wellbeing and societal cost. Nevertheless, the advantages of early-stage diagnosis of Alzheimer's disease gives the reason to improve the methodology for early detection.

Various studies to diagnose Alzheimer's have been conducted using Convolutional Neural Networks (CNN) (Kunz & de Silva, 2023). Although the definitive diagnosis of Alzheimer's Disease is difficult, in practice, Alzheimer's Disease is diagnosed based on the clinical history and neuropsychological data including Magnetic Resonance Imaging (MRI) (Luo, et al., 2017).

Magnetic Resonance Imaging (MRI) is an integral part of the clinical assessment of patients with suspected Alzheimer((Frisoni, et al., 2010).

The main aim of the research is to find the feasibility to use the Convolutional Neural Network (CNN) model of deep learning in early detection of Alzheimer's Disease using the T-1 weighted Magnetic Resonance Imaging (MRI). The state-of-the-art Artificial Technology is utilized in the specific domain to detect the Alzheimer's as early as possible. The goal is to develop an application capable of detecting Alzheimer's using the T-1 weighted Magnetic Resonance Imaging (MRI). The application is available only for the health professionals.

For the detection of Alzheimer's Disease, Structural imaging, fusion of Convolutional Neural Network with 2D projections, 3D Deep Convolutional Neural Network. (Frisoni, et al., 2010) (Aderghal, et al., 2017) (Backstrom, et al., 2018). Unfortunately, these models require large computational abilities for the detection and classification of Alzheimer's Disease.

The Convolutional Neural Network is the most successful tool in deep learning (Wang, et al., 2018). Convolutional Neural Network has performed excellently in many application areas, especially in image classification and assisted clinical diagnosis in the medical field (Wang, et al., 2018). The Convolutional Neural Network (CNN) model consists of multiple layers of convolutional filters designed to extract hierarchical features from input images. These convolutional layers are followed by fully connected layers responsible for classification tasks. The Convolutional Neural Network excel in image-related tasks like classification and detection dur to their ability to autonomously learn complex patterns and relationships directly from raw image data.

Precisely detecting Alzheimer's Disease is very critical for early intervention of the professional healthcare. This study is conducted to automate and enhance diagnostics precision, reduce processing duration, and ultimately enhance patient livelihood due to the benefits of early detection of Alzheimer's Disease.

1.2 Problem Statement

Currently there is no drugs that can cure the Alzheimer's Disease; however, early detection of the Alzheimer's Disease can help in the substantial benefits, both in terms of personal wellbeing and societal cost. The requirement of a long clinical history and neuropsychological data including Magnetic Resonance Imaging (MRI) is a time requiring process. To automate the process and detect Alzheimer's Disease in one try, to minimize the time required to identify the Alzheimer's Disease.

1.3 Proposed Solution

By integrating state-of-the-art deep learning techniques with Magnetic Resonance Imaging data, this project endeavors to advance the capabilities to detect Alzheimer's Disease, enabling earlier detection and intervention to improve patient condition. The project aims to leverage advanced deep learning techniques, specifically Convolutional Neural Networks (CNNs), to detect signs of Alzheimer's disease from T1-weighted MRI brain scans. This approach aims to enhance diagnostic accuracy, streamline the detection process, and ultimately contribute to early intervention and treatment planning.

1.3 Aim of Project

The project focuses on creating a user-friendly application capable of detecting Alzheimer's disease in an individual from T1-weighted MRI.

1.4 Objective of Project

- To train a model that can detect Alzheimer's
- To develop a mobile application integrating the model

1.5 Intellectual Challenges

- Complexities of medical image analysis
    - The data obtained may have vary level of noise.
- Ensuring data security
    - The data of the patients may be leaked.

2. Project Plan

2.1 Gantt Chart

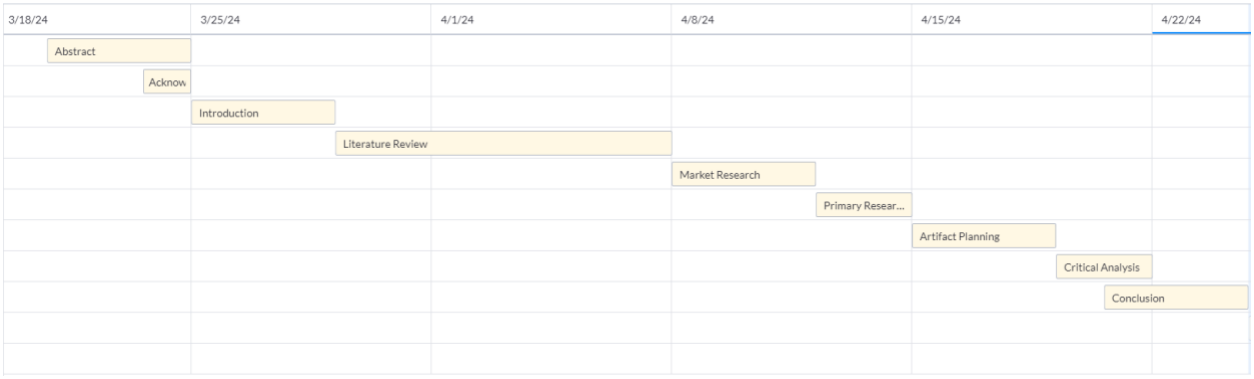

Figure 1 Gantt Chart of Phase. I

Section	Start Date	End Date
Abstract	20/03/2024	22/03/2024
Acknowledge	23/03/2024	24/03/2024
Introduction	25/03/2024	27/03/2024
Literature Re	28/03/2024	07/04/2024
Market Resea	08/04/2024	10/04/2024
Primary Rese	11/04/2024	14/04/2024
Artifact Plann	15/04/2024	17/04/2024
Critical Analy	18/04/2024	20/04/2024
Conclusion	21/04/2024	23/04/2024

Figure 2 Data For Gantt Chart

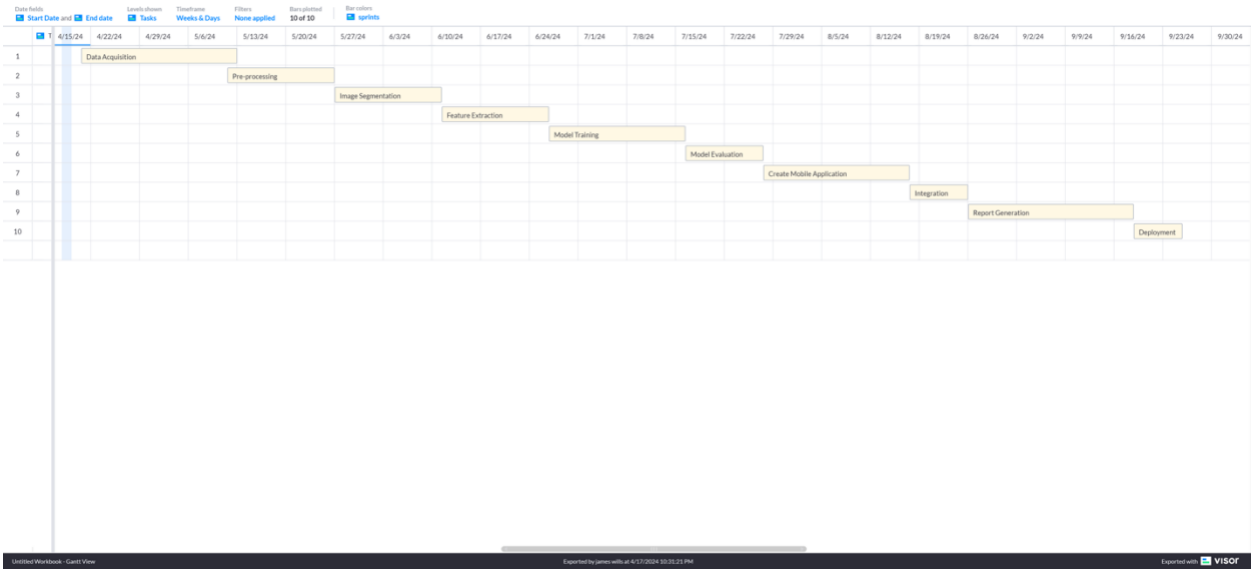

Figure 3 Gantt Chart for Phase II

Task Description	Start Date	End Date	Duration (Days
Data Acquisition	19/04/2024	10/05/2024	22
Pre-processing	11/05/2024	26/05/2024	16
Image Segmentation	27/05/2024	10/06/2024	15
Feature Extraction	11/06/2024	25/06/2024	15
Model Training	26/06/2024	15/07/2024	20
Model Evaluation	16/07/2024	25/07/2024	10
Create Mobile Application	26/07/2024	15/08/2024	21
Integration	16/08/2024	25/08/2024	10
Report Generation	26/08/2024	17/09/2024	23
Deployment	18/09/2024	24/09/2024	7

Figure 4 Data For Gantt Chart

2.2 Work Breakdown Structure

The workflow encompasses the following stages:

- Data Acquisition: Gather a comprehensive dataset comprising T1-weighted MRI brain scans from individuals diagnosed with Alzheimer's disease and healthy individuals.
- Pre-processing: Standardize image resolution, normalize intensity values, and perform other pre-processing steps to enhance data quality.

