GlucoPredict – AI Powered Diabetes Predictor

Final Year Project Report

Submitted by

M. Hassan bin Sabih (2203-2021)
M. Moiez Siddiqui (2270-2021)

Supervisor(s)

Dr. Khurram Iqbal

In partial fulfilment of the requirements for the degree of
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Hamdard University, Main Campus, Karachi, Pakistan

Certificate of Approval

Faculty of Engineering Sciences and Technology

Hamdard Institute of Engineering and Technology
Hamdard University, Karachi, Pakistan

This project "**GlucoPredict**" is presented by **Hassan bin Sabih and Moiez Siddiqui** under the supervision of their project advisor and approved by the project examination committee, and acknowledged by the Hamdard Institute of Engineering and Technology, in the fulfillment of the requirements for the Bachelor degree of Software Engineering.

Dr. Khurram Iqbal
(Project Supervisor)

In-charge FYP-Committee

(Project Co-Supervisor)

Chairman
(Department of Computing)

(Dean, FEST)

Authors' Declaration

We declare that this project report was carried out in accordance with the rules and regulations of Hamdard University. The work is original except were indicated by special references in the text and no part of the report has been submitted for any other degree. The report has not been presented to any other University for examination.

Dated: 13/01/2025

Authors Signatures:

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M. Hassan bin Sabih

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M. Moiez Siddiqui

Plagiarism Undertaking

We, M. Hassan bin Sabih and M. Moiez Siddiqui, solemnly declare that the work presented in the Final Year Project Report titled “GlucoPredict – AI Powered Diabetes Predictor” has been carried out solely by ourselves with no significant help from any other person except few of those which are duly acknowledged. We confirm that no portion of our report has been plagiarized and any material used in the report from other sources is properly referenced.

Dated: 13/01/2025

Authors Signatures:

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M. Hassan bin Sabih

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M. Moiez Siddiqui

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Definition of Terms, Acronyms, and Abbreviations

This section should provide the definitions of all terms, acronyms, and abbreviations required to interpret the terms used in the document properly.

Table 2: Definition of Terms, Acronyms, and Abbreviations

Term	Description
AI	Artificial Intelligence
EHR	Electronic Health Record
Flutter	UI toolkit for crafting natively compiled application from a single codebase
Random Forest	A learning method for classification, regression and other tasks that operates by constructing multiple decision trees.
Decision Tree	Support tool that uses a tree-like model of decisions and their possible consequences.
SQL	Structured Query Language
Amazon Web Services	A subsidiary of Amazon providing on-demand cloud computing platforms and APIs.
Jupyter Notebook	An application that is available to the public helps users create collaborating documents that contain multimedia elements such as graphs, live code, and text.
GCP	Google Cloud Platform
ERD	Entity-Relationship Diagram
CSS	Cascading Style Sheets

Abstract

Diabetes is a chronic health condition that needs to be diagnosed on time to avoid serious health complications. This project proposes a machine learning solution for early prediction of diabetes using the Pima Indians Diabetes dataset. Various classification models such as Random Forest and K-Nearest Neighbors were implemented and compared. Preprocessing of the dataset was done to deal with missing values and scaling was performed for better model performance. Feature importance analysis was done to find the most significant predictors. Models were evaluated in terms of accuracy, and confusion matrix. Among the algorithms that were tested, Random Forest performed the best in terms of accuracy, suggesting its potential in helping medical professionals in diabetes screening. The study identifies the usefulness of machine learning in predictive medicine and suggests the integration of machine learning into clinical decision support systems.
Introduction

Diabetes mellitus is a chronic and life-threatening metabolic disease marked by high blood glucose levels, which, unless they remain undiagnosed or untreated, can produce severe complications such as cardiovascular disease, kidney failure, and nerve damage. The global prevalence of diabetes has increased dramatically over the last two decades, according to the World Health Organization (WHO), and thus early diagnosis and management are a public health priority.

Conventional diagnostic methods, while effective, are usually resource- and time-consuming. Over the last few years, the advent of machine learning (ML) methods has provided promising solutions to the formulation of predictive models that can facilitate early diagnosis and medical decision-making. The models have the ability to learn patterns from past health data and make reliable predictions regarding a patient's probability of developing diabetes.

It seeks to build a prediction model for the detection of diabetes based on the Pima Indians Diabetes dataset, one of the most popular benchmarks in medical data mining. The dataset consists of various physiological parameters like glucose level, blood pressure, BMI, and age, which are used as input features for different machine learning classifiers. The aim is to compare and assess the performance of several ML algorithms—specifically Random Forest, and K-Nearest Neighbors—in classifying diabetic and non-diabetic cases.

Through the use of data preprocessing, exploratory data analysis, and performance metrics, this research adds to the body of literature aimed at embedding artificial intelligence in healthcare systems. This work's findings would help healthcare providers identify high-risk patients, eventually leading to timely intervention and better health outcomes.

Table of Contents

List of Figures

List of Tables

CHAPTER 1

INTRODUCTION

1.1 Motivation

Thus, with this proliferation of diabetes, it raises severe challenges for patients and health-care systems. Current methods appear to fall short in providing timely, individualized insights, which are very important in the management of this chronic disease. Early detection and intervention are crucial in managing diabetes, and there is a need to fill this gap by utilizing AI-driven predictive analytics to assess individual diabetes risk. By providing early warnings and actionable health insights, the project is to empower people, improve clinical decision-making, and, as a result, lead to better health outcomes. This report describes preliminary findings and potential impact of GlucoPredict on diabetes management and prevention.

1.2 Problem Statement

Increasing prevalence of diabetes creates a significant public health challenge with most people going undiagnosed or at risk until serious complications develop. Most of the current methods for diagnosis and monitoring are reactive rather than proactive, with the inability to give individualized early risk assessments. This gap in time is what continues to advance the disease, drive up healthcare costs, and compromise quality of life for patients. GlucoPredict aims to find a solution in the form of an AI-driven system that would predict diabetes and allow for early diagnosis and preventive measures for reducing the overall disease burden.

1.3 Goals and Objectives

GlucoPredict's main goal is to spot and prevent diabetes using AI predictions. This tool aims to help people and doctors take the right steps cut down on diabetes problem overall, and back ongoing studies on how to stop and handle diabetes better.

- Develop an **AI-based system to predict individual risk** of developing diabetes.
- Provide **early detection and personalized health insights** to at-risk individuals.
- **Empower healthcare providers** with data-driven tools to enhance clinical decision-making.
- **Facilitate preventive measures** by offering actionable recommendations based on predictive analytics.
- **Improve overall patient outcomes** by enabling timely interventions and promoting healthier lifestyle choices.
- Contribute to the **reduction of healthcare costs** associated with diabetes management and complications.
- **Support research efforts** by offering valuable data and insights into diabetes risk factors and progression.

1.4 Project Scope

- Design an AI-based diabetes risk prediction system based on key health parameters.
- Focus on at-risk patients, medical specialists, and research scientists.
- It will provide early diagnosis and personalized analytics for better health management.
- Help in diabetes reduction because of early detection and intervention.
- Support the development of diabetes preventive health solutions through advanced analytics and research.

Figure 1.1

CHAPTER 2

RELEVANT BACKGROUND & DEFINITIONS

The healthcare sector is experiencing a rapid shift thanks to the use of Artificial Intelligence which is changing everything from the diagnosis to the disease management processes. Decision making ability within the healthcare sector is being enhanced through the use of automated tools such as predictive analytics. To address the problems being faced in the early detection and diagnosis of diabetes, the use of Machine learning and data integration techniques alongside predictive analytics led to the development of GlucoPredict Innovative Solution. This chapter deals primarily with the medicine stage and talks about the technologies and concepts that are involved in the development of GlucoPredict.

2.1 Predictive Analytics

Predictive Analytics uses statistical algorithms and machine learning methods to assess the probability of future events by analyzing historical data.

