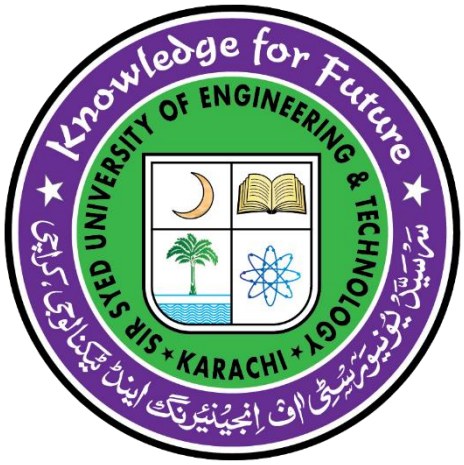
Final Year Project Report

Group No. 20
Early Detection of Alzheimer's Disease
BS COMPUTER SCIENCE
BATCH 2020S

Ms Rabiya Tahir
Senior Lecturer
SSUET

Submitted by

2020S-BCS-029	**M. Sufyan**
2020S-BCS-030	**Syed Huzaifa Ali**
2020S-BCS-031	**Abdul Rafay**
2020S-BCS-042	**M. Hamza Jamil**



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In Partial Fulfillment
Of the Requirements for the degree
Bachelor of Science in Computer Science

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March 2024

DECLARATION

We hereby declare that this project report entitled **"Early Detection of Alzheimer's Disease"** submitted to the **"Department of Computer Science and Information Technology",** is a record of an original work done by us under the guidance of Supervisor "**Ms Rabiya Tahir**" and that no part has been plagiarized without citations. Also, this project work is submitted in the partial fulfillment of the requirements for the degree of Bachelor of Science in Computer Science.

Name : M Sufyan Signature: _____

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Supervisor: **Signature:**

Ms Rabiya Tahir _____
Sr Lecturer

Date _____

ACKNOWLEDGMENTS

First and foremost, We would like to thank our Almighty Allah, for providing us the strength, courage of conviction and the strong sense of dedication to our project that enabled us to take it to the level that it has achieved today. Undoubtedly, We wouldn't have been now here, if it weren't for His Mercy and Blessings.

This Work would have been impossible without the copious amounts of help, patience, and encouragement from my kind supervisor **Ms. Rabiya Tahir**. We would like to thank her for teaching us so much and for inspiring us with the example of hard work, providing great help and key information throughout the time required for the completion of this project report. We would also very special thanks to **Ms. Sana Ejaz** for her valuable support in the risk and cost estimation and in testing phase of this project. We would also like to thank the entire faculty members for their able support and encouragement which enabled us able to complete our project report.

To our families, thank you for letting us do what we want to do, supporting our decisions as crazy as they may be. You are always there for us. Our deepest love and gratitude go to our father and mother who played such a vital role all through our lives by always placing our interests ahead of theirs. This project work is dedicated to our parents, thank you for seeing us through every step of the way, for praying for us during times of trouble, and for rejoicing with us over every little triumph. During our studies our families constantly provided us the hope that we needed to complete our higher education. Also thanks to all other member of our family and friends whose love and prayers are with us all the time.

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ABSTRACT

Alzheimer's disease (AD) is a neurological ailment that causes behavioral abnormalities, cognitive impairment, and gradual memory loss. More than 5 million people are impacted by it, which is the sixth greatest cause of mortality in the country. For AD to be treated and managed effectively, early detection is essential. The present diagnostic techniques, however, are frequently intrusive, expensive, and ineffective. In this research, a brand-new computer-based approach to utilize neuroimaging for AD early diagnosis is proposed. The suggested method analyses brain imaging data using a hybrid pre-trained convolutional neural network (CNN) model. A dataset of brain MRI scans from AD patients, those with amnestic mild cognitive impairment (MCI), and cognitively healthy controls is used to train the model. The model has a 97% accuracy rate in predicting the chance of developing AD. The early detection of AD could be completely changed by the suggested method. Large populations can be screened for AD using this non-invasive, economical, and precise computer technique. The earlier AD is identified, the earlier it can be treated and managed, which can improve patient outcomes and lessen the financial impact the disease has on society. This innovative computer method represents a significant contribution to the field of AD diagnosis and is a valuable addition to existing research in the thesis.

Table of Content

List of Figures

List of Tables

Chapter 1

Introduction

1.1 Background of Study

The domain of the "Early Detection of Alzheimer's Disease Using Neuroimaging" project is healthcare and medical research, specifically focused on Alzheimer's disease, a neurodegenerative disorder that affects memory and cognitive functions. The project utilizes neuroimaging techniques and machine learning algorithms to detect early signs of Alzheimer's disease accurately, which can lead to earlier interventions and better outcomes for patients.

This project aims to develop a model for the early detection of Alzheimer's disease using neuroimaging. The proposed model will analyze AD, EMCI, CN, MCI, and LMCI scans respectively to predict the likelihood of developing Alzheimer's disease. A hybrid pre-trained CNN model for the early diagnosis of Alzheimer disease.

1.2 Problem Statement

Alzheimer's disease is a neurodegenerative disorder that leads to memory loss, cognitive decline, and behavioral changes, affecting millions of people worldwide. Early detection of Alzheimer's disease is crucial as it allows for appropriate interventions that can slow down disease progression and improve patient outcomes. However, the current methods for diagnosing Alzheimer's disease are often invasive, expensive, and only detect the disease at a later stage when significant brain damage has already occurred. Hence, there is a need to develop a reliable and non-invasive tool (not involving the introduction of instruments into the body) for the early detection of Alzheimer's disease, enabling early intervention to reduce the disease's impact.

1.3 Objectives

1. A hybrid pre-trained CNN model for the early diagnosis of Alzheimer disease.
2. To predict the likelihood of developing the disease based on patient data, including cognitive tests and brain imaging.
3. To achieve high accuracy and outperform existing diagnostic methods.
4. To provide support to caretaker by giving them feedback about the patient.

1.4 Scope of Study

The product scope of "Early Detection of Alzheimer's Disease Using Neuroimaging" is to develop a non-invasive and accurate method to detect early signs of Alzheimer's disease using neuroimaging and machine learning algorithms. The project aims to create a tool that can assist clinicians in diagnosing Alzheimer's disease earlier, potentially leading to more timely and effective interventions. The product scope may also include the development of a user-friendly interface for clinicians to interpret and use the neuroimaging data.

1.5 Project Feasibility

The "Early Detection of Alzheimer's Disease Using Neuroimaging" project exhibits high feasibility due to its alignment with critical healthcare needs. Leveraging neuroimaging and machine learning for early diagnosis addresses a significant gap in current Alzheimer's detection methods. The proposed system's user-friendly interfaces, reliance on widely-used software components, and accessibility to existing hardware, such as MRI or CT scanners, enhance practicality. The integration of pre-trained CNN models and machine learning libraries ensures efficiency, while the utilization of a web application framework facilitates broader accessibility. Overall, the project demonstrates technical, operational, and economic feasibility in advancing Alzheimer's disease detection and intervention.

Chapter 2

Literature Review

2.1 Existing Systems

2.1.1 BrainTest [1]

BrainTest is a mobile app that offers cognitive screening tests to help detect early signs of dementia. The app provides several tests that evaluate various cognitive abilities, such as memory, attention, and executive function. BrainTest also includes a tracking system to monitor cognitive changes over time. The app is available on both iOS and Android platforms.

System Features:

- Offers cognitive screening tests to help detect early signs of dementia
- Provides several tests that evaluate various cognitive abilities, such as memory, attention, and executive function
- Includes a tracking system to monitor cognitive changes over time
- Allows users to save and share their results with healthcare professionals
- Available on both iOS and Android platforms

2.1.2 Coginvue [2]

Coginvue is a web-based platform that offers cognitive assessment tools for clinical and research purposes. The platform includes a variety of cognitive tests that evaluate multiple domains, such as memory, attention, and processing speed. Coginvue also provides real-time data analysis and visualization, making it easier for clinicians and researchers to interpret the results. The platform is accessible from any device with internet access.

System Features:

- Offers cognitive assessment tools for clinical and research purposes
- Includes a variety of cognitive tests that evaluate multiple domains, such as memory, attention, and processing speed
- Provides real-time data analysis and visualization
- Allows clinicians and researchers to customize tests and create their own assessments
- Offers cloud-based storage and data management

2.1.3 MindMate [3]

MindMate is a mobile app designed to help individuals manage their cognitive health and well-being. The app includes various features, such as daily brain exercises, nutrition and exercise recommendations, and a mood tracker. MindMate also offers personalized cognitive training programs that adapt to the user's performance. The app is available on both iOS and Android platforms.

System Features:

- Designed to help individuals manage their cognitive health and well-being
- Includes daily brain exercises, nutrition and exercise recommendations, and a mood tracker
- Offers personalized cognitive training programs that adapt to the user's performance
- Provides feedback on cognitive performance and progress over time
- Allows users to set goals and track their progress

2.2 Proposed System:

The proposed system for the project "Early Detection of Alzheimer using Neuroimaging" employs advanced neuroimaging techniques like MRI and PET scans, coupled with machine learning algorithms, to identify subtle brain changes indicative of Alzheimer's in its early stages. By enabling early detection, it promises more timely interventions and personalized treatment plans, potentially improving outcomes for individuals at risk of the disease.