- Image Segmentation: Implement Convolutional Neural Network-based segmentation algorithms to isolate brain regions and distinguish abnormal structures associated with Alzheimer's disease.
- Feature Extraction: Extract pertinent features from segmented images to capture relevant patterns indicative of Alzheimer's disease pathology.
- Model Training: Utilize Convolutional Neural Network architectures tailored for medical image analysis to train the model on the extracted features for accurate disease classification.
- Model Evaluation: The model is evaluated using the methods described below.
- Create Mobile Application: Develop a user-friendly mobile application where clinicians can upload MRI scans and receive automated Alzheimer's disease detection results in a simple format.
- Integration: Integrating developed mobile application with the trained model, Alzheimer's Disease detection model, to create the user-friendly interface for clinicians.
- Report Generation: The development process including the methodology, findings and conclusions is recorded in a document.
- Deployment: The application developed is deployment.

3. Literature Review

3.1 Domain Research

More than 35 million patients are suffering from Alzheimer's Disease and this number is growing, which puts a heavy burden on the countries around the world (Jiang, et al., 2020). Alzheimer's Disease currently have no cure. There are medicine that will help the patients with the symptoms and slows the progression. In practice, the Alzheimer's Disease is diagnosed based on the long clinical history and neuropsychological data including Magnetic Resonance Imaging (MRI).

Alzheimer's Disease was diagnosed using Magnetic Resonance Imaging with an efficient 3D Convolutional Network in a study conducted by (Backstrom, et al., 2018) with the test accuracy

98.74%, 100% Alzheimer's Disease detection and 2.4% false alert. The study was conducted to study the impacts of a) hyper-parameters, b) pre-processing, c) data partitioning and d) dataset size.

A study conducted by (Kunz & de Silva, 2023) found that the Convoutional Neural Network of deep learning is capable of producing the accuracy of the 0.89. They stated that there are studies that uses Convolutional Neural Network in the Alzheimer's Disease Neuroimaging Initiative (ADNI) -datasets obtained from the ADNI organization which contains data of 1455 patients with five diagnosis group. The study was conducted to examine if the Convolutional Neural Networks can also be applied as a diagnostic tool using the MIRIAD-data (Minimal Interval Resonance Imaging in Alzheimer's Disease).

These research investigates how computer vision can enhance the accuracy of detection and classification of Alzheimer's Disease for medical diagnosis.

3.2 Technical Research

Deep learning algorithms, in particular convolutional networks, have rapidly become a methodology of choice for analyzig medical images. The paper by (Litjens, et al., 2017) reviews the major deep learning concepts pertinent to medical image analysis and summarizes over 300 contributions to the field. They surveyed the use of deep learninf for image classification, object detection, segmentation, registration, and other tasks.

Medical image classification is a key technique of Computer-Aided Diagnosis (CAD) systems. Recent deep learning methods provide an effective way to construct an end-to-end model that can compute final classification labels with the raw pixels of medical images. (Lai & Deng, 2018) proposed a deep learning model that integrates Coding Network with Multilayer Perceptron (CNMP), which combines high-level features that are extraced from a deep convolutional neural network and some seleveted traditional features. An overall accuracy of 90.1% was achieved.

Similarly, (Basaia, et al., 2019) used Convolutional Neural Network on 3D t1-weighted Magnetic Resonance Imaging to get 99% on Alzheimer's Disease Neuroimaging Initiative (ADNI)-dataset and 98% on Alzheimer's Disease Neuroimaging Initiative (ADNI)-dataset + non ADNI-dataset.

(Luo, et al., 2017) used deep learning, Convolutional Neural Network on 3D brain Magnetic Resonance Image and obtained 0.93 accuracy on the recognition of Alzheimer's Disease.

These research investigates how computer vision can enhance the accuracy of detection and classification of Alzheimer's Disease for medical diagnosis.

3.3 Summary

The importance of automated Alzheimer's Disease is underscored by the literature study, particularly the medical imaging. To enhance the efficiency and clinical application some more studies are still required. The main aim of this research is to automate and detect Alzheimer's Disease as early as possible, and allow the patients to live a happy life.

4. Market Research / Secondary Research

The global Alzheimer's Disease diagnostics market was valued at approximately $4.05 billion in 2022 and is expected to grow at a compound annual growth rate (CAGR) of around 19.9% from 2023 to 2030 (Research, 2023). Currenlty the diagnostic of Alzheimer's Disesase is done on the basis of the long clinical history and neuropsychological data. As this asks for lot of time to completely diagnosis a patients. The trends have shift towards early diagnosis and intervention, rising prevalence of Alzheimer's due to aging populations, and increasing investments in AI-based diagnostic tools for neurodegenerative diseases.

The following points are helping to shift toward the AI-based tools:

- Growing Patients Number : The number of people living with Alzheimer's disease doubles every 5 years beyond age 65. This number is projected to nearly triple to 14 million people by 2060 (Prevention, 2020).
- Technological Advancement : Advancement in computer vision using deep learning have faciliated increased accuracy in medical imaging. Using the computer vision the early detection of Alzheimer's Disease may also be possible.

To sum all of this, the increase in AI-based tools can be seen in the coming years. One of them will be early Alzheimer's Disease detection model due to its demand and cost effective diagnostics. As the technological advancements continues, the result in Alzheimer's Disease detection also become good and all the people involved will be benifited.

Several research and projects is completed to detect Alzheimer's Disease while classifying them as very mild demented, mild demented and demented. Some projects are:

- NeuroQuant: NeueoQuant is a sotware tool used for automated measurement of brain structures from MRI scans. It provides quantitative analysis of brain volumes and can assist in detecting changes associated with Alzheimer's disease and other neurodegenerative conditions (Cortechs.ai, 2024).
- Neuroreader: Neuroreader is a software that process the MRI scan and provides a patient report with total brain volume, hippocampal volume and volumetric data on segments of the brain measured against a healthy database (Brainreader, 2024).

5. Primary Research / Data Collection and Analysis

The main aim of the primary research is to boarden the knowledge of the current practices and problem in detection of the Alzheimer's Disease. To gather the essential information interviews, with health care, and surveys were conducted. After the interviews and surveys were conducted, valuable insights were obtained.

During the interviews, with the health professionals, they shared that there is no defenitive way to detect Alzheimer Disease. They would take Magnetic Resonance Imaging of the patients and questions the people that interact with the patients regular for the detection of Alzheimer's Disease. This usually takes a long time, while the patients condition is only worsening daily. They said the timely intervetion may help a patient to live a normal for as long as possible.

The healthcare professional suggested that integrating technology like machine learning tools into diagnostics woul not pnly enhance accuracy and efficiency but could also potentially result in early detection of Alzheimer's Disease.

In essence, this discussion highlighted the importance of developing efficient methods for detecting Alzheimer's Disease and underscored the need to align these advancements with healthcare professionals' priorities to positively impact patient cate through the implementation of machine learning, thereby enhancing accuaracy and efficiency in diagnosis.

Futhermore, a survey was conducted and the questions was directed to normal citizens and the healthcare professionals. The data obtained is as follows:

Question 1 : What is your age?

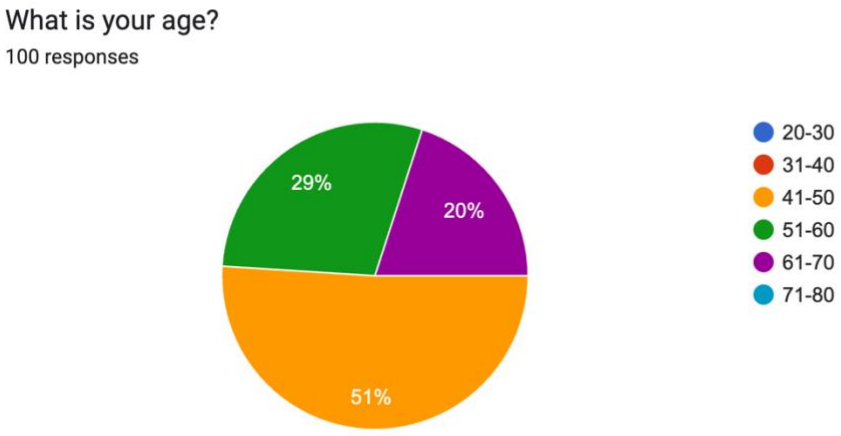

Figure 5 Survey Question One And Outcome

Objective : The objective of this question was to target the people above 40 years old as the symptoms start at that age.

Analysis : The objective was fulfilled as the data shows that all the response is received from people above 40 years.

Question 2 : What is your gender?