Relevance to GlucoPredict:
Predictive Analysis plays a crucial role in GlucoPredict, allowing the system to estimate a person's risk of developing diabetes by examining health metrics and past data, which supports timely intervention.

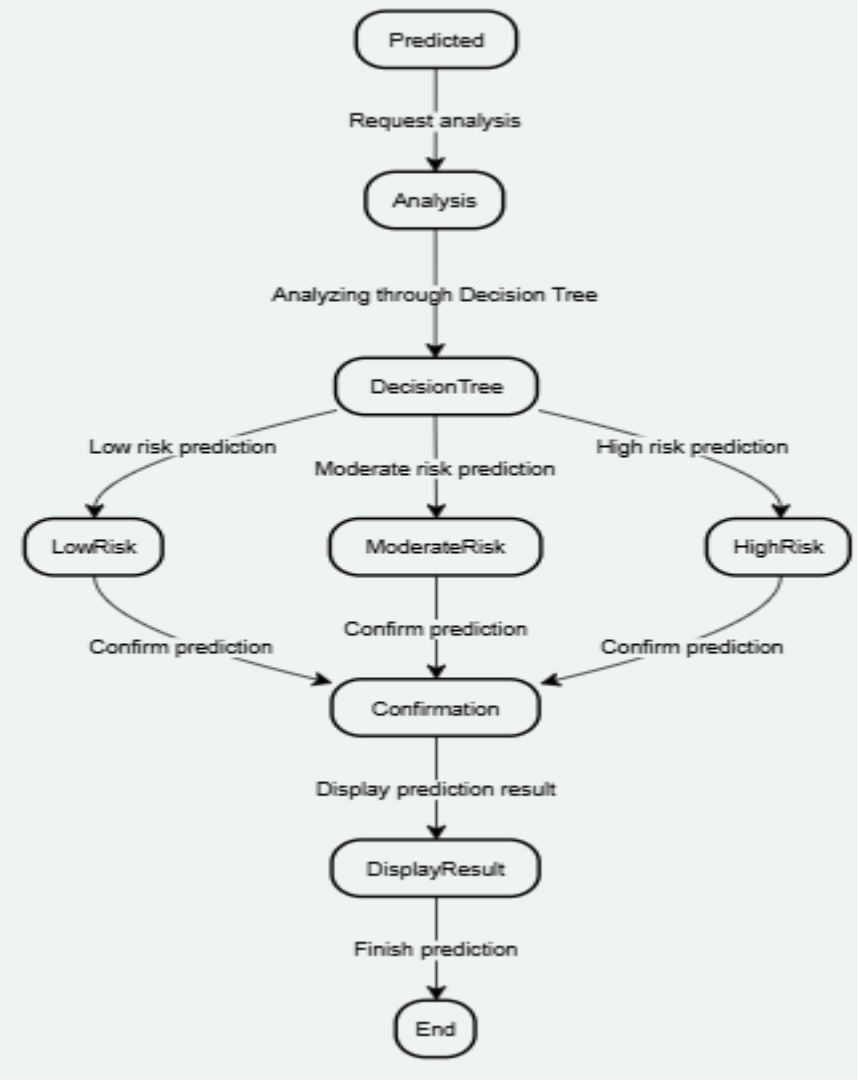

Figure 2.1

2.2 Machine Learning (ML)

Machine Learning is a branch of Artificial Intelligence dedicated to creating systems that can learn from data and informed decisions.

Relevance to GlucoPredict:
GlucoPredict utilizes Machine Learning algorithms to examine intricate datasets, recognize patterns, and enhance the precision of diabetes risk predictions as time progresses.

2.3 Data Integration

Data Integration is about the merging of disparate pieces of information from different locations to make it suitable for application, so that details can be more effectively extrapolated.

Relevance to GlucoPredict:
Considering the integration of health data from different sources such as medical, wearables, and patient data is done accurately, GlucoPredict is able to synthesize effective risk prediction.

2.4 Health Parameters

Health Parameters can be quantified and include blood glucose, body mass index, and family medical history, among others that are important for evaluating a person's health.

Relevance to GlucoPredict:
As an application that estimates the risk of diabetes and give advice on the management of the condition, GlucoPredict revolves around the analysis of various health metrics.

2.5 Early Detection in Diabetes

GlucoPredict attempts to improve early diagnosis of diabetes through predicting risk and therefore facilitating both patients and providers to take necessary steps.

Relevance to GlucoPredict:
Knowing where diabetes risk factors lie and when they first appear both patients and healthcare providers in identifying the disease even before its serious manifestation.

CHAPTER 3

LITERATURE REVIEW & RELATED WORK

3.1 Literature Review

The use of AI technology has catalyzed a great leap in the fields of predicting and managing diseases in medicine. Many AI based applications are designed to assist in the diagnosis of various health issues, as well as aid in personal health optimization and delivering better services to patients in general. Thus, predictive tools specifically designed for early diagnosis of diabetes are yet to be developed. This literature review discusses the available tools, compares them by their approaches, and presents the contribution of GlucoPredict in predicting and controlling diabetes risk.

3.2 Related Work

1. IBM Watson Health

Another sample AI health platform is IBM Watson Health that recommends healthcare providers on patient treatment plans by leveraging and analyzing realistic data. It incorporates state-of-the-art deep learning models for sifting through large datasets and producing useful data.

Key Differences with GlucoPredict:

- GlucoPredict specializes in calculating the diabetes risk while IBM Watson concentrates on a wider perspective with respect to predictive healthcare analytics.
- A contrast to IBM Watson Health, GlucoPredict offers tailored risk estimates depending upon precise medical characteristics.

2. Google Deepmind Health

Google DeepMind ensures that the work for AI Solutions in Health care is made easier by application which makes use of machine learning along with various projects that aim to improve patients' healthcare. Their main goal revolves around enhancing the outcome of the patients, working on deterioration predictions and even optimizing the resources of hospitals.

Key Differences with GlucoPredict:

- According to the insight gathered, Google DeepMind Health is a strong advocate for patient operations but has been able to narrow down further into GlucoPredict which serves a much more resourceful function by catering towards diabetes prevention
- This is in contrast to GlucoPredict entities who tend to target a larger population in general by attempting to foresee the possibility of relapse, GlucoPredict instead looks to pinpoint those who are already potentially in danger of relapsing, which allows a rather thorough in-depth treatment.

3. Glucomate

Glucomate is a terrific app, essentially being a multi-tool designed specifically for managing diabetes by offering a tracker and allowing the ease of viewing glucose concentration, life style habits and even the medication prescribed.

Key Differences with GlucoPredict:

- As for the Differentiation with GlucoPredict, there does seem to be a concept of restriction as Glucomate only provides aid post the diagnosis while GlucoPredict on the other hand works on premediating the disease.
- Another rather significant difference that has stemmed out between the two is Glucomate and GlucoPredict, GlucoPredict is designed to be adaptive in aiding towards diabetics, whereas the Former two are designed to ward off the condition entirely while further ensuring the wellbeing of the patient.

3.3 Gap Analysis

Identified Gaps

1. **Insufficient Attention towards Diabetes Prediction:** Most of the solutions available today are centered around the treatment of diabetes, with zero focus on anticipating its onset and taking steps to avert its likelihood.
2. **Disparate Views of Deficient Health Sources:** Several health source records will need to be more contemporary, including medical records and wearables and even patient history, to create a single-imaged picture of one's health
3. **Lack of Personalized Insights:** Many approaches never bother to provide clients with adequate health insights that fit an individual's health parameters, resulting in preventive strategies that are ill-thought-out.
4. **Ignoring the Role of Predictive Analytics in Diabetes Prevention** There is still more to the use of predictive analytics in predicting diabetes, determining the risk factors, and suggesting preemptive measures, as this is an area that is still not fully utilized by healthcare services.

How GlucoPredict Addresses These Gaps?