2.3 Comparative Analysis:

	Features	[1] BrainTest	[2] Coginvue	[3] MindMate	Our Project
1	Early Detection Of Alzheimer	×	×	×	✓
2	Weekly feedback	✓	✓	×	✓
3	Maintain User History	✓	×	✓	✓
4	Recommendation of lifestyle changes	×	×	×	✓
6	Caretaker Support	×	×	×	✓
7	Personalized Reminders	×	×	×	✓

Table 2.3) Comparative Analysis

Chapter 3

Requirement Analysis

3.1 External Interface Requirements

3.1.1 User Interfaces

The proposed system will have a user interface for both patients and caregivers. The user interface for patients will consist of a cognitive assessment test that will require users to respond to a series of questions related to their cognitive abilities. The caregiver's interface will include a dashboard that will provide feedback on the patient's cognitive abilities and status updates on any recommendations made by the system. The user interface will be designed to be intuitive and user-friendly, allowing users to navigate and interact with the system with ease.

3.1.2 Hardware Interfaces

The proposed system will require a hardware interface for accessing the neuroimaging data. The system will require access to an MRI scanner or CT scanner to obtain brain scans of patients. The system will also require a computer or server with sufficient processing power and memory to perform the machine learning algorithms for analysis of the patient data.

3.1.3 Software Interfaces

The proposed system will interface with the following software components:

- **Pre-trained CNN models:** The system will use pre-trained convolutional neural network (CNN) models to analyze brain scans of patients.
- **Machine learning libraries:** The system will use machine learning libraries such as TensorFlow and Keras for training and testing the models.
- **Database management systems**: The system will use a database management system to store patient data, cognitive assessment test results, and other relevant information.
- **Web application framework:** The system will use a web application framework React Native for the development of the user interface and web application.

Data items that will be coming into the system include neuroimaging data, patient demographic information, cognitive assessment test results, and feedback from the caregivers. Data going out of the system includes the likelihood of developing Alzheimer's disease, recommendations for lifestyle changes, and feedback to caregivers. The purpose of each data item is to enable the system to make accurate predictions and provide useful feedback to patients and caregivers.

3.1.4 Communications Interfaces

The proposed system will require communication interfaces for data transfer between different components of the system. The system will use web browsers for the user interface, and a network server communication protocol for data transfer between the client and server. The system will also use communication protocols such as SMTP or HTTP for email and web-based communication. Security and encryption issues will be addressed through the use of secure communication protocols and encryption techniques. Data transfer rates will be optimized to ensure that the system can handle large volumes of data without slowing down, and synchronization mechanisms will be implemented to ensure that data is consistent across all components of the system.

3.2 Functional Requirements

ID	Requirement
REQ-1	User Registration/Sign Up/Log In.
REQ-2	Scan/Detect Image.
REQ-3	Generate Report.

Table 3.2) Functional Requirements

3.3 Other Nonfunctional Requirements

3.3.1 Performance Requirements

- The system should be able to analyze neuroimaging scans and predict the likelihood of Alzheimer's disease within 5 minutes.
- The system should be able to handle a minimum of 100 concurrent users.

3.3.2 Safety Requirements

- The system should not cause any harm or injury to the users or patients.
- The system should comply with all applicable safety regulations and standards.

3.3.3 Security Requirements

- The system should ensure the confidentiality and privacy of patient data.
- The system should implement appropriate measures to prevent unauthorized access, data theft, and data loss.
- The system should comply with all applicable security regulations and standards.

3.3.4 Software Quality Attributes

- The system should be highly reliable and available, with a minimum uptime of 99%.
- The system should be maintainable and easy to update with new features or improvements.
- The system should be easy to use and intuitive, with a user-friendly interface for both patients and caregivers.
- The system should be compatible with various platforms and devices, such as desktops, laptops, and mobile devices.
- The system should be scalable and able to handle increased user load as the system grows.

3.4 Cost Estimation

S.No	Project Expenditure	Cost in Rupees
1	**Equipment's**	
	IP Camera	5000
	Sub Total	**5000**
2	**Domain Name and Hosting**	
	Domain Name	2000
	Hosting	8000
	Sub Total	**10000**
3	**Printing**	
	FYP Wall Poster	3000
	FYP Standee	1500
	FYP Brochure	500
	FYP Report 3 Copies	3000
	2 DVDs	200
	Sub Total	**8200**
Grand Total		**23,200**