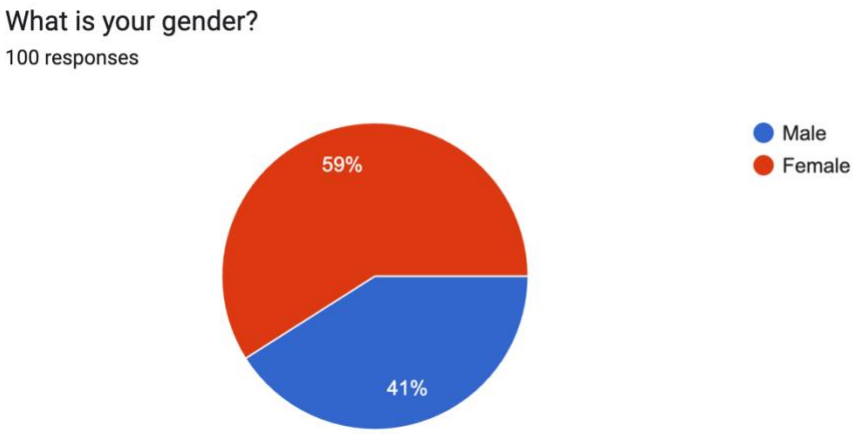

Figure 6 Survey Question Two And Outcome

Objective : The objective was to find how many people from each gender will response.

Analysis : As shown in the result, female have more provided more response than male.

Question 3: What is your education level?

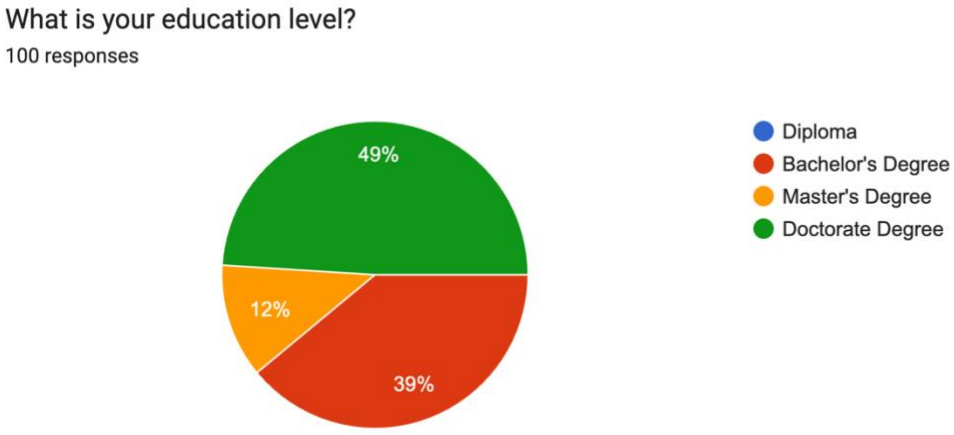

Figure 7 Survey Question Three And Outcome

Objective : The objective was to find the educational level/

Analysis : The results shown that about 49% have completed doctorate degree.

Question 4: Have you ever undergone an MRI scan before?

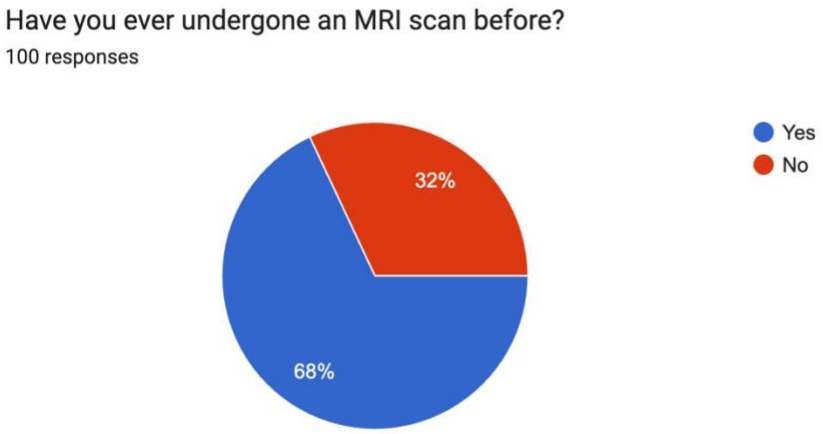

Figure 8 Survey Question Four And Outcome

Objective : The objective was to find how many have undergone MRI.

Analysis : The result shows that more than 65% have not undergone MRI.

Question 5: If yes, how many MRI scans have you undergone in the past?

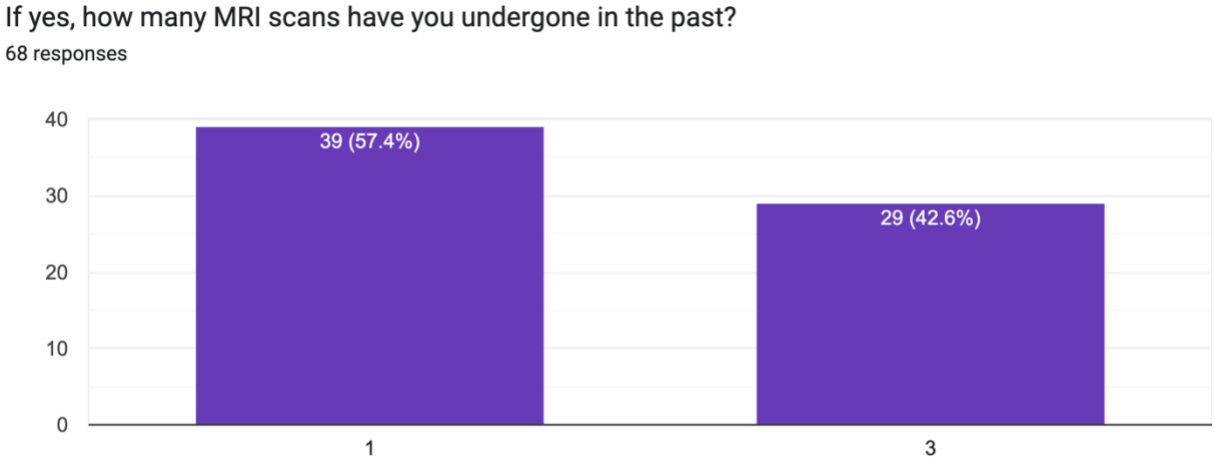

Figure 9 Survey Question Five And Outcome

Objective : The objective was to find the number a person have under gone MRI.

Analysis : The results shows that many people have undergone MRI only once while some had undergone as many as 3 times.

Question 6: How familiar are you with Alzheimer's disease?

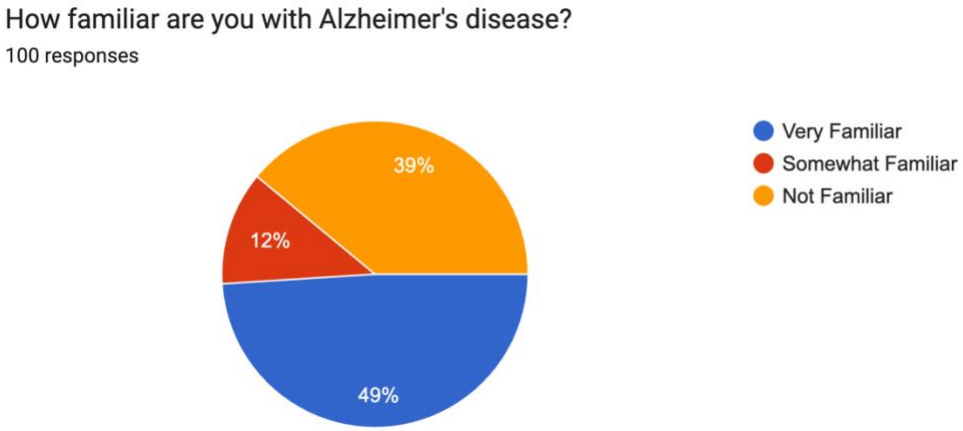

Figure 10 Survey Question Six And Outcome

Objective : The objective was to find the famaliarity with the Alzheimer's Disease.

Analysis : The result shows that 49% are very familiar, while 12% are somewhat famailiar and 39% are not familiar at all.

Question 7: Have you or anyone you know been diagnosed with Alzheimer's disease?

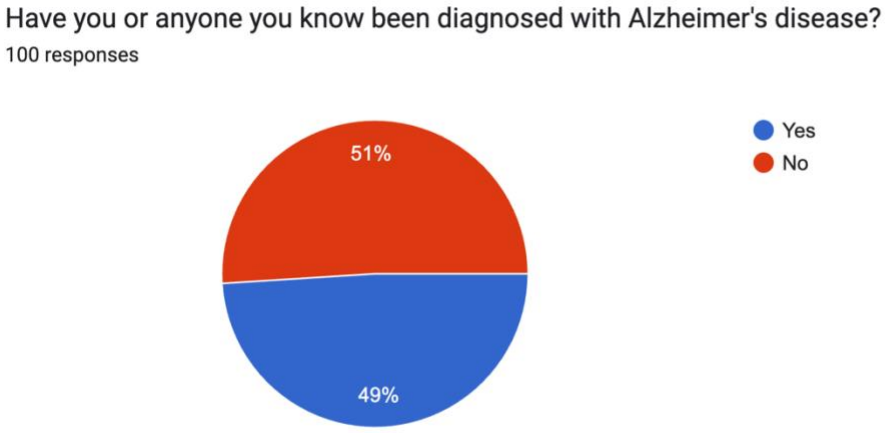

Figure 11 Survey Question Seven And Outcome

Objective : The objective was to find if people have seen people suffering from Alzheimer's Disease.