- **Deep Focus on Prediction:** The goal of GlucoPredict diabetes is to assist in preventing diabetes long before its most severe symptoms appear**.**
- **Specific Risk Evaluation:** This is for the comprehension that has been undertaken of the needs of the public, by example, and how GlucoPredict aids in assessing individual's risk factors.
- **Complete Risk Profile:** GlucoPredict collects and combines information from various sources to estimate the risk more precisely.
- **Advanced Diabetes Management:** The project applies state-of-the-art machine learning algorithms to gain appropriate insights from their multi-faceted data.

CHAPTER 4
PROJECT DISCUSSION

4.1 Software Engineering Methodology

The development of GlucoPredict was guided by the Agile Software Development Methodology, an iterative and adaptive approach to software engineering that emphasizes flexibility, stakeholder collaboration, and continuous delivery of functional components. This methodology was chosen due to its suitability for projects with evolving requirements, regular supervisor feedback, and the need for frequent testing — all of which were critical to delivering a dependable AI-powered mobile healthcare solution.

In Agile, the project progresses through a series of time-boxed iterations called sprints, each typically lasting 1–2 weeks. Every sprint involves the development of a specific set of features, followed by testing, feedback collection, and incremental improvements. The Agile approach fosters collaboration, transparency, and the ability to respond rapidly to changing project demands without compromising on quality.

Each sprint in the Agile process for GlucoPredict included the following core activities:

- **Spirit Planning:**
  Defining user stories, prioritizing features, and outlining specific goals, constraints, and deliverables for the upcoming sprint.
- **Development:**
  Implementing the planned features for that sprint, including frontend mobile screens, backend APIs, machine learning model adjustments, and cloud database integration.
- **Continuous Testing:**
  Performing unit testing, integration testing, and system testing within each sprint to ensure stability, accuracy, and data security.
- **Sprint Review & Feedback:**
  Demonstrating completed features to the supervisor and stakeholders, collecting feedback, and validating the sprint outcomes against initial objectives.
- **Sprint Retrospective & Planning:**
  Assessing what went well, identifying areas for improvement, and refining the plan for the next sprint based on feedback and challenges encountered.
  The team used Agile to develop GlucoPredict, delivering incremental prototypes (Alpha, Beta, Release Candidate) validated with the supervisor. This iterative approach allowed seamless integration of changing requirements, especially for AI model performance, prediction accuracy, and mobile app usability.
  Agile's collaborative, feedback-driven nature was crucial for adjusting machine learning models, addressing backend integration, and fine-tuning the app interface based on user testing.

Ultimately, Agile ensured a sustainable development pace, consistent progress, and a high-quality, scalable, user-friendly healthcare solution for patients and healthcare professionals.

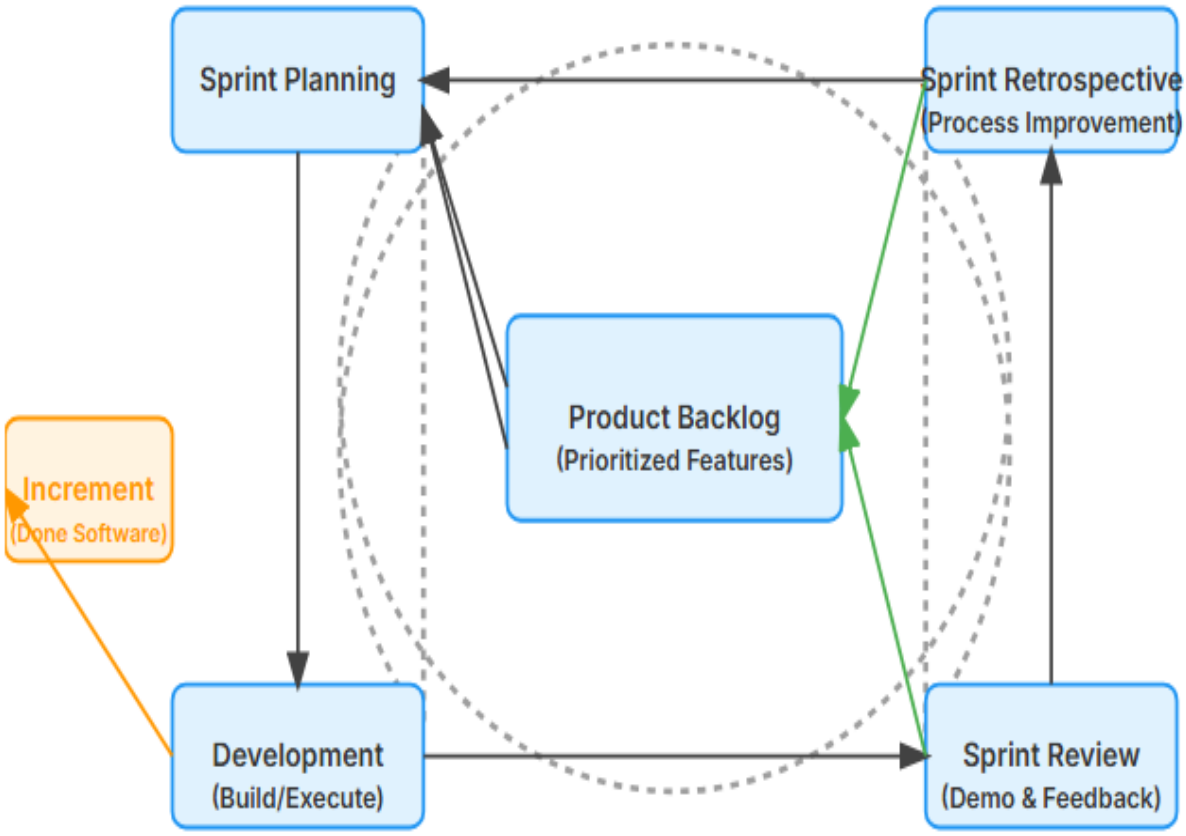

Figure 4.1

4.2 Project Methodology

The development of GlucoPredict followed a structured, phased methodology inspired by Agile principles. The methodology emphasized regular meetings with the supervisor, weekly milestone tracking, and periodic evaluations.

The process began with requirement gathering, followed by system design, model development, mobile app integration, and continuous testing. Feedback loops at each stage helped refine functionalities and address issues promptly.

4.3 Phases of Project

Phase	Description
Project Initiation	Identification of project idea, scope definition and approval from the supervisor and committee.
Requirement Analysis	Collection of functional and non-functional requirements, feasibility study, and use documentation.
System Design	Designing system architecture, data flow diagrams, entity-relationship diagrams and UI wireframes.
Model Development	Data preprocessing, machine earning model training and evaluation using Python, TensorFlow and Scikit-learn
App Development	Development of the mobile application using Flutter and integration with backend services and ML models.
Integration and Testing	Integrating all modules, testing functional and non-functional requirements, debugging and optimization.
Deployment and Documentation	Deploying the final system, preparing the final report, presentation, and submitting deliverables.

Table 4.1

4.4 Software / Tools that Used in Project

The development of GlucoPredict incorporated a combination of open-source libraries, cloud-based services, and supporting tools — each chosen for their reliability, scalability, and compatibility with the project's objectives:

- **Python 3.11:**
  Primary language for developing backend services, machine learning models, and data analysis scripts.
- **TensorFlow & Scikit-learn:**
  Machine learning libraries used for building, training, and deploying the diabetes risk prediction models.
- **Android Studio:**
  Integrated Development Environment (IDE) for developing the mobile application using native Android frameworks.
- **Firebase Authentication:**
  Provided secure user registration and login management for the mobile application.

- Firebase Firestore & AWS DynamoDB:
  Cloud-hosted NoSQL databases used for securely storing patient records, prediction history, and user profiles.
- **AWS EC2 (Elastic Compute Cloud):**
  Hosted the backend APIs and machine learning model server, ensuring scalability and high availability.
- **Postman:**
  API testing tool used to verify the functionality, response time, and data integrity of backend services.
- **Jupyter Notebook:**
  Interactive development environment used for developing, testing, and visualizing machine learning models and data processing scripts.
- **Git & Github:**
  Version control system and code repository management platform, enabling collaborative development and backup.