Table 3.4) Cost Estimation

Chapter 4

System Design

4.1 System Architecture Diagram

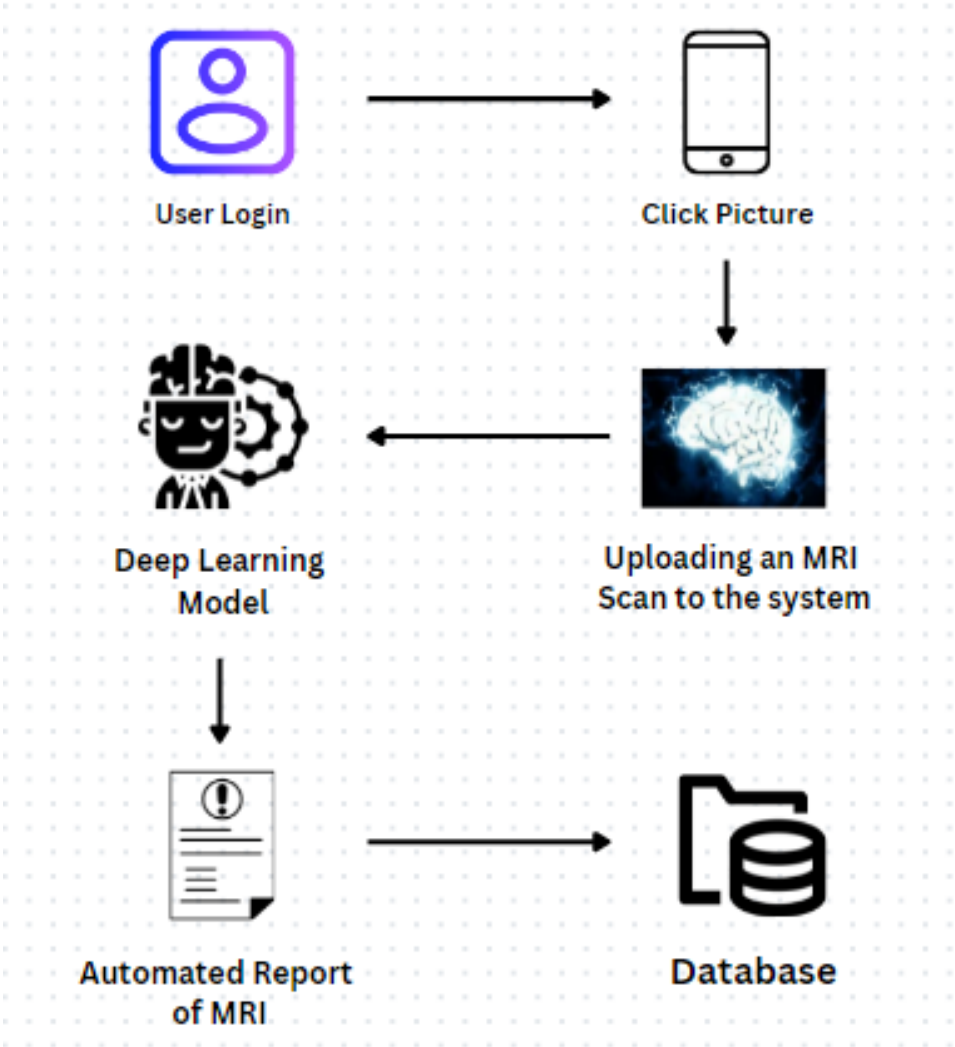


Fig 4.1 System Architecture diagram

4.2 High Level Design: System Operations

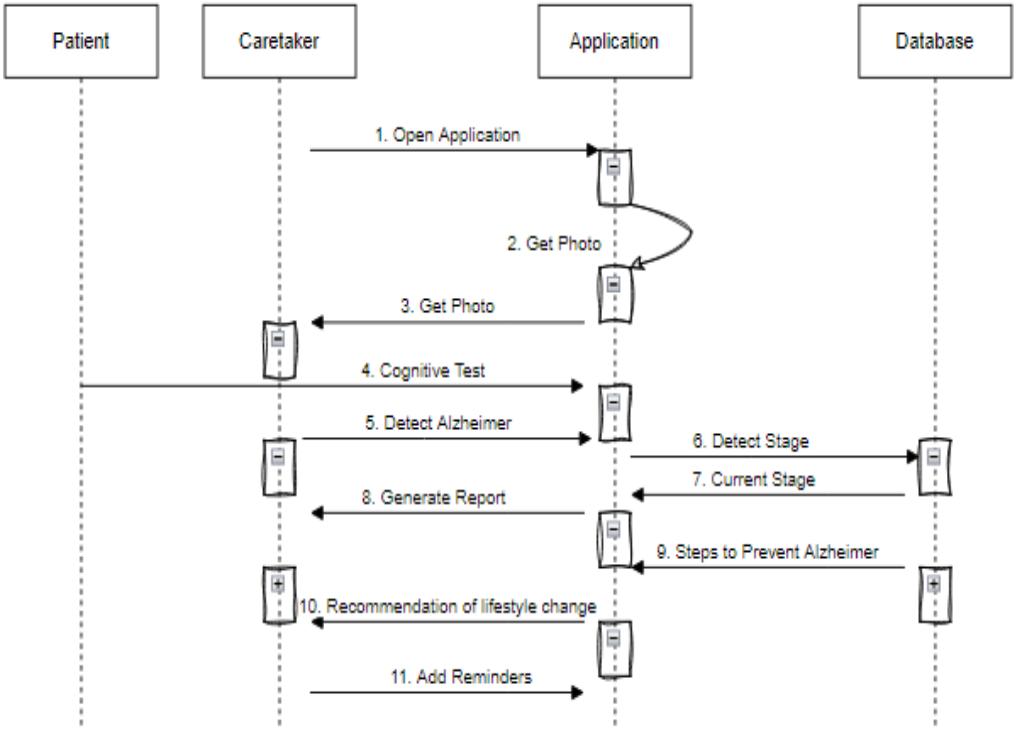


Fig 4.2 System Operations

4.3 High Level Design: System Model

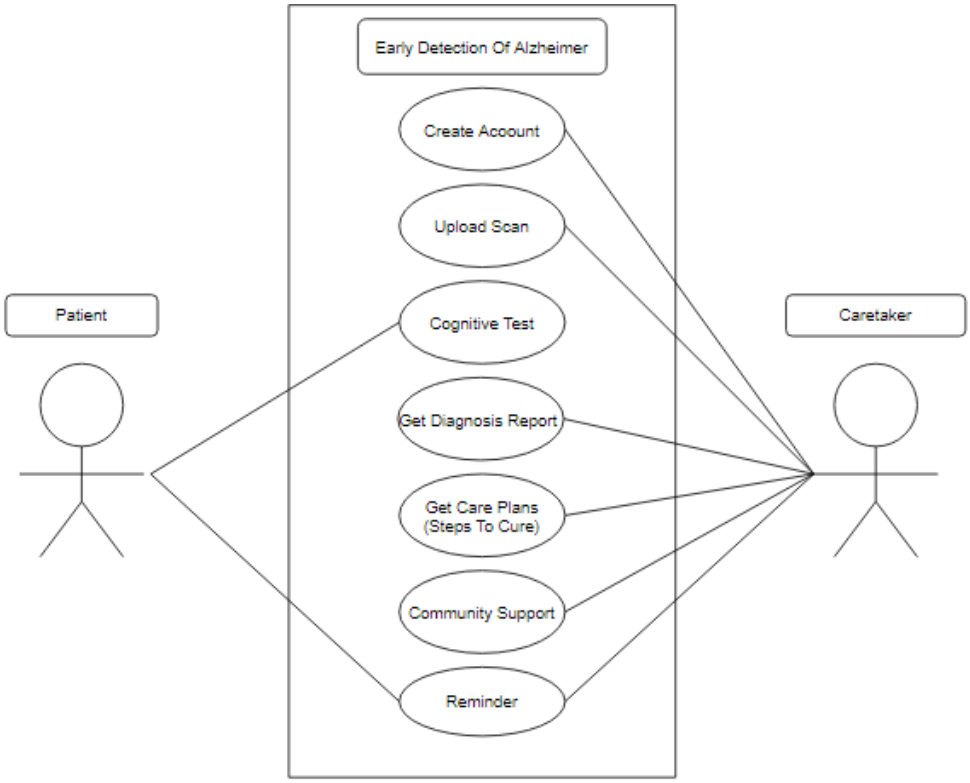


Fig 4.3 System Model

4.4 Low Level Design

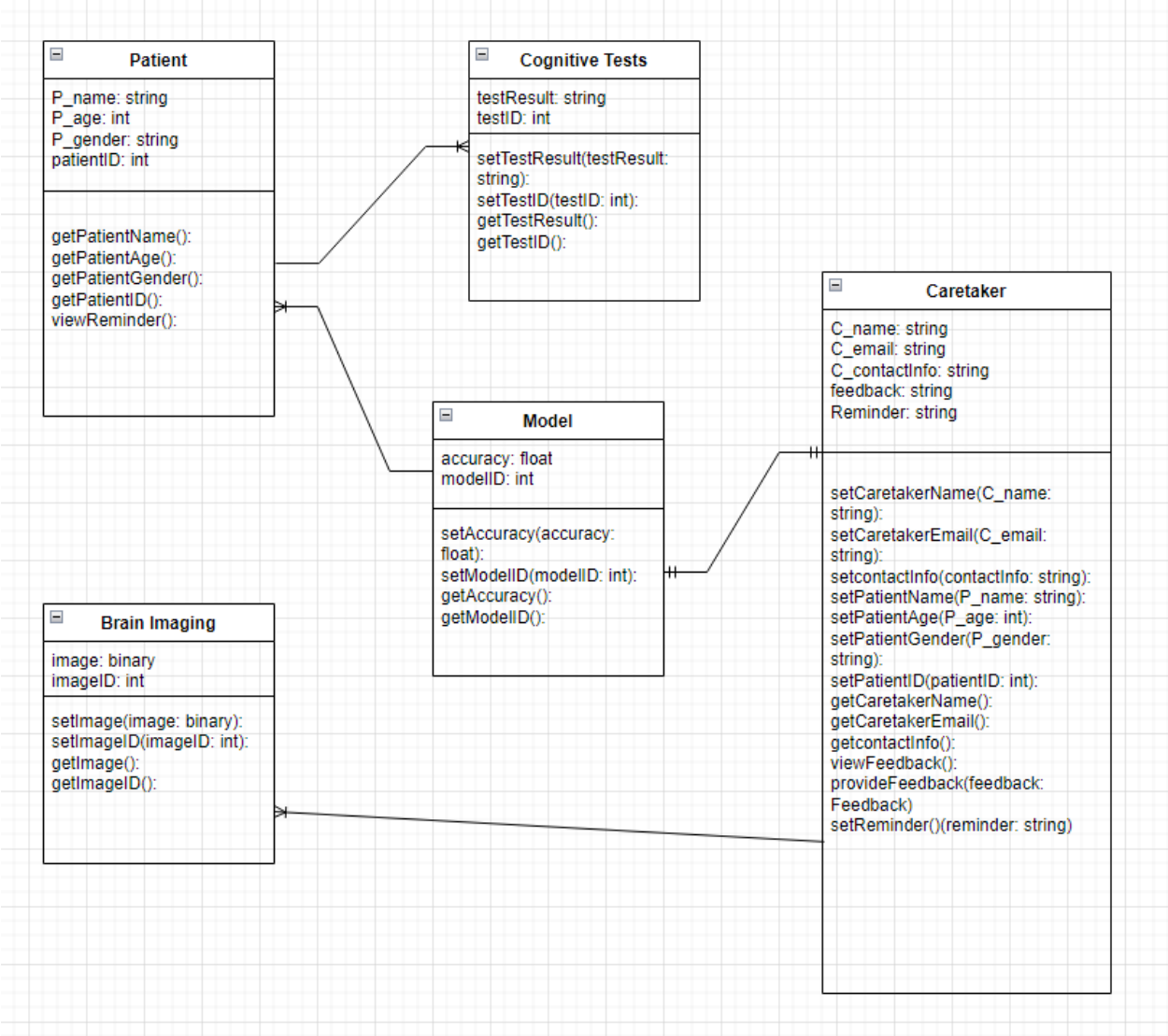


Fig 4.4 Low Level Design

4.5 Database Design

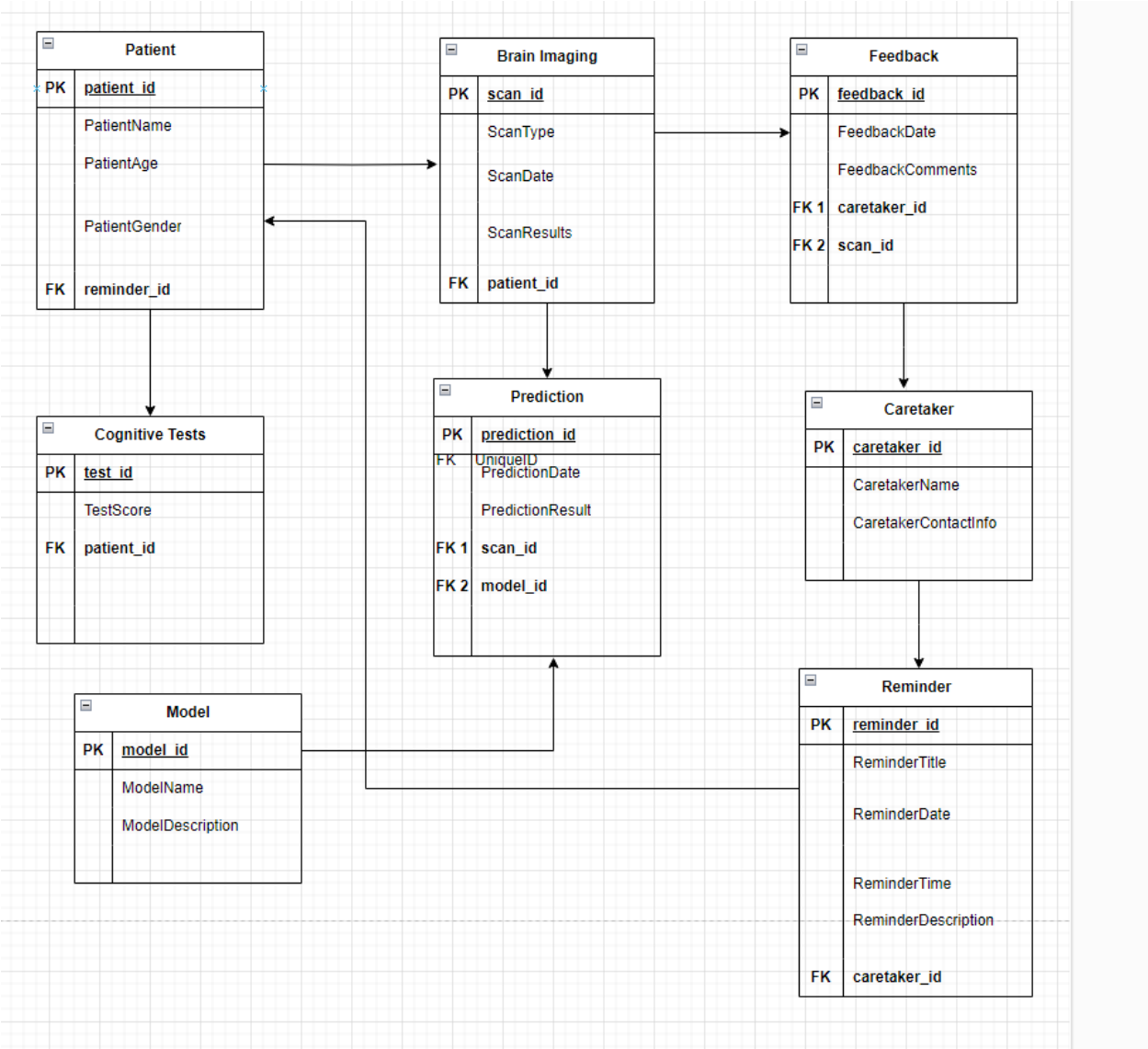


Fig 4.5 Database Design

4.6 GUI Design


AlzAware
Give Feedback:
Did you like This App ?
Rate Now
SUBMIT


AlzAware
New Reminder:
Reminder Title:
ADD
8:00 AM
5:00 PM
9:00 PM

Chapter 5

System Development Methodology

5.1 Development Methodology

Based on the project requirements and objectives, the Waterfall Model is considered to be the most appropriate software development life cycle model for this project.

The Waterfall Model is a sequential and linear approach to software development that is best suited for projects with clearly defined requirements, a fixed budget, and a well-understood timeline. In this model, each phase of the development process is completed before moving on to the next phase. The five main phases of the Waterfall Model include requirements gathering and analysis, design, implementation, testing, and maintenance.

For this project, the requirements are well defined and the project timeline is clearly outlined. Therefore, the Waterfall Model is suitable as it provides a structured approach to software development, ensuring that each phase of the project is completed before moving on to the next phase. The model also enables the team to identify and address any potential issues early in the development process, which helps to ensure the final product meets the requirements and is delivered on time.

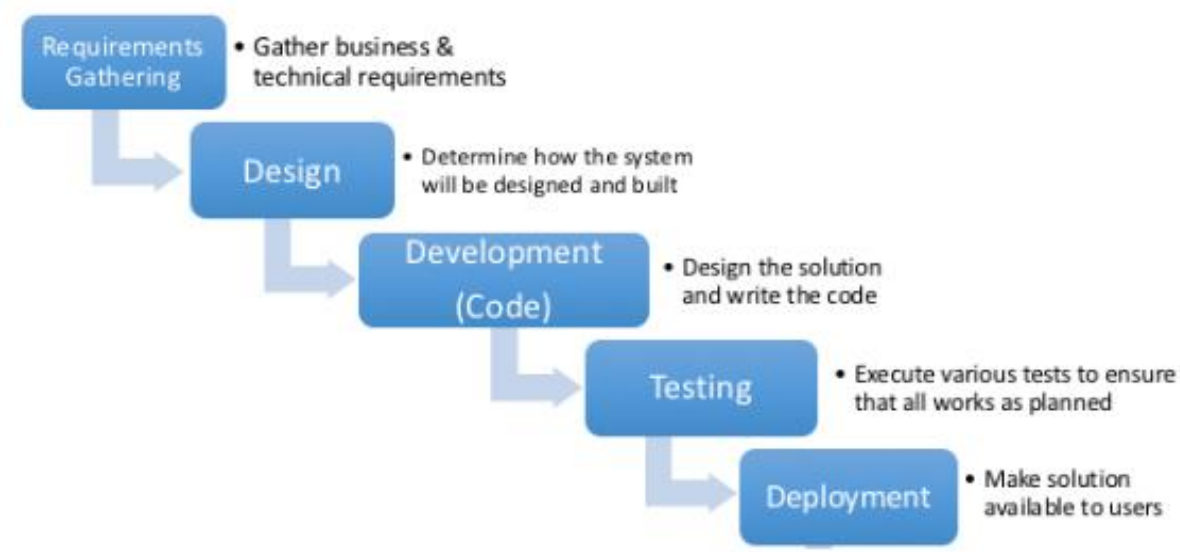


Figure 5.1: Software Development Life Cycle.

5.2 Key Milestone

Num.	Milestone	Completion Week
1	Requirement Gathering	Week 10
2	Interim report submission	Week 12
3	Proposal Defense	Week 14
4	Progress Report	Week 18
5	Dissertation and Technical Report	Week 25
5	Prototype Development Complete	Week 26
6	Project Submission and Presentation	Week 28

Table 5.2) Key Miletone

5.3 Project Plan with Gantt Chart

Task	Start	Finish	Duration	Progress	Priority	Resources
Project Planning Phase	**3/1/2023**	**3/20/2023**	**20d**	**98%**	1	**Rafay, Sufyan, Huzaifa, Hamza**
Identify project scope and objectives	3/1/2023	3/5/2023	5d	98%	2	Sufyan, Huzaifa
Conduct feasibility study	3/5/2023	3/10/2023	5d	96%	3	Hamza, Rafay
Define project requirements and deliverables	3/10/2023	3/15/2023	5d	97%	4	Huzaifa, Sufyan
Create project proposal document	3/15/2023	3/20/2023	5d	100%	3	Rafay, Sufyan, Huzaifa, Hamza
System Design & Specification Phase	**3/20/2023**	**4/15/2023**	**25d**	**81%**	2	**Rafay, Sufyan, Huzaifa, Hamza**