Analysis : The result shows that more than half of the people have not seen anyone suffering from Alzheimer's Disease.

Question 8: How famailiar are you with Artificial Intelligence?

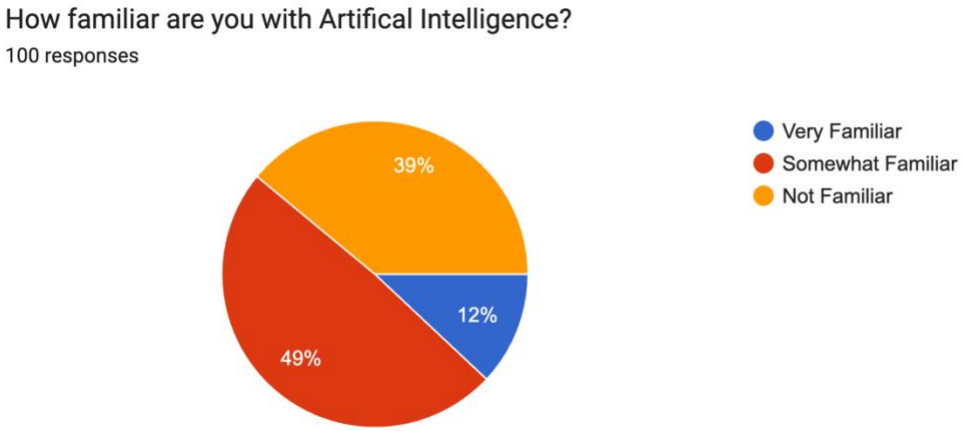

Figure 12 Survey Question Eight And Outcome

Objective : The objective was to find the famaliarity with the Artificial Intelligence.

Analysis : The result shows that 49% are not familiar at all, while 12% are very famailiar and 39% are familiar with Artificial Intelligence.

Question 9: What is your opinion on using Artificial Itelligence for medical imaging analysis?

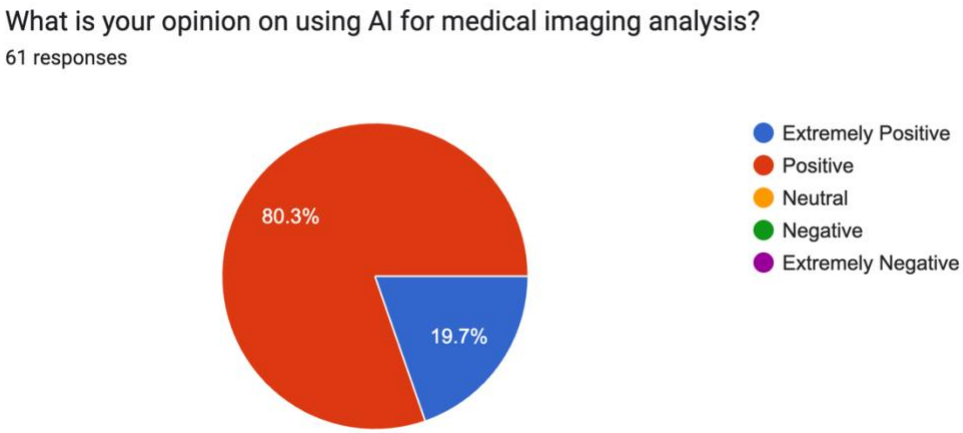

Figure 13 Survey Question Nine And Outcome

Objective : The objective is to find the opinion of the people.

Analysis : The results shows that more than 80% people show exteremly positivity while rest shows somw positivity.

Question 10: Are you aware of T1-weighted MRI?

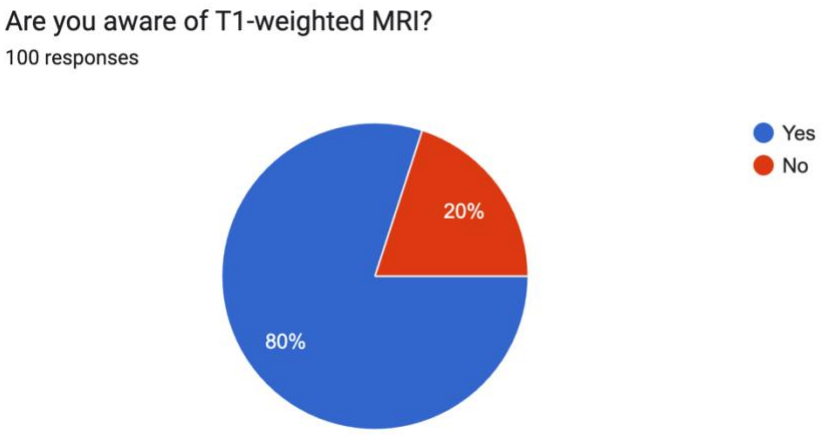

Figure 14 Survey Question Ten And Outcome

Objective : The objective is to check the awarness about T1-weighted MRI.

Analysis : The result shows that 80% of people are aware while rest are not.

Question 11: Are you aware of MRI (T1-weighted) scans being used for Alzheimer's detection?

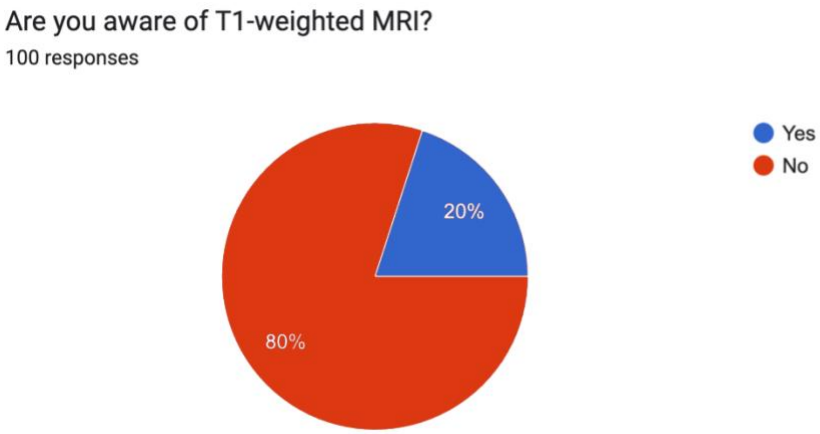

Figure 15 Survey Question Eleven And Outcome

Objective : The obejctive is to check the awareness of people to use MRI (T1-weighted)

Analysis : The result shows that the 80% are not aware while only 20% are aware.

Question 12: Do you believe MRI scans can effectively contribute to early detection of Alzheimer's disease?

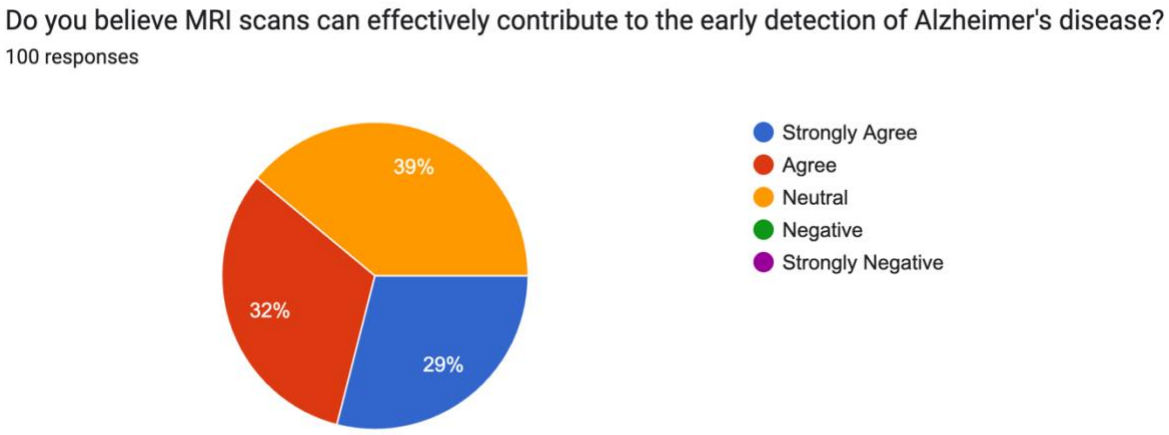

Figure 16 Survey Question Twelve And Outcome

Objective : The objective to see the people opinion.

Analysis : The results shows that 29% strongly agree, 32% agree and 39% are neutral.

Question 13: How much trust do you have in the accuracy of AI for diagnosing medical conditions like Alzheimer's disease?