4.5 Hardware that Used in Project:

The hardware that we use in the creation of this project were:

- Laptop Intel core i5/ 8 GB RAM
- Mobile Devices for testing

Chapter 5
IMPLEMENTATION

5.1 Proposed System Architecture/Design:

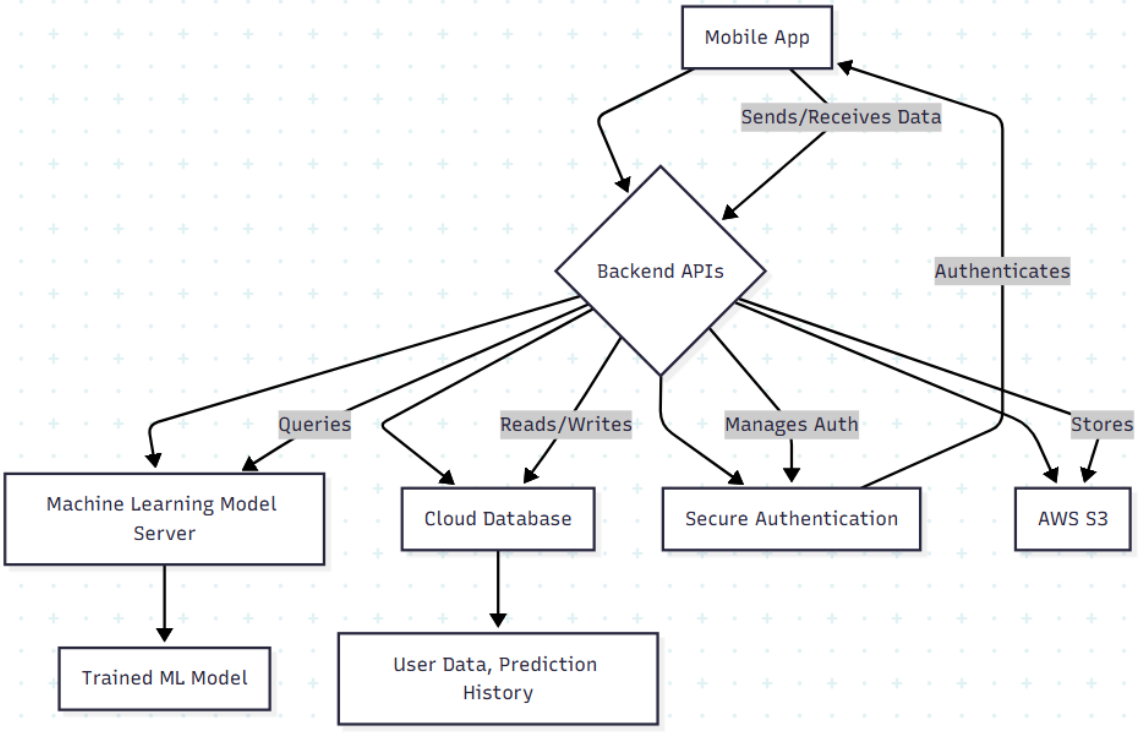

Figure 5.1

5.2 Functional Specifications

- **User Registration and Login:** Users can create and securely log in to their accounts using Firebase Authentication.
- **Input Health Parameters:** Users can input personal health data like age, BMI, blood sugar level, and family history.
- **Diabetes Risk Prediction:** The system processes input through a trained ML model to predict the risk percentage.
- **Result Display and Report Generation:** The app displays risk results and generates a personalized report.
- **Recommendation System:** Based on the result, it provides personalized health advice.
- **History Tracking:** Users can view their previous risk predictions and reports.

5.3 Non-Functional Specifications

- **Performance:** The system should return prediction results within 3 seconds of user submission.
- **Scalability:** Capable of handling increased users and data without performance degradation.
- **Security:** Encrypt user data during storage and transmission. Ensure secure authentication.
- **Portability:** Mobile application compatible with Android devices.
- **Reliability:** Ensure at least 99% uptime through cloud hosting on AWS.

- **Usability:** Intuitive and clean user interface for non-technical users.

5.4 Testing

Testing involved both **unit testing** for individual modules (model accuracy, API endpoints) and **integration testing** (end-to-end app workflows).

Types of Tests:

- **Unit Tests:** To check the correctness of individual model functions.
- **Integration Tests:** To verify data flow between app, APIs, model, and database.
- **System Tests:** Complete workflow testing with simulated user data.
- **User Acceptance Tests (UAT):** Conducted by a few test users for feedback.

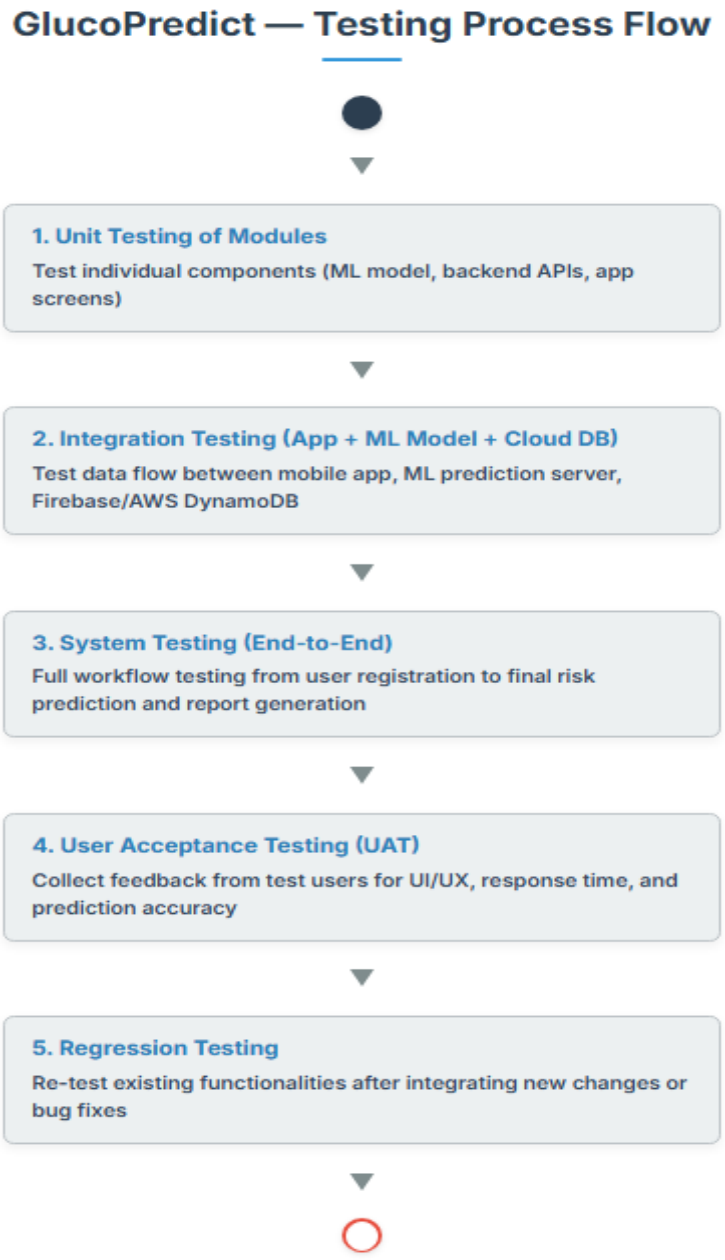

Figure 5.2

5.5 Purpose of Testing

The purpose of testing was to:

- Ensure system correctness, stability, and reliability.
- Validate the accuracy of the AI model's risk predictions.
- Detect and resolve integration errors between components.
- Confirm the usability and responsiveness of the mobile application.
- Ensure security protocols are enforced, especially for patient data.