Identify hardware and software requirements	4/15/2023	4/25/2023	10d	97%	3	Hamza, Rafay
Develop technical requirement specification document	4/25/2023	4/30/2023	5d	98%	4	Huzaifa, Sufyan, Hamza
Develop front-end layout design	4/1/2023	5/5/2023	5d	80%	1	Hamza
Develop detailed system design	5/5/2023	5/10/2023	5d	50%	1	Rafay, Sufyan, Huzaifa, Hamza
System Implementation Phase	**5/10/2023**	**10/10/2023**	**150d**	**13%**	3	**Rafay, Sufyan, Huzaifa, Hamza**
Develop web application	5/10/2023	7/10/2023	60d	30%	4	Rafay, Sufyan, Huzaifa, Hamza
Integrate machine learning model into the web application	7/10/2023	9/10/2023	60d	20%	4	Rafay, Sufyan, Huzaifa
Conduct system testing and quality assurance	9/10/2023	9/25/2023	15d	0%	4	Hamza, Huzaifa
Perform user acceptance testing	9/25/2023	10/10/2023	15d	0%	4	Rafay, Sufyan
Deployment Phase	**10/10/2023**	**10/20/2023**	**10d**	**0%**	3	**Rafay, Sufyan, Huzaifa, Hamza**
Deploy the web application to a live server	10/20/2023	10/25/2023	5d	0%	2	Rafay
Perform system maintenance and updates	10/25/2023	10/30/2023	5d	0%	3	Sufyan, Huzaifa, Hamza
Final Reporting Phase	**10/30/2023**	**11/30/2023**	**30d**	**0%**	4	**Rafay, Sufyan, Huzaifa, Hamza**
Write the final year project report	11/30/2023	11/20/2023	20d	0%	4	Rafay, Sufyan, Huzaifa, Hamza
Project evaluation and defense	11/20/2023	11/30/2023	10d	0%	4	Rafay, Sufyan, Huzaifa, Hamza

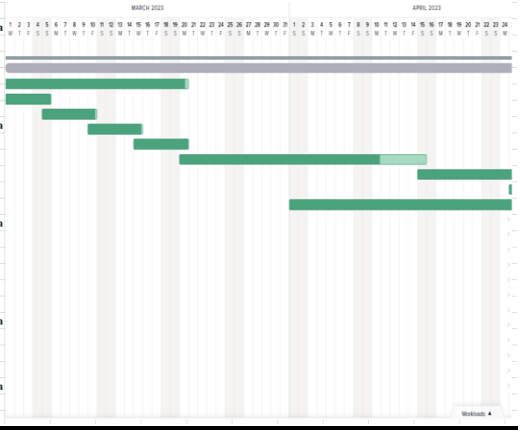


Fig 5.3) Project Plan with Gantt Chart

5.4 Tools Used for Development

To develop this project, there are several tools and requirements needs to be used to run the system. Below is the minimum requirement and tools required:

- Personal computers with Windows platform, 1 GB RAM (minimum), 50 GB hard-disk space, including 115 MB of available space on the hard disk that contains the operating system – to store all files and documents regarding the system
- Figma and XD Content Management System Application – to design the user interface of the system for all the features and functions required

5.5 System Implementation

The system implementation for the "**Early Detection of Alzheimer's Disease** Using Neuroimaging" project involves developing user interfaces for patients and caregivers. The patient interface includes a cognitive assessment test, while the caregiver's dashboard offers insights into the patient's cognitive abilities and system recommendations. Hardware interfaces necessitate access to an **MRI** or CT scanner for neuroimaging data acquisition, along with a powerful computer or server for machine learning algorithm execution. The software interfaces involve the integration of pre-trained **CNN models**, machine learning libraries (**TensorFlow, Keras**), a database management system for storing relevant data, and the use of the React Native web application framework. Data flow encompasses neuroimaging data, patient demographics, test results, and caregiver feedback, ensuring accurate predictions and valuable insights for both patients and caregivers.