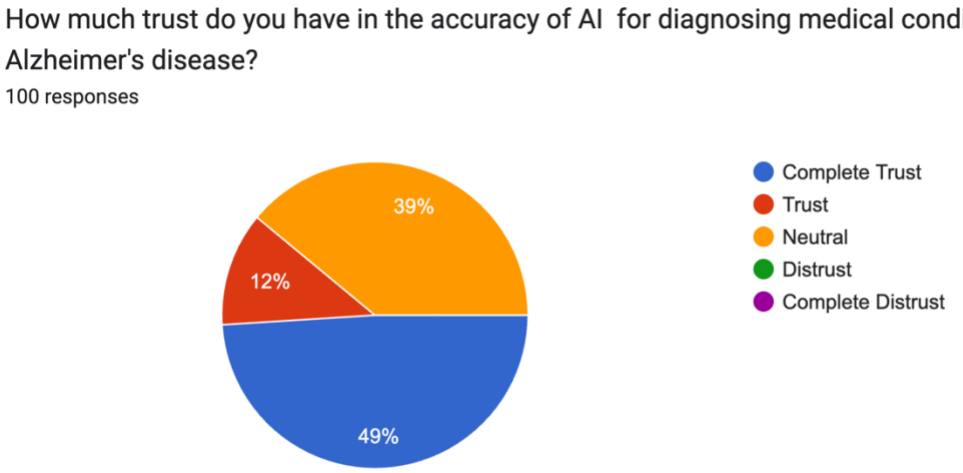

Figure 17 Survey Question Thirteen And Outcome

Objective : The objective is to see the people opinion.

Analysis : The results shows that 49% shows complete trust, 12% shows some trust, and 39% are neutral.

6. Artifact Planning

6.1 System Requirement

6.1.1 Functional Reauirement

- User must be able to register.
- User must be able to login.
- User must be able to upload t1-weighted Magnetic Resonance Imaging.
- User must be able to view the result generated after processing the uploaded image.
- User should be able to download the result.

6.1.2 Non-Functional Requirement

- System must be highly reliable with minimal errors.
- System should respond to as fast as possile.
- System should be able to cope with increase in users.
- System should be operational 24 hours.

6.1.3 Usability Requirement

- User interface must be user-friendly.
- The application should have clear and intuitive navigation.
- Layout and style should be consistent throughout the application.

6.2 Development Methodology

For the development of the Alzheimer's detection using deep learning model, Convolutional Neural Network, waterfall methodology will be applied. Various parts, like market research, data collection, preprocessing, model desing, implementation along witht the testing will be done during the developmental phase.

6.3 System Design

6.3.1 UML Diagrams

UML, which stands for Unified Modeling Language, is a way to visually represent the architecture, design, and implementation of complex software systems (Chart, 2024).

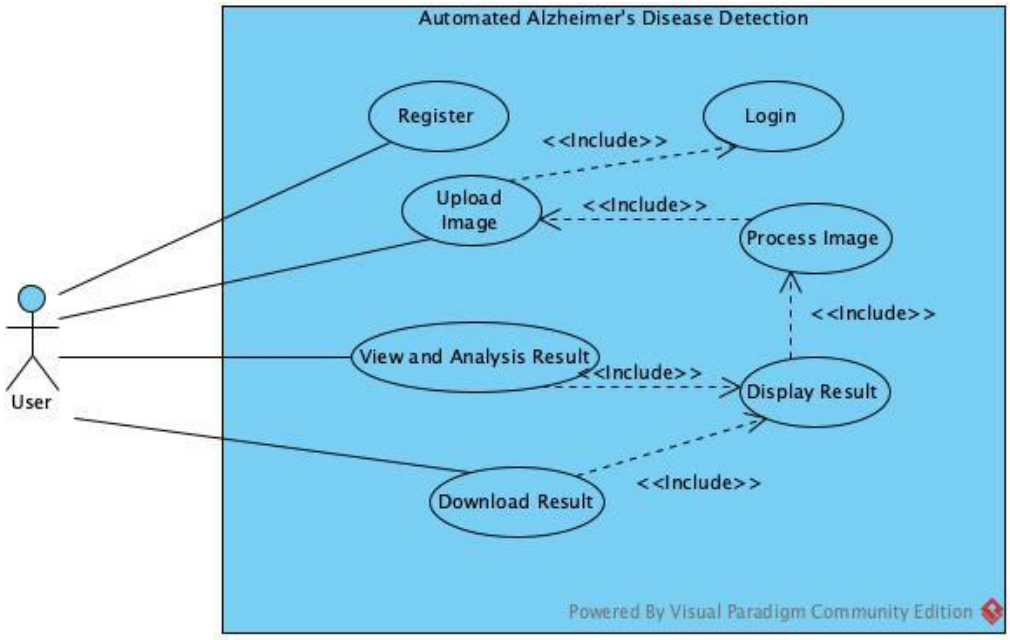

Figure 18 Use Case Diagram

In the Unified Modeling Language (UML), a use case diagram can summarize the details of your system's users (also known as actors) and their interactions with the system (Chart, 2024).

The above diagram shows that a user will be able to upload image for processing but first they need to login in the existing account. The result obtained from the processing and be viewed and analysed. The result can also be downloaded to provide the patients.

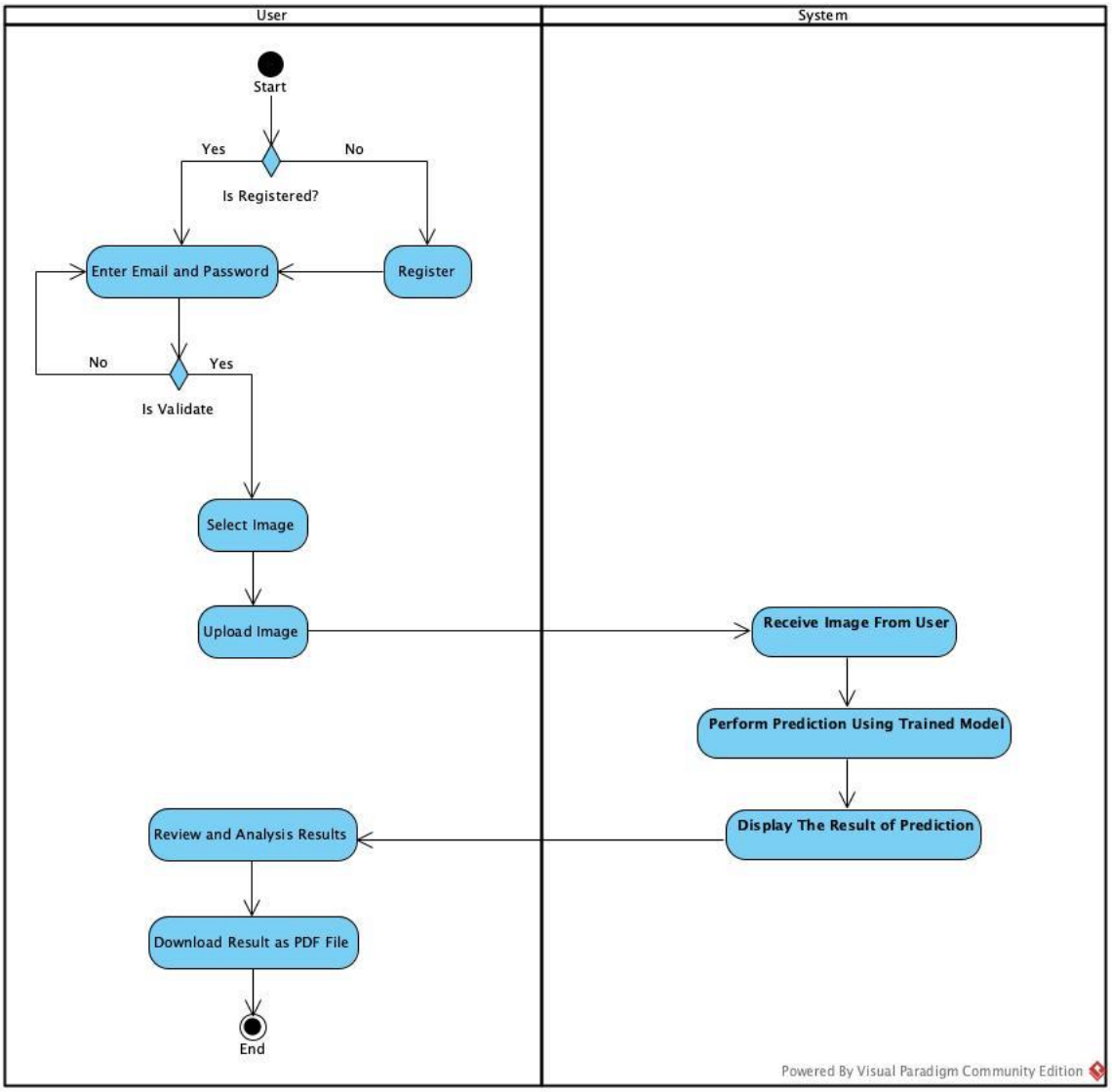

Figure 19 Activity Diagram

As shown in the figure, the user login first in the already created account. After logging, the user can upload image for the processing. The system receives the image and the image is passed in the trained model to produce result. The produced result can be viewed and analysed. The produced result can also be downloaded as a PDF file.