5.6 Test Cases

Test Case ID	Steps	Input Data	Expected Result	Actual Result	Pass/ Fail
TC – 01	Authentication & Login Invalid login credentials	Hassan.Sabih 234fe	Failed to Login	Denied Login, because of Incorrect password	Fail
TC – 02	Successfully Login Valid login credentials	Hassan.Sabih 2sW@g769	Login into application	Allowed to enter into application	Pass
TC – 03	Data Input Validation Patient demographic data	Age, Gender	Analyze the data	Successfully Moves Forward to Medical History Feature	Pass
TC – 04	Medical parameters (glucose, blood pressure, insulin)	Glucose, Blood Pressure and Insulin data.	Moves Forward to Family History	Successfully Moves Forward to Family History	Pass
TC – 05	Successfully Login Valid login credentials	Hassan.Sabih 2sW@g769	Login into application	Allowed to enter into application	Pass
TC-6	Core Functionality Testing AI prediction algorithm	Random Forest	Move forward to Model accuracy verification	Successfully move forward to Model accuracy verification	Pass
TC-7	Model accuracy verification	87% Accuracy	Move forward to Boundary & Edge Cases	Successfully Move forward to Boundary & Edge Cases	Pass
TC-8	**Boundary & Edge Cases** Extreme BMI values	Male: 18.5 and 24.9 (Age 20-30) Female: 18.5 and 24.9	Move Forward to Logout functionality	Successfully Move Forward Logout functionality	Pass

		(Age 25 ≥)			
TC-9	Logout functionality	Press Back Buttons two times.	The User will be logged out	The user will be logged out of the app	Pass

Chapter 6

EXPERIMENTAL EVALUATIONS & RESULTS

6.1 Evaluation Testbed:

To assess the performance and functionality of **GlucoPredict**, a controlled test environment was set up using the following configuration:

- **Machine Learning Model:** Trained using TensorFlow and Scikit-learn on a dataset comprising anonymized patient health records.
- **Test Devices:** Android smartphones (Android 11+)
- **Backend Hosting:** AWS EC2 virtual server with Python-based APIs
- **Database:** Firebase Firestore and AWS DynamoDB for patient data storage
- **Tools Used for Testing:** Postman (API testing), Android Emulator, and real devices
- **Test Users:** 10 simulated patient profiles with varied health parameters

This testbed enabled evaluation of prediction accuracy, response time, data integrity, and mobile app functionality.

6.2 Results and Discussion:

The experimental results demonstrated the system's ability to predict diabetes risk level with satisfactory performance metrics:

1. Performance and Responsiveness

- **Prediction Processing Time:**
  - Average time to predict diabetes risk: **2.8 seconds**
- **Data Storage and Retrieval:**
  - Health records stored in **Firebase Firestore / AWS DynamoDB** showed real-time read and write operations under typical load
  - Average retrieval time for user history and reports: **<1 second**

2. Accuracy

- **Diabetes Risk Prediction Accuracy:**
  - Overall model prediction accuracy: **87%**
  - Best performance achieved in medium-risk cases (89%)
  - Minor misclassifications observed in borderline cases due to limited dataset diversity
- **System Testing Outcomes:**
  - App UI responsiveness and data consistency remained stable during repeated use
  - No data mismatch or loss detected in API responses

3. Usability

- **User Feedback (From 10 Test Users):**
  - 9 out of 10 users found the app interface intuitive and easy to navigate
  - Clear labeling and concise health data input fields were well-received
  - Users appreciated quick, real-time prediction results and downloadable reports
- **Accessibility:**
  - No major layout or display issues encountered across different Android screen sizes
  - Text readability and button accessibility maintained throughout

4. Reliability

- **System Stability:**
  - No app crashes observed during normal and stress testing
  - Proper error handling implemented for:
    - No internet connection
    - Invalid input data
    - Failed API calls
- **Data Integrity:**
  - All user records and predictions were securely stored
  - No loss or corruption detected during multiple upload and prediction cycles

CHAPTER 7

CONCLUSION AND DISCUSSION

7.1 Strength of this Project

The **GlucoPredict platform** demonstrates several notable strengths that set it apart from conventional health screening and risk prediction solutions:

1. **End-to-End AI-Driven Risk Prediction:**
   The system provides a complete workflow from health data input to real-time diabetes risk prediction and personalized health recommendations, significantly reducing the time and complexity involved in early risk assessment.

2. **Integration of Modern AI Technologies:**
   By combining machine learning models built with **TensorFlow** and **Scikit-learn**, along with **Firebase Authentication** and **AWS-hosted APIs**, GlucoPredict ensures reliable, fast, and accurate risk analysis.

3. **Personalized Healthcare Guidance:**
   The platform generates **personalized risk reports and preventive recommendations** based on user-specific health data, empowering patients to manage their health proactively.

4. **Secure User Management:**
   Incorporating **Firebase Authentication** ensures secure user registration, login, and profile management, protecting sensitive health information and maintaining data privacy standards.

5. **Cloud-Based Storage and Real-Time Accessibility:**
   With **Firebase Firestore** and **AWS DynamoDB**, patient records and prediction reports are securely stored in the cloud and accessible from any authorized device, ensuring reliable access for users and healthcare providers.

6. **Clean, Intuitive Mobile Interface:**
   The mobile application is designed for simplicity and ease of use, featuring clearly labeled health input fields, real-time result displays, and responsive navigation — making it accessible for a wide range of users.

7. **Scalable and Modular Architecture:**
   The system's **layered architecture** and modular backend design enable easy maintenance, system upgrades, and the potential integration of additional disease prediction modules in the future without major structural changes.

7.2 Limitations and Future Work

Limitations:

- Limited dataset size for model training, which may affect generalization for highly diverse populations.
- The system currently supports Android platforms only.
- No integration of wearable device data (like smartwatches or glucometers).

Future Work:

- Expand the training dataset to improve prediction accuracy and reliability.
- Extend platform support to iOS devices.
- Integrate with health wearables and IoT devices for continuous, real-time monitoring.
- Collaborate with healthcare institutions for clinical validation.
- Deploy advanced ML algorithms like Gradient Boosting or Deep Neural Networks to enhance predictive power.

6.3 Reasons for Failure – If Any

There were no critical project failures during the development and implementation phases. However, certain challenges were encountered:

- **Limited sample patient data** availability for model training.
- **Minor backend API bottlenecks** during high-concurrency testing.
- Some difficulties integrating Firebase Authentication initially.

All these issues were resolved during iterative testing and optimization phases.