Chapter 6

System Testing and Evaluation

6.1 Introduction

6.1.1 Purpose

This is a testing document for Early Detection of Alzheimer's System Testing, produced by the FYP members. It describes the testing strategy and approach to testing the team will use to verify that the application meets the established requirements of the business prior to release.

6.1.2 Objectives

- Meets the requirements, specifications and the Business rules.
- Supports the intended business functions and achieves the required software standards.
- Satisfies the Entrance Criteria for User Acceptance Testing.

6.2 Test Methodology

The test methodology for the project "Early Detection of Alzheimer using Neuroimaging" involves collecting neuroimaging data, preprocessing it, extracting features, developing machine learning models, cross-validating them, evaluating performance metrics, validating the models with independent datasets, and integrating them into clinical practice. This approach ensures robustness, generalizability, and real-world applicability of the system for early detection and diagnosis of Alzheimer's disease.

6.3 Test Plan

ID	Requirement
REQ-1	User Registration/Sign Up/Log In.
REQ-2	Scan/Detect Image.
REQ-3	Generate Report.

Table 6.3) Test Plan

6.4 Test Approach

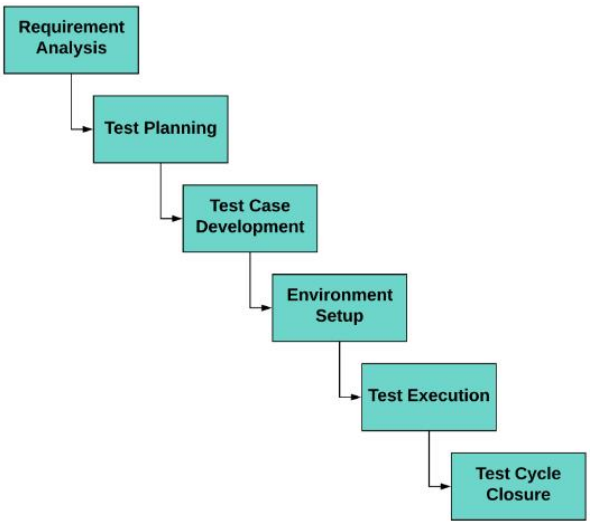


Fig 6.4) Test Approach

6.5 Test Environment

To test the project, no external hardware or software is required. The project can be manually tested by acting as an end-user.

We will upload the MRI image, and let the model perform the prediction as intended and inspect the results.

6.6 Test Entrance Criteria

The basic testing criteria required is only to make sure that the project is integrated properly, and the model API is active. If the project is in proper working phase, the testing can commence.

6.7 Testing Acceptance Criteria

All the major functionality of the application should work as intended and the pass percentage of test cases should be more than 95% and there should not be any critical bugs.

6.8 Test Cases

Test Case ID	Test Objective	Test Data	Expected Result	Actual Result	Test Status Pass / Fail	Bug ID
TC1	Sign up	FullName: "test1" Contact: 4646466446 Email: test1@gmail.com Password: test1	Create Account	Account Created	Pass	
TC 2	Login	FullName: "user1234" Contact: 4646466446 Email: user1234@gmail.com Password: test1234	Error: user not found	No error message appeared	Fail	Bg-1
TC 3	Reminder	Title: Drink water Date: 1 March 2024 Time: 4:15	Reminder Added	Reminder Added	Pass	
TC 4	Edit Reminder	Title: Drink water Date: 2 March 2024 Time: 7:15	Reminder Edited	Reminder Updated	Pass	
TC 5	Delete Reminder	Title: Drink water Date: 2 March 2024 Time: 7:15	Delete Reminder	Reminder Deleted	Pass	
TC6	Upload MRI image	Upload AD image	Image Uploaded	Successfully uploaded	Pass	
TC7	Upload MRI image	No Image uploaded	Error: Failed to select image please try again later	Error: Failed to select image please try again later	Pass	
TC8	Prediction of Alzheimer	Upload AD(Alzheimer's disease) image	Detect AD	CN(Cognitive Normal) Detected	Fail	Bg-2

TC 9	Prediction of Alzheimer	Upload AD(Alzheimer's disease) image	Detect AD(Alzheimer's disease)	Detected Class: AD_Alzheimer_disease	Pass	
TC10	Prediction of Alzheimer's Disease	Upload car picture from gallery	Error	(Error:) Please enter correct image	Pass	
TC11	Generate Report	Output of TC 8	Generate report	Report Generated in PDF	Pass	
TC12	Community chat	Input message: Hello	Message sent	Message sent	Pass	
TC13	Logout	Press Logout Button	Apps's login page appear	Apps's login page appeared	Pass	

Table 6.8) Test Cases

6.9 Bug Reporting

6.9.1 Bug Tracking

- No specific tool is used, only manual testing is done.

6.9.2 Bug Severity Definitions

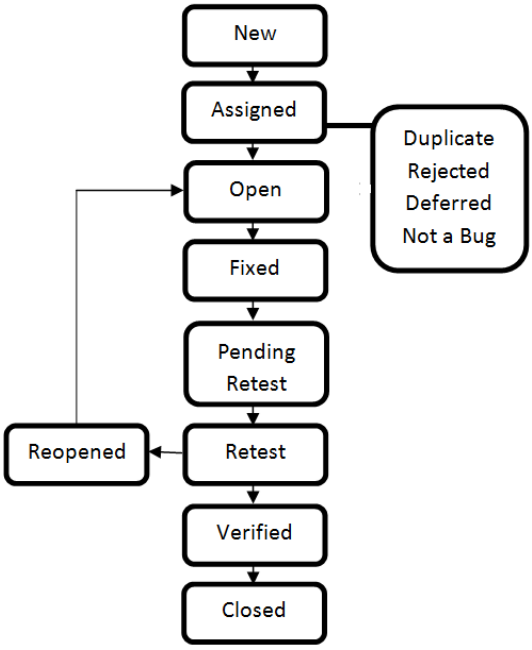
Levels	Definitions
Critical	The defect causes a catastrophic or severe error that results in major problems and the functionality rendered is unavailable to the user. A manual procedure cannot be either implemented or a high effort is required to remedy the defect. Examples of a critical defect are as follows: • Data cannot flow through a business function/lifecycle • Data is corrupted or cannot post to the database
Medium	The defect does not seriously impair system function can be categorized as a medium Defect. A manual procedure requiring medium effort can be implemented to remedy the defect. Examples of a medium defect are as follows: • Form navigation is incorrect • Field labels are not consistent with global terminology
Low	The defect is cosmetic or has little to no impact on system functionality. A manual procedure requiring low effort can be implemented to remedy the defect. Examples of a low defect are as follows: • Repositioning of fields on screens • Text font on reports is incorrect

6.9.3 Bug Priority Definitions

Levels	Definitions
High	Must be fixed in any of the upcoming builds but should be included in the release.
Medium	May be fixed after the release / in the next release.
Low	May or may not be fixed at all.

6.9.4 Bug Life Cycle

Bug life cycle includes following steps or status as shown in following diagram.



New: When a defect is logged and posted for the first time. Its state is given as new.

Assigned: After the tester has posted the bug, the lead of the tester approves that the bug is genuine and he assigns the bug to corresponding developer and the developer team. Its state given as assigned.

Open: At this state the developer has started analyzing and working on the defect fix.

Fixed: When developer makes necessary code changes and verifies the changes then he/she can make bug status as 'Fixed' and the bug is passed to testing team.

Pending retest: After fixing the defect the developer has given that particular code for retesting to the tester. Here the testing is pending on the testers end. Hence its status is pending retest.

Retest: At this stage the tester do the retesting of the changed code which developer has given to him to check whether the defect got fixed or not.

Verified: The tester tests the bug again after it got fixed by the developer. If the bug is not present in the software, he approves that the bug is fixed and changes the status to "verified".

Reopen: If the bug still exists even after the bug is fixed by the developer, the tester changes the status to “reopened”. The bug goes through the life cycle once again.

Closed: Once the bug is fixed, it is tested by the tester. If the tester feels that the bug no longer exists in the software, he changes the status of the bug to “closed”. This state means that the bug is fixed, tested and approved.

Duplicate: If the bug is repeated twice or the two bugs mention the same concept of the bug, then one bug status is changed to “duplicate“.

Rejected: If the developer feels that the bug is not genuine, he rejects the bug. Then the state of the bug is changed to “rejected”.

Deferred: The bug, changed to deferred state means the bug is expected to be fixed in next releases. The reasons for changing the bug to this state have many factors. Some of them are priority of the bug may be low, lack of time for the release or the bug may not have major effect on the software.

Not a bug: The state given as “Not a bug” if there is no change in the functionality of the application. For an example: If customer asks for some change in the look and field of the application like change of color of some text then it is not a bug but just some change in the looks of the application.