6.3.2 Database Diagram

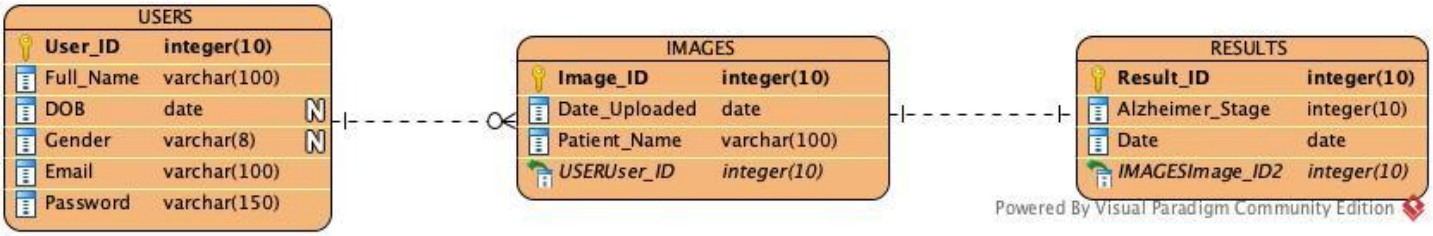

Figure 20 Entity Relation Model

An Entity Relationship Diagram is a type of flowchart that illustrates how "entities" such as people, objects or concepts relate to each other within a system (Chart, 2024).

The above figure shows the relations between the entities. The entites identified are users, images and results. All the entities contains at least one primary key. The relation between the users and images is one to many as a single user can upload many images. The relation is shown as the primary key of users is imported in images as foreign key. The relation between the images and results is one to one as one image can have only one result. The relation is shown as the primary key of images is imported in results as foreign key.

6.4 Testing Strategy

The testing strategy for the Alzheimer's disease detection application will focus on ensuring the accuracy, reliability, and usability of the system. Given the critical nature of medical diagnostics, rigorous testing is essential to validate the performance of the deep learning model and the application.

1. Unit Testing
    a. Conduct unit tests for indiviual components of the application, including data preprocessing modules, model training, and result generation.
    b. Verify the accuracy of eacn method to ensure they perform as expected.
2. Integration Testing
    a. Test the integration of different modules within the application, such as data acquisition, preprocessing, model training, and inteference.
3. Model Testing
    a. Evaluate the trainded Convolutional Neural Network (CNN) model extensively.
    b. Assess performance metrics such as accuracy, precision, recall, and F1 score.

4. Performance Testing
    a. Check response times for image processing and result generation.
    b. Measure the performance of the application under various load and conditions.The evaluation strategy will focus on assessing the effectiveness and impact of the Alzheimer's disease detection application, both from a technical and practical perspective.

6.5 Evaluation Strategy

The evaluation strategy will focus on assessing the effectiveness and impact of Alzheimer's disease detection, both from a technical and practical perspective.

1. Technical Evaluation
    a. Evaluate the performance metrics of the Convoultional Neural Network (CNN) mode, including accuracy, precisiom, and area under the receiver operating characteristic curve (AUC-ROC).
    b. Compare the model's performance with the existing approaches and research studies.
2. Clinical Validation
    a. Collaborate with healthcare professionals to validate the accuracy and reliability of the application.
3. User Feedback
    a. Gather feedback from end-users (health professionals) through surveys.
4. Impact Assessment
    a. Analyze how the application contributes to timerlu intervention.

7. Critical Analysis

After reading various articles, journals, research, etc. I have found various method which can be utilized for image processing in the medical field. However, the utilization of the Convolutional Neural Network (CNN) has proven to optimal for the medical image processing. So for the

detection of the Alzheimer's Disease detection, I will be using Convolutional Neural Network (CNN), as the timely intervention may help a patient live a long normal life.

As Convolutional Neural Network (CNN) model a collection of various algorthims I have studied some and I am still not sure which one to use. I will continue to research and find the optimal algorthim suitable for my project. The application being developed for the project boast a high accuracy, fast result generation with roboust system.

8. Conclusion

The success of project marks a huge breakthrough in the medical and IT field. The project seeks to select correct model and algorithm for the increased accuracy. The project will demonstrate the use of Artificial Intelligence in medical field will completely change the medical imaging in the future.

9. Reference

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Appendix 1- Project Proposal Form

Part 1 – Project Proposal

Student Name	Santosh Tamang
Student Number	2147440
Degree Pathway	BSc(Hons.) Computer Science and Software Engineering
Supervisor Name	Himalaya Kakshapati
Course Coordinator name	Ajay Sharma
Title of Project	Utilizing Convolutional Neuron Networks With T1-Weighted MRI For Detecting Alzheimer's
Abstract of the project	Alzheimer's disease presents significant challenge in healthcare due to its progressive nature and the need for early detection to provide timely intervention. Magnetic Resonance Imaging(MRI) is a potent technique in diagnosis Alzheimer's, mainly T1-weighted MRI, which provide high-resolution structural images of the frontal lobe. Use of Convolutional Neuron Networks(CNNs) with T1-weighted MRI can provide high-accuracy while being efficient for Alzheimer's detection. The project aims to leverage advanced deep learning techniques, specifically Convolutional Neural Networks (CNNs), to detect signs of Alzheimer's disease from T1-weighted MRI brain scans. This approach aims to enhance diagnostic accuracy, streamline the detection process, and ultimately contribute to early intervention and treatment planning. By integrating state-of-the-art deep learning techniques with MRI imaging data, this project endeavours to advance the capabilities of Alzheimer's disease diagnosis, enabling earlier detection and intervention to improve patient outcomes.
Project deliverables	Trained model capable of detecting Alzheimer's Mobile application to use the trained model and provide results Final Report Academic Poster

Figure 21 Project Proposal 1

Description of your artefact	**Problem Statement** Alzheimer's Disease destroys brain cells causing people to lose their memory, mental functions and ability to continue daily activities. It is a severe neurological brain disorder which is not curable, but earlier detection of Alzheimer's Disease can help for proper treatment and to prevent brain tissue damage (Islam & Zhang, 2017). As manual interpretation of MRI scan for AD is time-consuming, subjective and prone to difference in interpretation. **Aim of Project** The project focuses on creating a user-friendly application capable of detecting Alzheimer's disease in an individual from T1-weighted MRI. **Objective of Project** • To train a model that can detect Alzheimer's • To develop a mobile application integrating the model **Feature of Proposed System** • Allows user to upload the image • Analyse the image using the trained model • Show the result of the analysis • Option to save the result **Impact of Project** This development is composed to have a significant impact in several ways. Firstly, it facilitates early detection of Alzheimer's

Figure 22 Project Proposal 2

	disease, potentially leading to timely intervention and slowing the progress. Secondly, it liberates the professionals time, which they can use in more pressing matter, by making the detection automatic. Thirdly, with its user-friendly interface, the application ensures accessibility for healthcare professionals of varying technical backgrounds. Finally, it's anticipated to drive advancements in Alzheimer's disease research by providing a reliable tool for diagnosis and treatment evaluation. **Challenges** Challenges include navigating the complexities of medical image analysis, ensuring data security and availability and rigorously validating the system's accuracy and reliability. Despite these challenges, we are committed to overcoming them through collaborative efforts and thorough testing to deliver a solution that significantly impacts Alzheimer's disease diagnosis and treatment.
What methodology (structured process) will you be following to realise your artefact?	The research will be done following the mixed methods research. The research integrates both quantitative and qualitative approaches within a single study to provide a comprehensive understanding of the research problem. Interviews and questionaires will be taken for data collection purpose. The development of application will be done using waterfall methodology. This methodology is selected as the methodology consists of phase that progresses linearly from one to next, with each phase building upon the outcomes of the last phase. The workflow encompasses the following stages: • Data Acquisition: Gather a comprehensive dataset comprising T1-weighted MRI brain scans from individuals diagnosed with Alzheimer's disease and healthy individuals.