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APPENDICES

List of Appendices

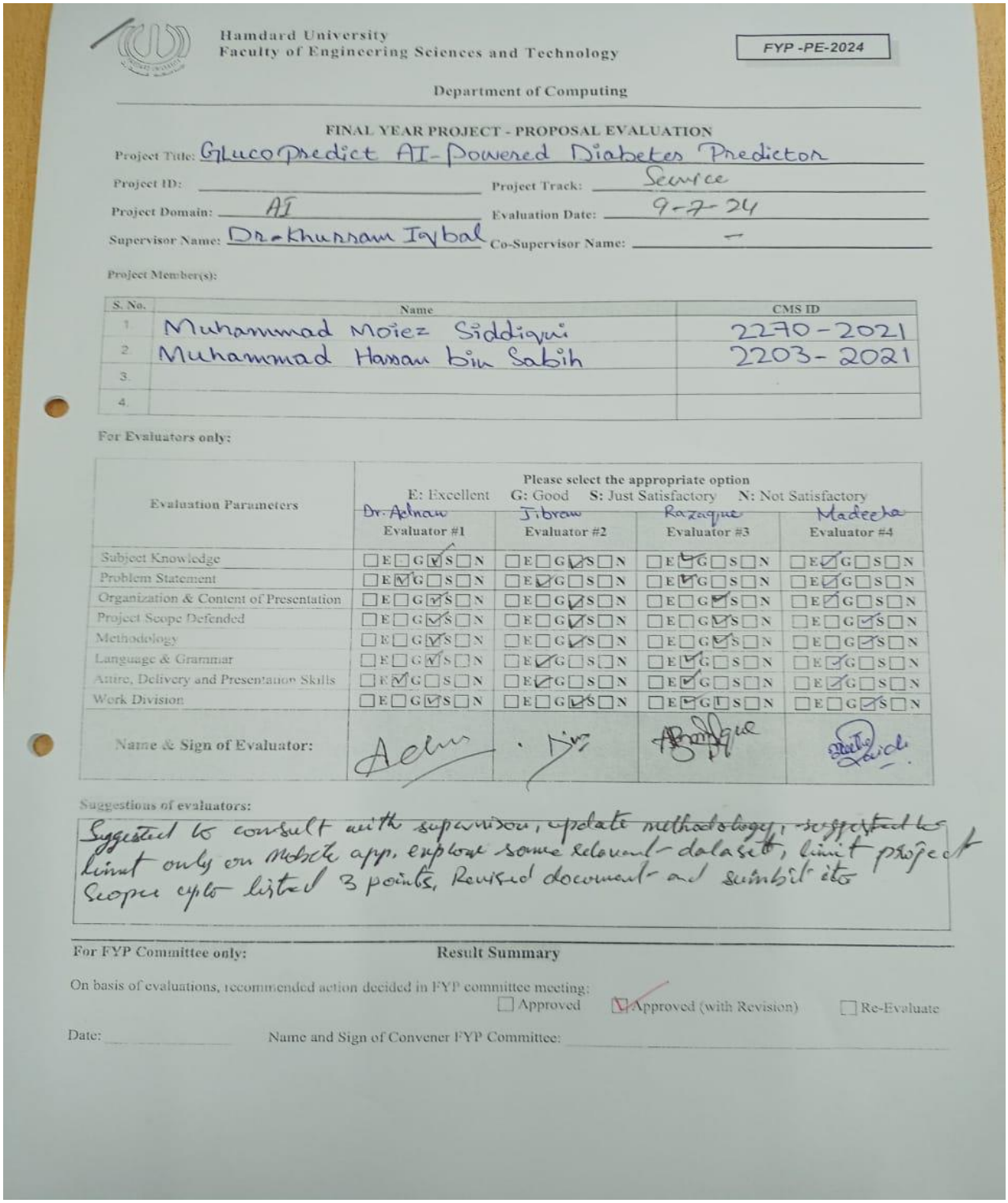
A1a. Project Proposal and Vision Document
A1b. Copy of Proposal Evaluation Comments by Jury
A2. Requirement Specifications
A3. Design Specifications
A4. Other Technical Details
Test cases
UI/UX Details
Coding Standards
Project Policy
A5. Flyer & Poster Design
A6. Copy of Evaluation Comments
Copy of Evaluation Comments by Jury for Project – I End Semester Evaluation
A7. Meetings' Minutes
A8. Research Paper
A9. Document Change Record

A1A. PROJECT PROPOSAL AND VISION DOCUMENT

Below is the link of the Proposal and Vision Document:

https://github.com/Moiez-Siddiqui/Project-Documentation-/blob/main/Project%20proposal%20and%20vision.pdf

A1B. COPY OF PROPOSAL EVALUATION COMMENTS BY JURY



Hamdard University
Faculty of Engineering Sciences and Technology

FYP -PE-2024

Department of Computing

FINAL YEAR PROJECT - PROPOSAL EVALUATION

Project Title: GlucoPredict AI-Powered Diabetes Predictor

Project ID: _____ Project Track: Service

Project Domain: AI Evaluation Date: 9-7-24

Supervisor Name: Dr. Khurram Iqbal Co-Supervisor Name: –

Project Member(s):

S. No.	Name	CMS ID
1	Muhammad Moiez Siddiqui	2270-2021
2	Muhammad Hassan bin Sabih	2203-2021
3		
4		

For Evaluators only:

Evaluation Parameters	Please select the appropriate option (E: Excellent G: Good S: Just Satisfactory N: Not Satisfactory)			
	Dr. Adnan Evaluator #1	Jibran Evaluator #2	Razaque Evaluator #3	Madeeha Evaluator #4
Subject Knowledge	G	S	G	E
Problem Statement	G	G	G	G
Organization & Content of Presentation	S	S	S	G
Project Scope Defended	S	S	S	S
Methodology	S	S	S	S
Language & Grammar	G	G	G	G
Attire, Delivery and Presentation Skills	G	G	G	G
Work Division	S	S	G	S
Name & Sign of Evaluator:	Adnan	Jibran	Razaque	Madeeha Zaidi

Suggestions of evaluators:

Suggested to consult with supervisor, update methodology, suggested to limit only on mobile app, explore some relevant dataset, limit project scope upto listed 3 points. Revised document and submit it to

For FYP Committee only: Result Summary

On basis of evaluations, recommended action decided in FYP committee meeting:

☐ Approved ☑ Approved (with Revision) ☐ Re-Evaluate

Date: _____ Name and Sign of Convener FYP Committee: _____

A2. REQUIREMENT SPECIFICATIONS

Below is the link of the Software Requirements Specification Document:

https://github.com/Moiez-Siddiqui/Project-Documentation-/blob/main/Software%20Requirements%20Specifications.pdf

A3. DESIGN SPECIFICATIONS

Below is the link of the Software Design Specification Document:

https://github.com/Moiez-Siddiqui/Project-Documentation-/blob/main/Software%20Design%20Specifications.pdf

A4. OTHER TECHNICAL DETAIL DOCUMENTS

Test Cases Document:

Software Test Plan:

The following table describes the test plan and schedule for each module of GlucoPredict.

S. No	**Description**	**Test Engineer**	**Start Date**	**End Date**
1	Sign Up Screen	Hassan	02-June-2025	03-June-2021
2	Sign In Screen	Hassan	04-June-2025	07-June-2025
3	Health Input Screen	Moiez	08-June-2025	11-June-2025
4	Result Screen	Moiez	12-June-2025	14-June-2025
11	Test-1	Moiez	14-June-2025	14-June-2025
12	Test-2	Hassan	16-June-2025	16-June-2025
13	Test-3	Hassan	17-June-2025	17June-2025

Test Case 1:

Project Name: GlucoPredict
Iteration No: 1
Module Name: Sign Up Screen
Date: 14-June-2025
Test Case ID: TC – 1
Test Engineer: Hassan
Test Case Description: Detailed testing of this module

S. No	Steps	Input Data	Expected Result	Actual Result	Pass/ Fail
1.1	Open the Sign-Up Screen	-	Sign Up form displays correctly	It did display as expected	Pass
1.2	Enter email and password	Valid credentials	Input fields and accept data	Data entered successfully	Pass

Test Case 2:

Project Name: GlucoPredict
Iteration No: 1
Module Name: Log In Screen
Date: 16-June-2025
Test Case ID: TC – 2
Test Engineer: Hassan
Test Case Description: Detailed testing of this module

S. No	Steps	Input Data	Expected Result	Actual Result	Pass/ Fail
2.1	Open the Log In Screen	-	Log In form displays correctly	It did display as expected	Pass
2.2	Enter email and password	Valid credentials	Input fields and accept data	Data entered successfully	Pass
2.3	The GlucoPredict Dashboard appears	-	Dashboard displays correctly	It did display as expected	Pass

Test Case 3:

Project Name: GlucoPredict
Iteration No: 1
Module Name: Input Health Data Screen
Date: 17-June-2025
Test Case ID: TC – 3
Test Engineer: Moiez
Test Case Description: Detailed testing of this module

S. No	Steps	Input Data	Expected Result	Actual Result	Pass/ Fail
3.1	Open the Data Entering Screen	-	Dashboard displays correctly	It did display as expected	Pass
2.2	Enter data as per the required fields	Valid credentials	Input fields and accept data	Data entered successfully	Pass
2.3	The result screen is displayed	-	Dashboard displays correctly	It did display as expected	Pass

UI/UX DETAIL DOCUMENT

1. Introduction

This document provides a comprehensive overview of the User Interface (UI) and User Experience (UX) design considerations for the GlucoPredict mobile application. It describes the design principles, layout decisions, and interaction patterns implemented to ensure the application is intuitive, responsive, and accessible to its primary users — patients, healthcare providers, and clinical staff.