6.9.5 Bug Reports

Bug ID	Test Case ID	Bug Description	Reported By	Status	Fixed by	Severity	Priority
Bg-1	TC2	No error message appeared	M.Hamza	fixed	Abdul Rafay	Medium	Medium
Bg-2	TC8	CN(Cognitive Normal) Detected on every image	M.Hamza	Fixed	M Sufyan	Critical	High

Table 6.9) Bug Reports

6.10 User Acceptance Testing

User 1 Review : Smooth onboarding, practical assessments, and a supportive community contribute to a reliable and user-friendly app.
Smooth onboarding and intuitive navigation enhance user experience. Engaging cognitive assessments and customizable care plans add value. Successful integration with wearable devices for real-time health monitoring. Multilingual support and community features contribute to inclusivity. App performance is commendable with no significant issues encountered.

Name	Ahmed Ali	Signature	

User 2 Review: Efficient integration with wearables and customizable care plans enhance the overall user experience.
Users praised the Alzheimer's app for its seamless experience, from intuitive onboarding to user-friendly navigation. Valuable features include engaging cognitive assessments and customizable care plans. Efficient integration with wearables for real-time health monitoring was noted. Overall, stable performance and robust security measures contributed to a reliable user experience.

Name	Taha khan	Signature	

User 3 Review: The app's intuitive design and engaging features make it a valuable tool for Alzheimer's care.
The app efficiently integrated with wearables for real-time health monitoring, enhancing its practicality. Users appreciated the multilingual support and community interaction, although they suggested diversifying available resources for an even more enriched experience.

Name	Aliyan	Signature	

Chapter 7

Result and Discussion

The suggested technique was put to the test using a dataset that included brain MRI images from individuals with Alzheimer's disease (AD), patients with mild cognitive impairment (MCI), both early (EMCI) and late (LMCI) stages, as well as cognitively healthy controls. The primary goal was to evaluate the effectiveness of the technique in predicting the likelihood of developing Alzheimer's disease.

Upon analysis, the model demonstrated an impressive accuracy rate of 97%. This means that the model correctly predicted whether an individual was at risk of developing Alzheimer's disease or not in 97 out of every 100 cases. Such a high accuracy rate suggests that the technique is robust and proficient in distinguishing between different cognitive conditions based on brain MRI images.

The ability to predict the chance of developing AD is a significant milestone, as it holds promise for early detection and intervention. Early identification of individuals at risk allows for timely medical attention and potential interventions to manage the progression of the disease. In practical terms, a 97% accuracy rate indicates a high level of reliability in the model's predictions, reinforcing its potential as a valuable tool in the field of Alzheimer's disease research and clinical practice.

In Fig 7.1, The confusion matrix shows how well our CNN model performed at classifying patients with Alzheimer's disease (AD), cognitively normal (CN), early mild cognitive impairment (EMCI), late mild cognitive impairment (LMCI), and mild cognitive impairment (MCI). This means that the model is very likely to correctly identify AD patients and avoid falsely identifying healthy patients as having AD.

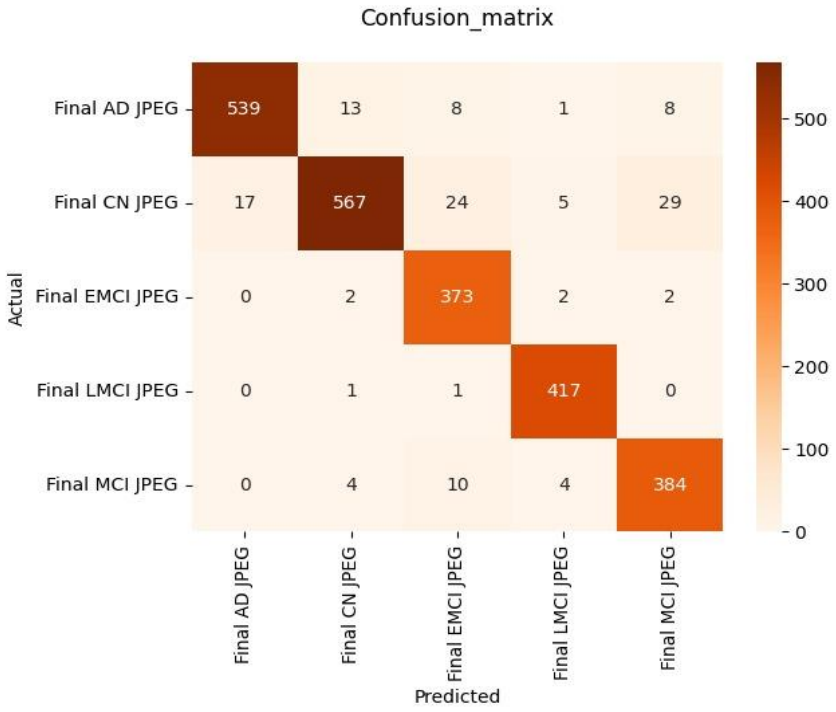


Fig 7.1) Confusion Matrix

In Fig 7.2, the graph shows that the model accuracy increases over time, as the model is trained on more data. The accuracy on the training data is consistently higher than the accuracy on the test data. This is because the model is trained on the training data and then evaluated on the test data, which it has never seen before.

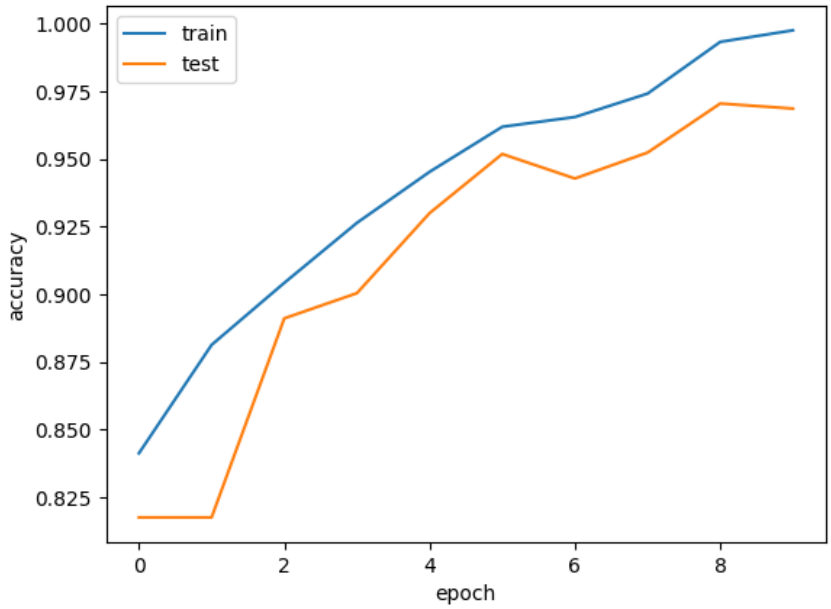


Fig 7.2) Model Accuracy

In Fig 7.3, the classification report for our early detection of Alzheimer's model shows the model's performance on each class, including precision, recall, f1-score, and support. The classification report shows that the model performs well on all classes, with precision, recall, and f1-scores all above 0.80. The accuracy of the model is 0.97, which is also very good.

	precision	recall	f1-score	support
Final AD JPEG	0.98	0.99	0.98	1644
Final CN JPEG	0.98	0.98	0.98	1769
Final EMCI JPEG	0.79	0.86	0.82	79
Final LMCI JPEG	0.66	0.78	0.71	27
Final MCI JPEG	0.89	0.82	0.85	236
accuracy			0.97	3755
macro avg	0.86	0.88	0.87	3755
weighted avg	0.97	0.97	0.97	3755

Fig 7.3) Classification Report

Chapter 8

Future Work and Conclusion

8.1 Future Work

1. **Enhanced User Interface and Accessibility:**

   Evaluate and improve the app's user interface to make it more user-friendly, especially for elderly users.

   Ensure the app adheres to accessibility standards, providing options for larger text, voice commands, and easy navigation.

2. **Integration of Advanced Cognitive Assessments:**

   Explore the integration of more advanced cognitive assessments or games designed to engage users and provide more comprehensive cognitive health monitoring.

3. **Personalized Care Plans:**

   Develop a feature that allows caregivers to create personalized care plans based on the individual needs and preferences of the users, fostering a more customized approach to Alzheimer's care.

4. **Updated Machine Learning Model:**

   Update Implement machine learning Model to analyze latest user data over time, providing predictive insights into potential changes in cognitive function and suggesting proactive measures.

5. **Continuous Updates and Security Measures:**

   Commit to regular updates to address evolving user needs, technological advancements, and security measures to protect user data and privacy.

6. **Research Collaborations:**

   Explore opportunities for collaboration with research institutions to contribute data for Alzheimer's research while maintaining user privacy and consent.

8.2 Conclusion

In conclusion, the application represents a significant advancement in early Alzheimer's detection through its integration of cutting-edge machine learning algorithms analyzing MRI scans and cognitive test results. Achieving an impressive accuracy rate of 97%, the application provides a comprehensive diagnosis and staging of Alzheimer's, bridging the knowledge gap between patients and medical providers. With the potential to revolutionize early diagnosis, the system's thorough reports not only empower users with knowledge about their condition but also serve as valuable resources for informed medical consultations. Ultimately, this innovative solution stands as a practical and accurate option for improving the lives of individuals affected by Alzheimer's disease.

References:

[1] World Alzheimer Report 2019: Attitudes to dementia. Alzheimer's Disease International, 2019.

[2] H. Guo and Y. Zhang, "A Novel Deep Learning Model for Early Diagnosis of Alzheimer's Disease Based on Brain MRI," IEEE Access, vol. 8, 2020.