Figure 23 Project Proposal 3

	• Pre-processing: Standardize image resolution, normalize intensity values, and perform other pre-processing steps to enhance data quality. • Image Segmentation: Implement CNN-based segmentation algorithms to isolate brain regions and distinguish abnormal structures associated with Alzheimer's disease. • Feature Extraction: Extract pertinent features from segmented images to capture relevant patterns indicative of Alzheimer's disease pathology. • Model Training: Utilize CNN architectures tailored for medical image analysis to train the model on the extracted features for accurate disease classification. • Create Mobile Application: Develop a user-friendly mobile application where clinicians can upload MRI scans and receive automated Alzheimer's disease detection results in a simple format. • Validation and Evaluation: Validate the performance of the CNN-based detection system using a diverse dataset, including unseen MRI scans, and assess its sensitivity, specificity, and overall accuracy in detecting Alzheimer's disease.
How does your project relate to your degree course and build upon the units/knowledge you have studied/acquired	The project requires report writing, time management which can be related to the Fundamental of Computer Studies. The project will use database for storing the data generated while preforming treatment process which was taught in the Computer Systems Structure. The developed application source code will use OOP which is related to Principle of Programming. The computer vision and image processing which is the most required for the project is related to the Concepts And Technologies Of Artificial Intelligence. The above-mentioned details shows that the project is developed using the knowledge obtained while learning in the

Figure 24 Project Proposal 4

	university.
Resources	**Hardware Requirements:** A laptop or desktop containing minimum of 16GB RAM and processor of i7 or more for smooth training of the model in medical data. Additionally, a GPU may be used to train the model for detection. **Software Requirements:** Python: Version 3.7 or higher (required for coding and implementation). Flutter: For the development of the mobile application Integrated Development Environment (IDE): Visual Studio Code, Jupyter Notebook Git: Version control system for collaborative development and tracking changes.

Have you completed & submitted your ethics form?	YES ✓	NO
If the project is a development of previous work by yourself or others, give details below. Failing to declare such previous work here may be treated as an academic offence		

Supervisor Signature: 01/03/2024

Course Coordinator Signature : Ojay 2024/3/1

Figure 25 Project Proposal 5

Part 2 – List of relevant resources

1. Teoh, T. T., 2023. *Convolutional Neural Networks for Medical Applications.* Singapore: Springer.

2. Mohamed Abdaelbassat, B. & Hariri, W., 2023. Alzheimer disease detection using advanced transfer learning techniques on MRI images. *2023 International Conference on Decision Aid Sciences and Applications (DASA).*

3. Jabason, E., Ahmad, M. O. & Swamy, M., 2019. Classification of alzheimer's disease from MRI data using an ensemble of hybrid deep convolutional Neural Networks. *2019 IEEE 62nd International Midwest Symposium on Circuits and Systems (MWSCAS).*

Figure 26 Project Proposal 6

Appendix 2 – Ethics Form

FACULTY OF CREATIVE ARTS, TECHNOLOGIES AND SCIENCE

Form for Research Ethics Projects (Ethics Form)

Student Name	Santosh Tamang
Student Number	2147440
Degree Pathway	BSc(Hons.) Computer Science and Software Engineering
Supervisor name	Himalaya Kakshapati
Supervisor Signature	01/03/2024
Title of project	Utilizing Convolutional Neuron Network With T1-Weighted MRI For Detecting Alzheimer's

Figure 27 Ethical Form 1

Please answer the following questions by circling **YES** or **NO** as appropriate.

Does the study involve vulnerable participants or those unable to give informed consent (e.g. children, people with learning disabilities, your own students)?	YES NO ✓
Will the study require permission of a gatekeeper for access to participants (e.g. schools, self-help groups, residential homes)?	YES NO ✓
Will it be necessary for participants to be involved without consent (e.g. covert observation in non-public places)?	YES NO ✓
Will the study involve sensitive topics (e.g. obtaining information about sexual activity, substance abuse)?	YES NO ✓
Will blood, tissue samples or any other substances be taken from participants?	YES NO ✓
Will the research involve intrusive interventions (e.g. the administration of drugs, hypnosis, physical exercise)?	YES NO ✓
Will financial or other inducements be offered to participants (except reasonable expenses or small tokens of appreciation)?	YES NO ✓
Will the research investigate any aspect of illegal activity (e.g. drugs, crime, underage alcohol consumption or sexual activity)?	YES NO ✓
Will participants be stressed beyond what is considered normal for them?	YES NO ✓
Will the study involve participants from the NHS (patients or staff) or will data be obtained from NHS premises?	YES NO ✓

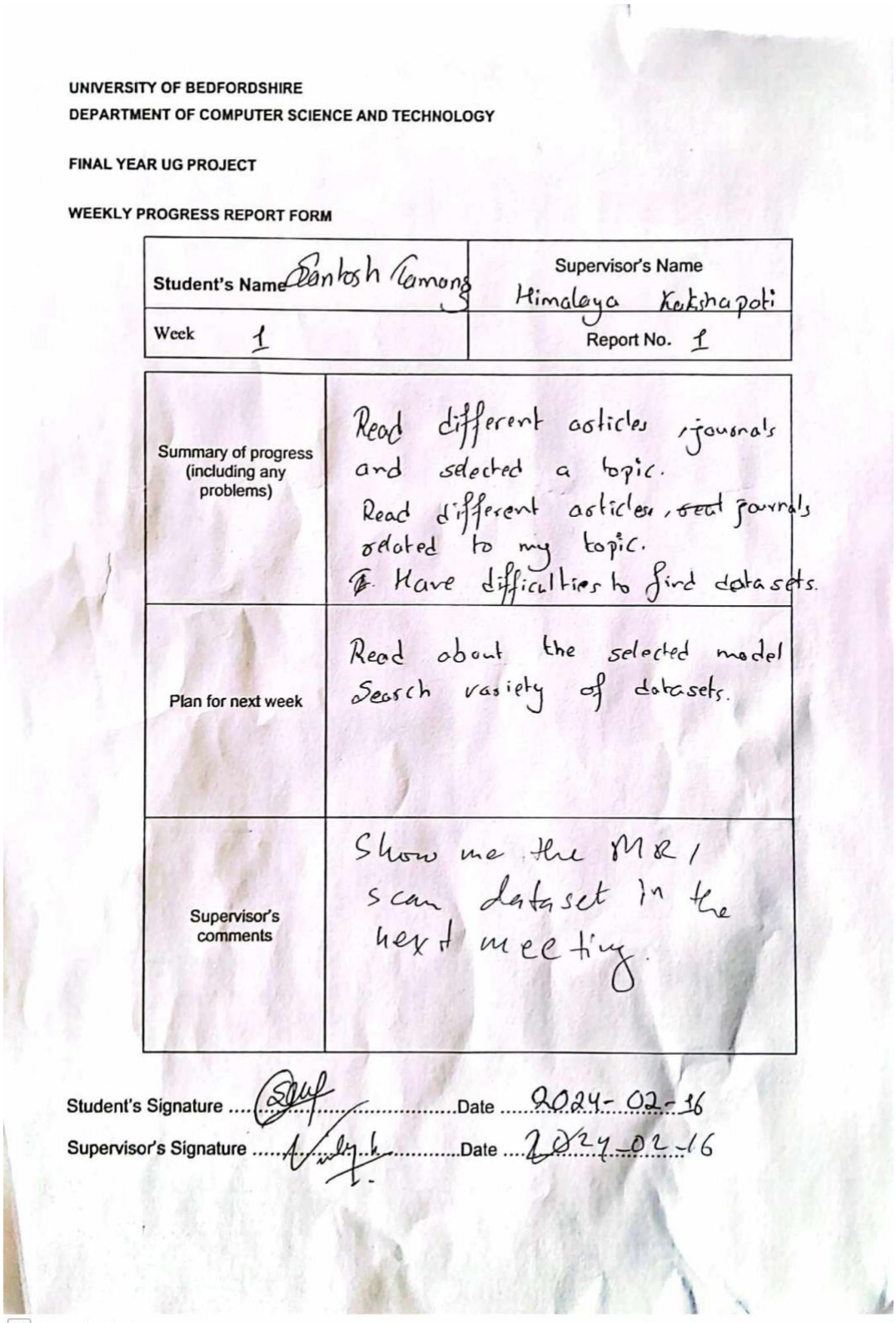
If the answer to any of the questions above is "Yes", or if there are any other significant ethical issues, then further ethical consideration is required. Please document carefully how these issues will be addressed.

Signed (student):
Date: 1st March 2024

Countersigned (Supervisor):
Date: 01/03/2024

Figure 28 Ethical Form 2

Appendix 3 -Weekly Report



UNIVERSITY OF BEDFORDSHIRE
DEPARTMENT OF COMPUTER SCIENCE AND TECHNOLOGY

FINAL YEAR UG PROJECT

WEEKLY PROGRESS REPORT FORM

Student's Name Santosh Tamang	Supervisor's Name Himalaya Kakshapati
Week 1	Report No. 1

Summary of progress (including any problems)	Read different articles, journals and selected a topic. Read different articles, ~~text~~ journals related to my topic. Have difficulties to find datasets.
Plan for next week	Read about the selected model Search variety of datasets.
Supervisor's comments	Show me the MRI scan dataset in the next meeting.