2. Purpose

The purpose of this document is to:

- Define the visual, interaction, and usability guidelines applied throughout the app.
- Present wireframes and disposable prototypes for each core screen.
- Provide detailed descriptions of interface components, workflows, and navigation structures.
- Establish a reference for developers and project stakeholders during app development and future updates.

3. Audience

This document is intended for:

- UI/UX Designers responsible for refining or extending the app's interface.
- Mobile App Developers implementing the front-end screens and interactions.
- Project Supervisors and Stakeholders reviewing and approving interface design.
- Quality Assurance Teams verifying adherence to UI/UX standards and usability guidelines.

4. Design Objectives

The GlucoPredict mobile app design aims to:

- Support a clean, modern, and minimalistic interface to reduce user cognitive load.
- Maintain consistent visual identity, typography, and button styling throughout the app.
- Ensure responsive layouts compatible with diverse Android screen sizes.
- Provide clear, direct navigation to simplify health data entry and result interpretation.
- Emphasize accessibility by following mobile design best practices and Google Material Design principles.
- Deliver an engaging, user-friendly experience that encourages continuous use for personal health management.

5. Design Principles

The following principles guided the UI/UX decisions:

- Simplicity:
  App screens are kept uncluttered, showing only the most essential fields and options.
- Consistency:
  Buttons, icons, and forms follow a unified design language, with consistent color schemes and padding.
- Immediate Feedback:
  All interactions (login, data submission, predictions) trigger instant visual or textual feedback via toasts, dialogs, or screen updates.
- Accessibility:
  Colors, contrasts, font sizes, and touch target areas are selected to accommodate users with visual or motor impairments.

- Efficiency:
  Navigation flows are optimized to minimize the number of steps required to submit health data, view predictions, or access history.

6. Visual Identity

The visual identity of GlucoPredict includes:

- Primary Color Palette:
  Soft green (#4CAF50) and white for a calming, clinical feel.
- Accent Colors:
  Light grey and teal for interactive elements like buttons and inputs.
- Typography:
  Modern sans-serif fonts (Roboto) for readability and consistency with Android platform standards.
- Iconography:
  Minimalist Material Design icons paired with clear text labels to improve comprehension.

7. Information Architecture Overview

GlucoPredict's app navigation is structured around the following primary modules:

- User Authentication (Login & Sign Up)
  Secure access to personal profiles.
- Health Data Entry
  Form to input age, gender, BMI, blood sugar levels, and family history.
- Diabetes Risk Prediction Result
  Displays risk percentage and personalized health recommendations.
- Report History & Download
  View previous predictions and download risk reports.
- User Profile Management
  Update personal information and manage app settings.
- Feedback & Support
  Submit app feedback or request assistance