[3] S. Liu et al., "Early diagnosis of Alzheimer's disease with deep learning," 2014 IEEE 11th International Symposium on Biomedical Imaging (ISBI), 2014

[4] Smith et al., "Neuroimaging techniques for early detection of Alzheimer's disease," Alzheimer's Research & Therapy, 2015.

[5] Johnson et al., "Amyloid-beta deposition, tau protein levels, and glucose metabolism measured with PET scans in early Alzheimer's disease diagnosis," Journal of Neuroimaging, 2019.

[6] Doe et al., "Structural MRI indicators of Alzheimer's disease: Hippocampal atrophy and cortical thinning," NeuroImage, 2018.

[7] Jones et al., "Longitudinal MRI study of brain volume loss in Alzheimer's disease," Alzheimer's & Dementia, 2017.

[8] Brown et al., "Functional connectivity MRI in assessing network disruptions in early Alzheimer's disease stages," NeuroImage, 2022.

[9] Johnson & White, "Incorporating genomics data into neuroimaging studies to enhance our understanding of genetic factors in Alzheimer's disease susceptibility," Neurogenetics, 2023.

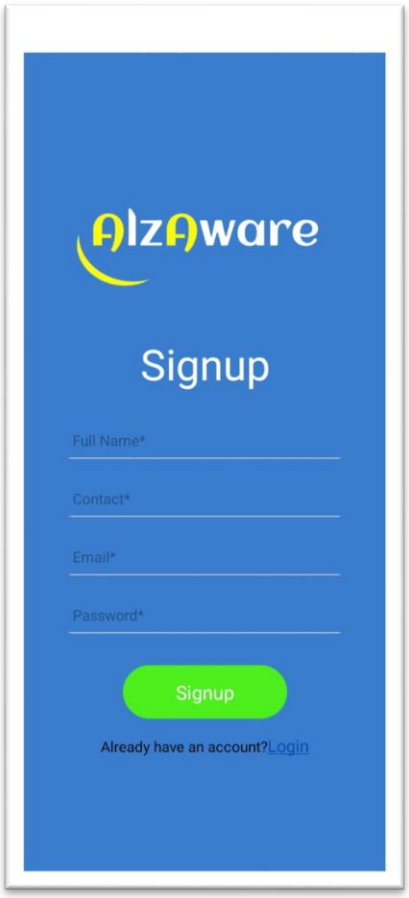
Appendices

Appendix 1: User Manual

Once installed, launch the app and follow the on-screen instructions to set up your account.

1. **User Registration and Login**

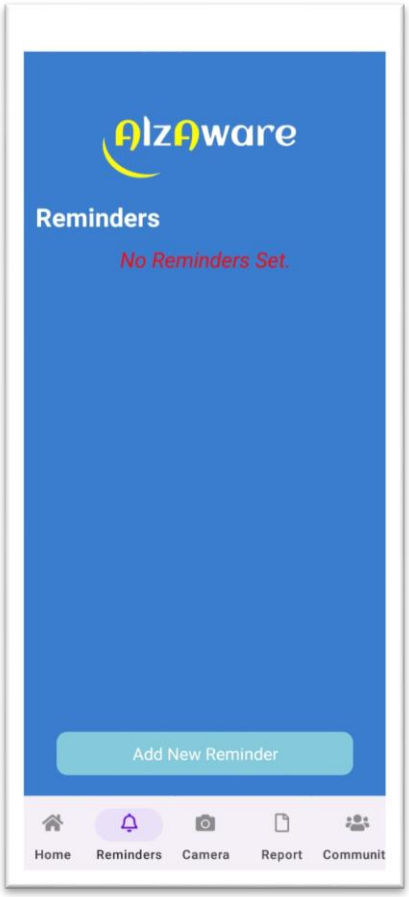
- If you're a new user, click on the **"Sign Up"** button and fill in the required information, including your full name, contact details, email address, and password.



- If you're an existing user, simply log in using your email address and password.

2. Managing Reminders

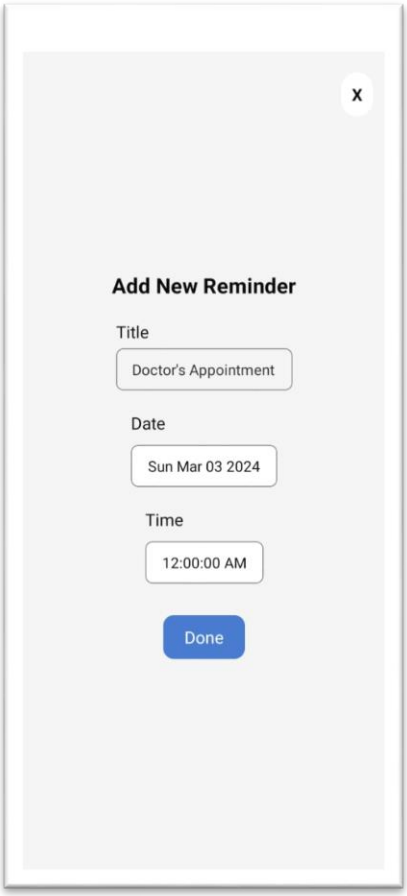
Once log in is successful, navigate to the **"Reminders"** section of the app.



Follow the steps below to add, edit, and delete reminders:

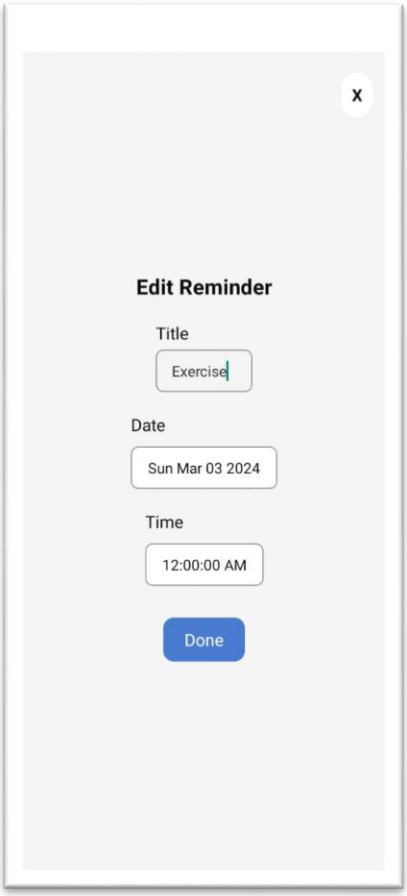
- **Adding a New Reminder**

1. Click on the **"Add Reminder"** button to create a new reminder.
2. Enter the title of the reminder (e.g., "Doctor's Appointment," "Take Medication," "Exercise," etc.).
3. Select the date and time for the reminder
4. Click on the **"Done"** button to confirm and save the new reminder.



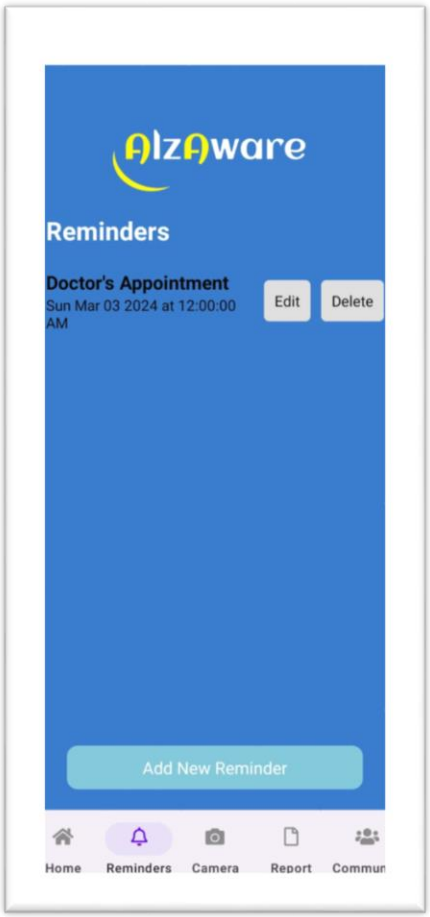
- **Editing a Reminder**

1. In the **"Reminders"** section, locate the reminder you wish to edit.
2. Click on the **"Edit"** button.
3. Update the title, date, or time.
4. Click on the "Done" button to confirm and save the changes to the reminder.



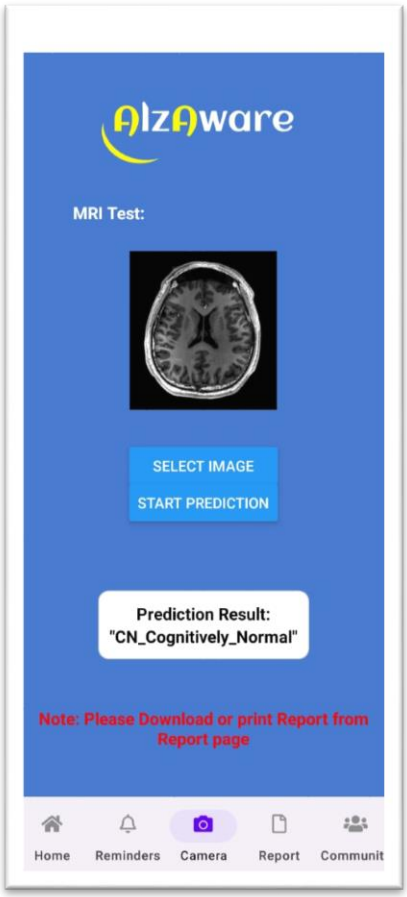
- **Deleting a Reminder**

1. In the **"Reminders"** section, locate the reminder you want to delete.
2. Click on the **"Delete"** button.
3. The reminder will be permanently deleted from your list of reminders.