Student's Signature .....Date 2024-02-16

Supervisor's Signature .....Date 2024-02-16

Figure 29 Weekly Report 1

UNIVERSITY OF BEDFORDSHIRE
DEPARTMENT OF COMPUTER SCIENCE AND TECHNOLOGY

FINAL YEAR UG PROJECT

WEEKLY PROGRESS REPORT FORM

Student's Name Santosh Kamarg	Supervisor's Name Himalaya Katsha pati
Week 2	Report No. 2

Summary of progress (including any problems)	Collected more datasets and applied for some more datasets to various organizations. Prepared draft proposal.
Plan for next week	Prepare and submit final proposal and ethics form.
Supervisor's comments	- informed me that he has requested for images datasets with Alzheimer's from diff. orgs. - showed me draft proposal form - Make changes to the draft as the feedback provided.

Student's Signature ..... Date 23rd Feb 2024

Supervisor's Signature ..... Date 23rd Feb 2024

Figure 30 Weekly Report 2

UNIVERSITY OF BEDFORDSHIRE
DEPARTMENT OF COMPUTER SCIENCE AND TECHNOLOGY

FINAL YEAR UG PROJECT

WEEKLY PROGRESS REPORT FORM

Student's Name Santosh Tamang	Supervisor's Name Himalaya Kakshapati
Week 3	Report No. 3

Summary of progress (including any problems)	Collected the datasets from the applied websites Pooposal , Ethics form submitted
Plan for next week	Reasearch some more and start preparing for final report. And literature review
Supervisor's comments	- Show datasets - Deridentify personal info from the raw data.

Student's Signature ..... Date 1st March 2024

Supervisor's Signature ..... Date 01/03/2024

Figure 31 Weekly Report 3

UNIVERSITY OF BEDFORDSHIRE
DEPARTMENT OF COMPUTER SCIENCE AND TECHNOLOGY

FINAL YEAR UG PROJECT

WEEKLY PROGRESS REPORT FORM

Student's Name	Supervisor's Name
Santosh Tamang	Himalaya Kakshapati
Week 4	Report No. 4

Summary of progress (including any problems)	Deidentified personal info from the raw data sets. Created Survey Questionnaire Started literature review Introduction part
Plan for next week	Complete literature review Introduction part Start remaining part of literature review
Supervisor's comments	-showed data. - Pls label the data.

Student's Signature .....Date ...6th March 2024

Supervisor's Signature .....Date ....6th Mar 2024

Figure 32 Weekly Report 4

UNIVERSITY OF BEDFORDSHIRE
DEPARTMENT OF COMPUTER SCIENCE AND TECHNOLOGY

FINAL YEAR UG PROJECT

WEEKLY PROGRESS REPORT FORM

Student's Name Santosh Tamang	Supervisor's Name Himalaya Kakshapati
Week 5	Report No. 5

Summary of progress (including any problems)	Relabelled the datasets Completed Introduction of literature review
Plan for next week	Complete Remaining literature review
Supervisor's comments	- Advised to use One-Hot-Encoding for Labels - Categorical.

Student's Signature ..... Date 14th March 2024

Supervisor's Signature ..... Date 14th Mar 2024

Figure 33 Weekly Report 5

UNIVERSITY OF BEDFORDSHIRE
DEPARTMENT OF COMPUTER SCIENCE AND TECHNOLOGY

FINAL YEAR UG PROJECT

WEEKLY PROGRESS REPORT FORM

Student's Name Santosh Tamang	Supervisor's Name Himalaya Kakshapati
Week 6	Report No. 6

Summary of progress (including any problems)	Applied One-Hot Encoding for data categorization Done some more report part Prepare questionnaire for survey
Plan for next week	Conduct surveys. Analysis the survey data.
Supervisor's comments	- informed that he has done one-hot encoding of data as suggested.

Student's Signature ..... Date 7th April 2024

Supervisor's Signature ..... Date 7th Apr 2024

Figure 34 Weekly Report 6

Appendix 4 – Questionnaire of Survey

https://docs.google.com/forms/d/e/1FAIpQLSeur5guUw1RkCo3C-6pYjwJGUqEFsxEMs8ieXEEdOholGkIng/viewform?usp=sf_link

Appendix 5 – Survey Result

Timestamp	What is your age?	What is your gender?	What is your education level?	Have you ever undergone an MRI scan before?	If yes, how many MRI scans have you undergone in the past?	How familiar are you with Alzheimer's disease?
2024/04/17 10:37:50 pm GMT+5:45	61-70	Female	Doctorate Degree	No		Very Familiar
2024/04/17 10:37:52 pm GMT+5:45	61-70	Female	Doctorate Degree	No		Very Familiar
2024/04/17 10:37:53 pm GMT+5:45	61-70	Female	Doctorate Degree	No		Very Familiar
2024/04/17 10:37:55 pm GMT+5:45	61-70	Female	Doctorate Degree	No		Very Familiar
2024/04/17 10:37:56 pm GMT+5:45	61-70	Female	Doctorate Degree	No		Very Familiar
2024/04/17 10:38:02 pm GMT+5:45	61-70	Female	Doctorate Degree	No		Very Familiar
2024/04/17 10:38:04 pm GMT+5:45	61-70	Female	Doctorate Degree	No		Very Familiar
2024/04/17 10:38:06 pm GMT+5:45	61-70	Female	Doctorate Degree	No		Very Familiar
2024/04/17 10:38:08 pm GMT+5:45	61-70	Female	Doctorate Degree	No		Very Familiar
2024/04/17 10:38:11 pm GMT+5:45	61-70	Female	Doctorate Degree	No		Very Familiar

2024/04/17 10:38:24 pm GMT+5:45	61-70	Female	Doctorate Degree	No		Very Familiar
2024/04/17 10:38:26 pm GMT+5:45	61-70	Female	Doctorate Degree	No		Very Familiar
2024/04/17 10:38:28 pm GMT+5:45	61-70	Female	Doctorate Degree	No		Very Familiar
2024/04/17 10:38:30 pm GMT+5:45	61-70	Female	Doctorate Degree	No		Very Familiar
2024/04/17 10:38:32 pm GMT+5:45	61-70	Female	Doctorate Degree	No		Very Familiar
2024/04/17 10:38:34 pm GMT+5:45	61-70	Female	Doctorate Degree	No		Very Familiar
2024/04/17 10:38:36 pm GMT+5:45	61-70	Female	Doctorate Degree	No		Very Familiar
2024/04/17 10:38:38 pm GMT+5:45	61-70	Female	Doctorate Degree	No		Very Familiar
2024/04/17 10:38:40 pm GMT+5:45	61-70	Female	Doctorate Degree	No		Very Familiar
2024/04/17 10:38:42 pm GMT+5:45	61-70	Female	Doctorate Degree	No		Very Familiar
2024/04/17 10:41:05 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:06 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:09 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:11 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar

2024/04/17 10:41:13 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:15 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:17 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:19 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:21 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:23 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:25 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:27 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:29 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:31 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:33 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:35 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:37 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:38 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar

2024/04/17 10:41:40 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:41 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:43 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:45 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:46 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:47 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:49 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:50 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:52 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:53 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:41:55 pm GMT+5:45	51-60	Male	Doctorate Degree	Yes	3	Very Familiar
2024/04/17 10:43:01 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:03 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:04 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar

2024/04/17 10:43:07 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:09 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:11 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:13 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:15 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:17 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:19 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:21 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:23 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:25 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:27 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:29 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:31 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:33 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar

2024/04/17 10:43:35 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:37 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:39 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:41 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:43 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:45 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:47 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:49 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:51 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:53 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:55 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:57 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:43:59 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:44:01 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar

2024/04/17 10:44:03 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:44:05 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:44:07 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:44:09 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:44:11 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:44:13 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:44:15 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:44:17 pm GMT+5:45	41-50	Female	Bachelor's Degree	Yes	1	Not Familiar
2024/04/17 10:49:00 pm GMT+5:45	41-50	Male	Master's Degree	No		Somewhat Familiar
2024/04/17 10:49:02 pm GMT+5:45	41-50	Male	Master's Degree	No		Somewhat Familiar
2024/04/17 10:49:04 pm GMT+5:45	41-50	Male	Master's Degree	No		Somewhat Familiar
2024/04/17 10:49:06 pm GMT+5:45	41-50	Male	Master's Degree	No		Somewhat Familiar
2024/04/17 10:49:08 pm GMT+5:45	41-50	Male	Master's Degree	No		Somewhat Familiar
2024/04/17 10:49:10 pm GMT+5:45	41-50	Male	Master's Degree	No		Somewhat Familiar

2024/04/17 10:49:12 pm GMT+5:45	41-50	Male	Master's Degree	No	Somewhat Familiar
2024/04/17 10:49:14 pm GMT+5:45	41-50	Male	Master's Degree	No	Somewhat Familiar
2024/04/17 10:49:16 pm GMT+5:45	41-50	Male	Master's Degree	No	Somewhat Familiar
2024/04/17 10:49:18 pm GMT+5:45	41-50	Male	Master's Degree	No	Somewhat Familiar
2024/04/17 10:49:20 pm GMT+5:45	41-50	Male	Master's Degree	No	Somewhat Familiar
2024/04/17 10:49:22 pm GMT+5:45	41-50	Male	Master's Degree	No	Somewhat Familiar