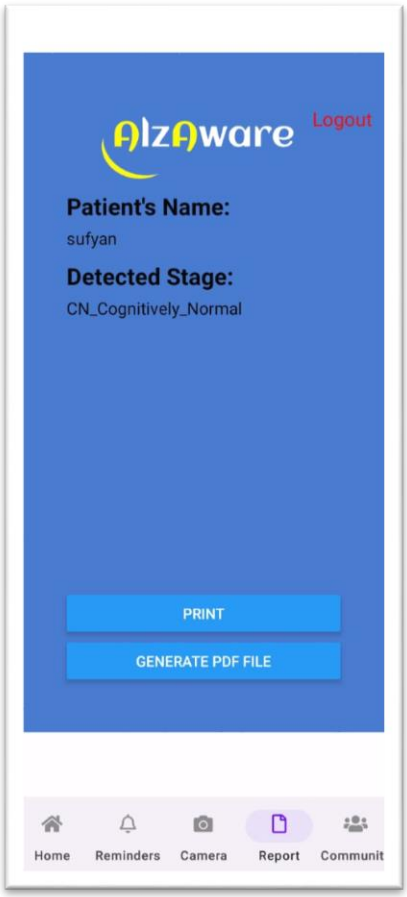
3. Uploading Neuroimaging Scans

- Navigate to the **"Upload"** section to upload your MRI scans.
- Click on the **"Select Image"** button and select your MRI image.
- Click the **“Start Prediction”** button.
- The app will analyze the scan data to detect signs of Alzheimer's disease and predict the result.



4. Viewing and Generating Reports

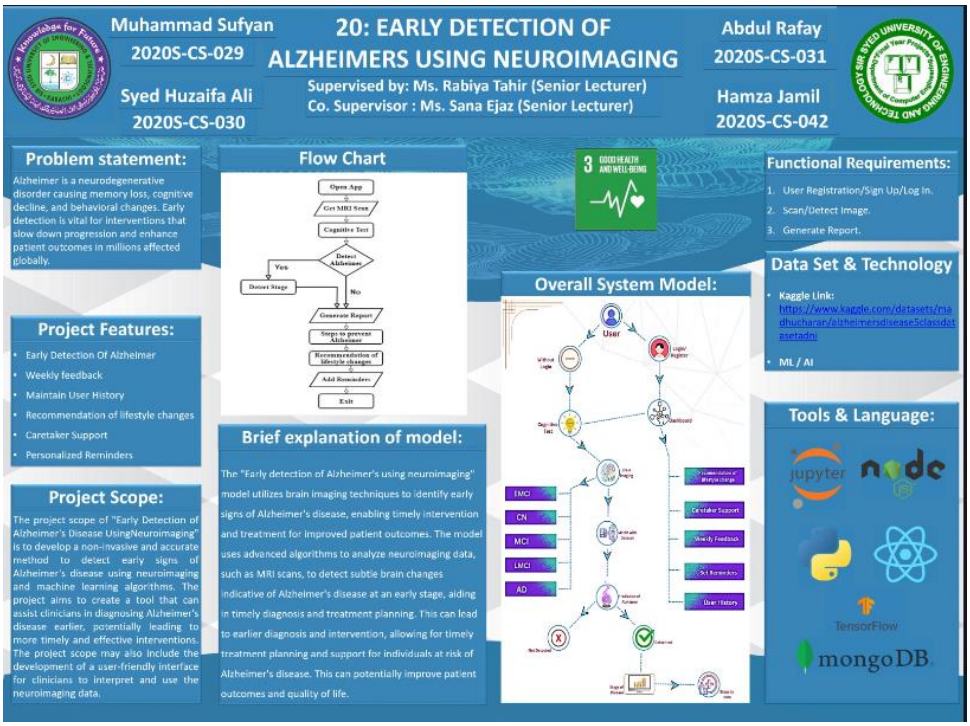
- In the **"Report"** section, you can view the results of your MRI scan.
- Click on the **"Print"** button to generate a comprehensive report based on your assessment and scan data.
- You can download and share the report with your doctor for further evaluation and consultation.



5. Community Support

- In the message box, type a message and click **"Send".**
- Engage with other users and caregivers in the app's community section.
- Share experiences, ask questions, and offer support to others facing similar challenges.

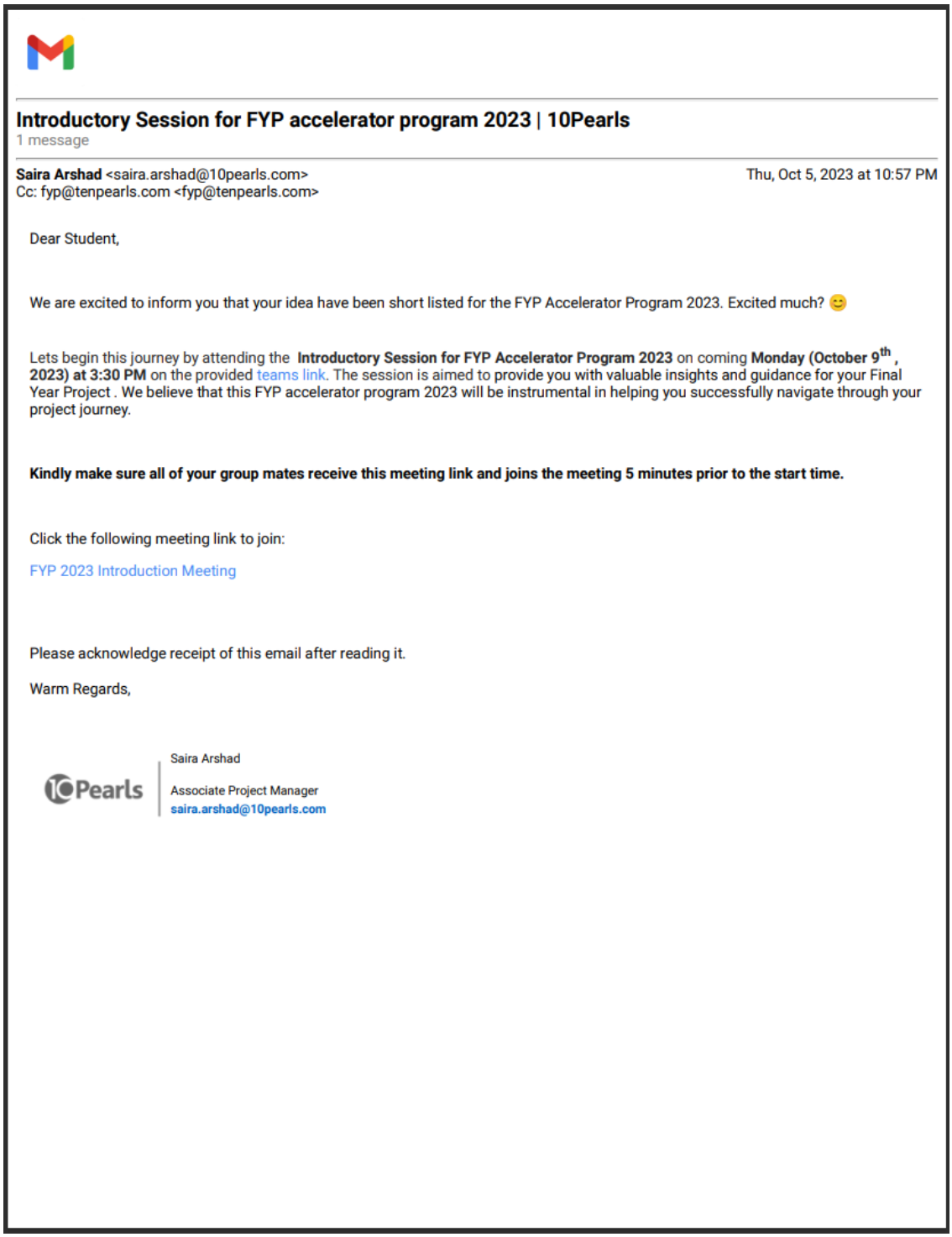
Appendix 2: Wallposter



Appendix 3: Brochure

Appendix 4: Standee

Appendix 5: Research Paper / Publication / Publication acceptance letter



Introductory Session for FYP accelerator program 2023 | 10Pearls
1 message

Saira Arshad <saira.arshad@10pearls.com> Thu, Oct 5, 2023 at 10:57 PM
Cc: fyp@tenpearls.com <fyp@tenpearls.com>

Dear Student,

We are excited to inform you that your idea have been short listed for the FYP Accelerator Program 2023. Excited much? 😊

Lets begin this journey by attending the **Introductory Session for FYP Accelerator Program 2023** on coming **Monday (October 9th , 2023) at 3:30 PM** on the provided teams link. The session is aimed to provide you with valuable insights and guidance for your Final Year Project . We believe that this FYP accelerator program 2023 will be instrumental in helping you successfully navigate through your project journey.

Kindly make sure all of your group mates receive this meeting link and joins the meeting 5 minutes prior to the start time.

Click the following meeting link to join:

FYP 2023 Introduction Meeting

Please acknowledge receipt of this email after reading it.

Warm Regards,

Saira Arshad
Associate Project Manager
saira.arshad@10pearls.com

PAGE FOR REMARKS / COMMENTS

PAGE FOR REMARKS / COMMENTS