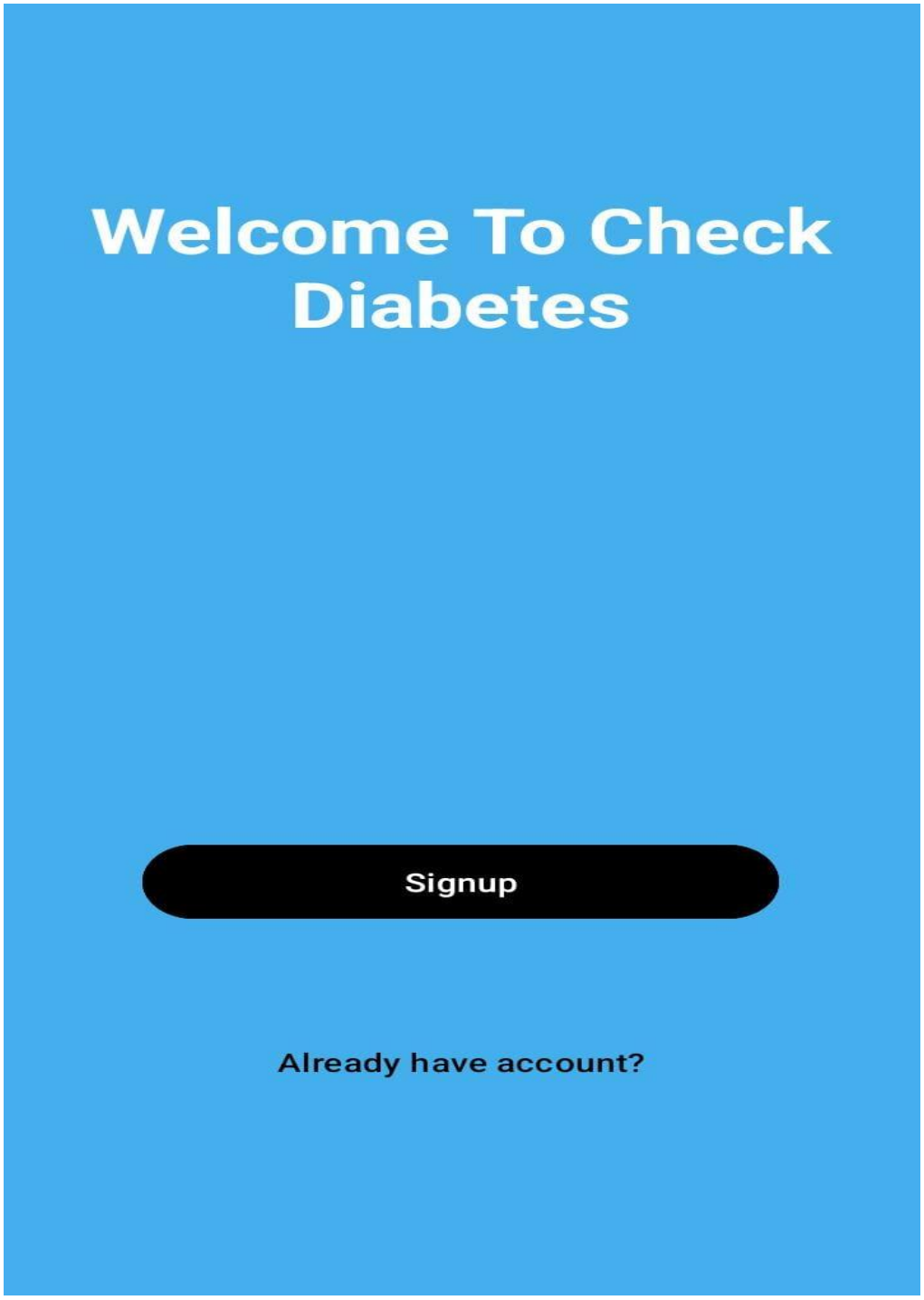
8. Wireframes and Screens

Home Page - Mock Screen 1

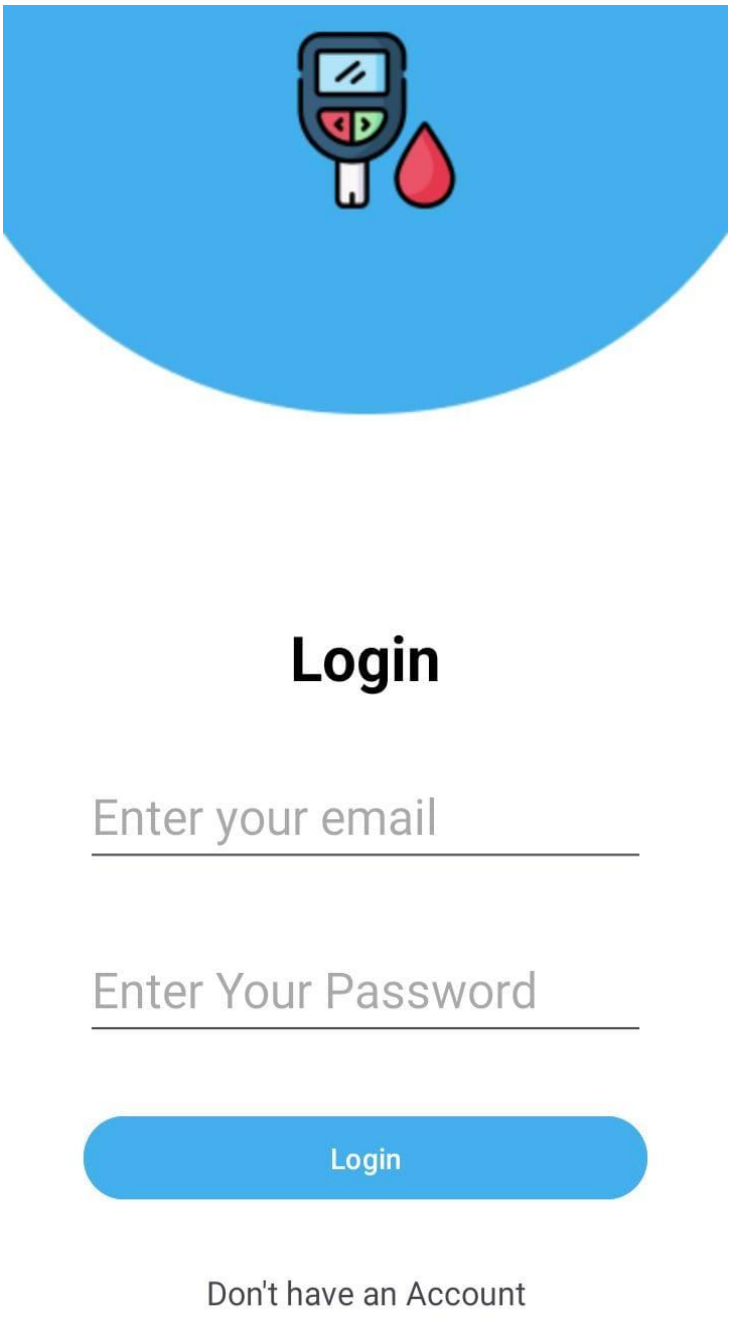
Purpose:

As the application's entry point, the Home Page introduces users to the system

Elements and Functions: Contains the welcoming message for the Diabetes App with the option given to create account or to login in to the existing account.



Login Page - Mock Screen 2
Purpose:
Allows registered users to authenticate themselves and access the system's features.
Elements and Functions:
• Input field for the user's Email ID.
• Input field with masking for user passwords.
• Submits credentials for verification.

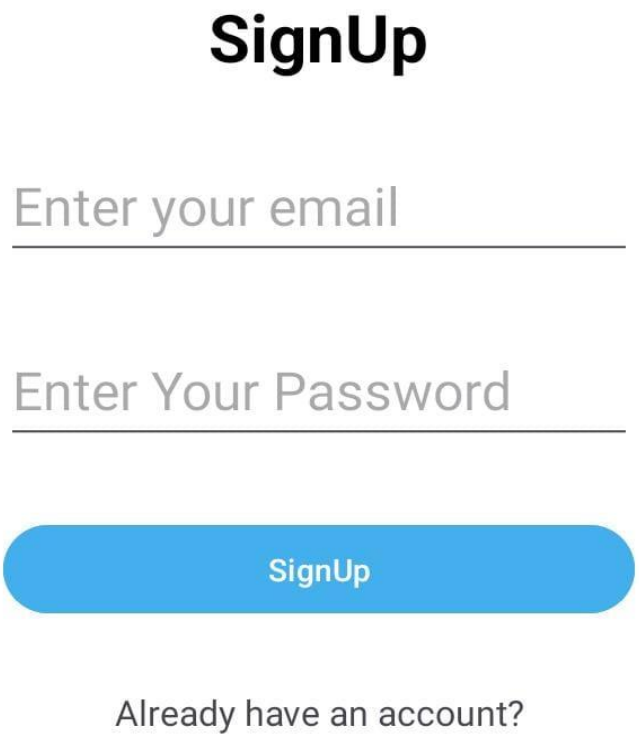


Sign Up Page - Mock Screen 3

Purpose: Allows new users to create an account by providing their details**.**

Elements and Functions:

- Name
- Email Address
- Password
- Submits user details to create an account.
- Redirects existing users back to the Login Page.



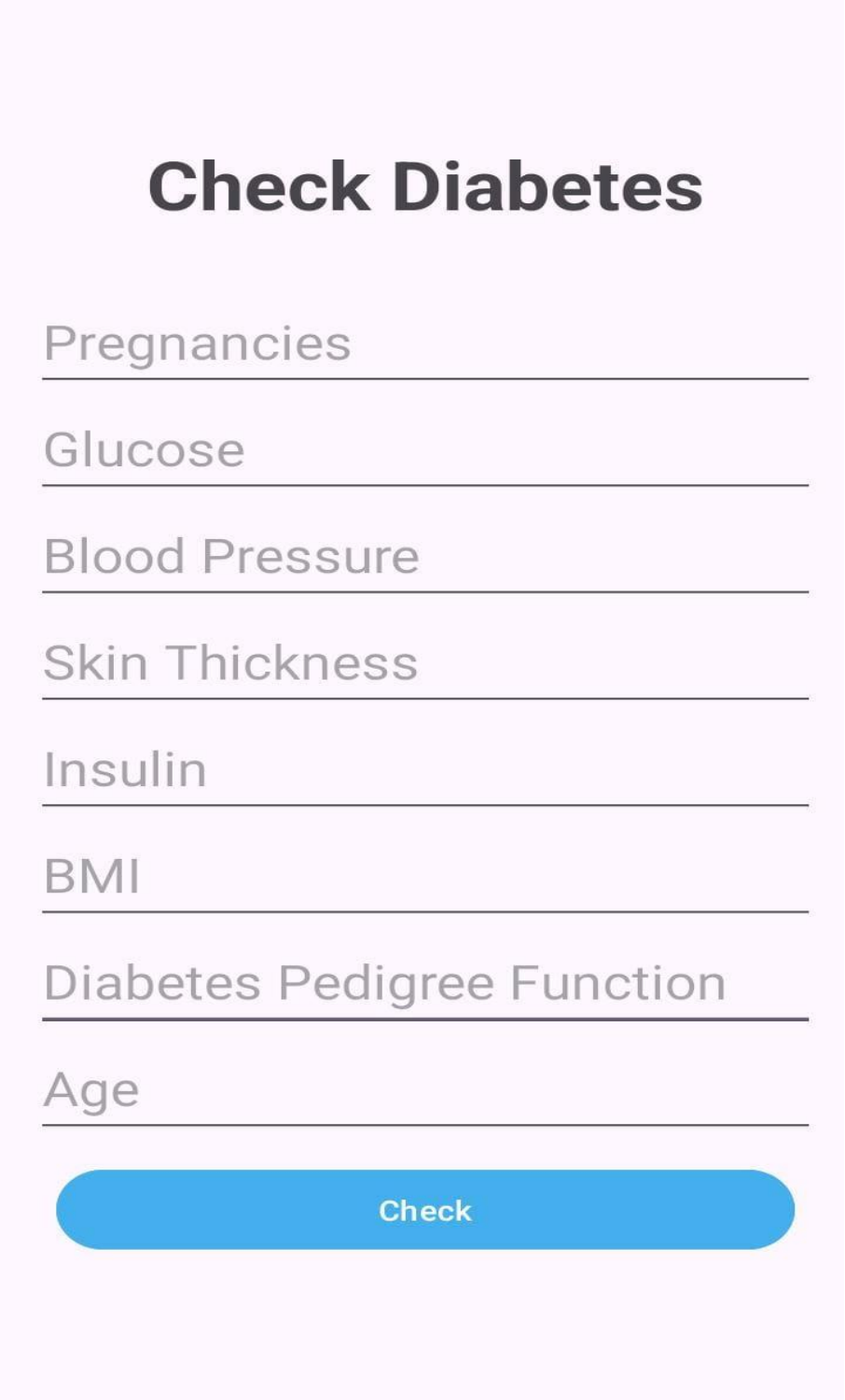
Data Collection Screen - Mock Screen 3

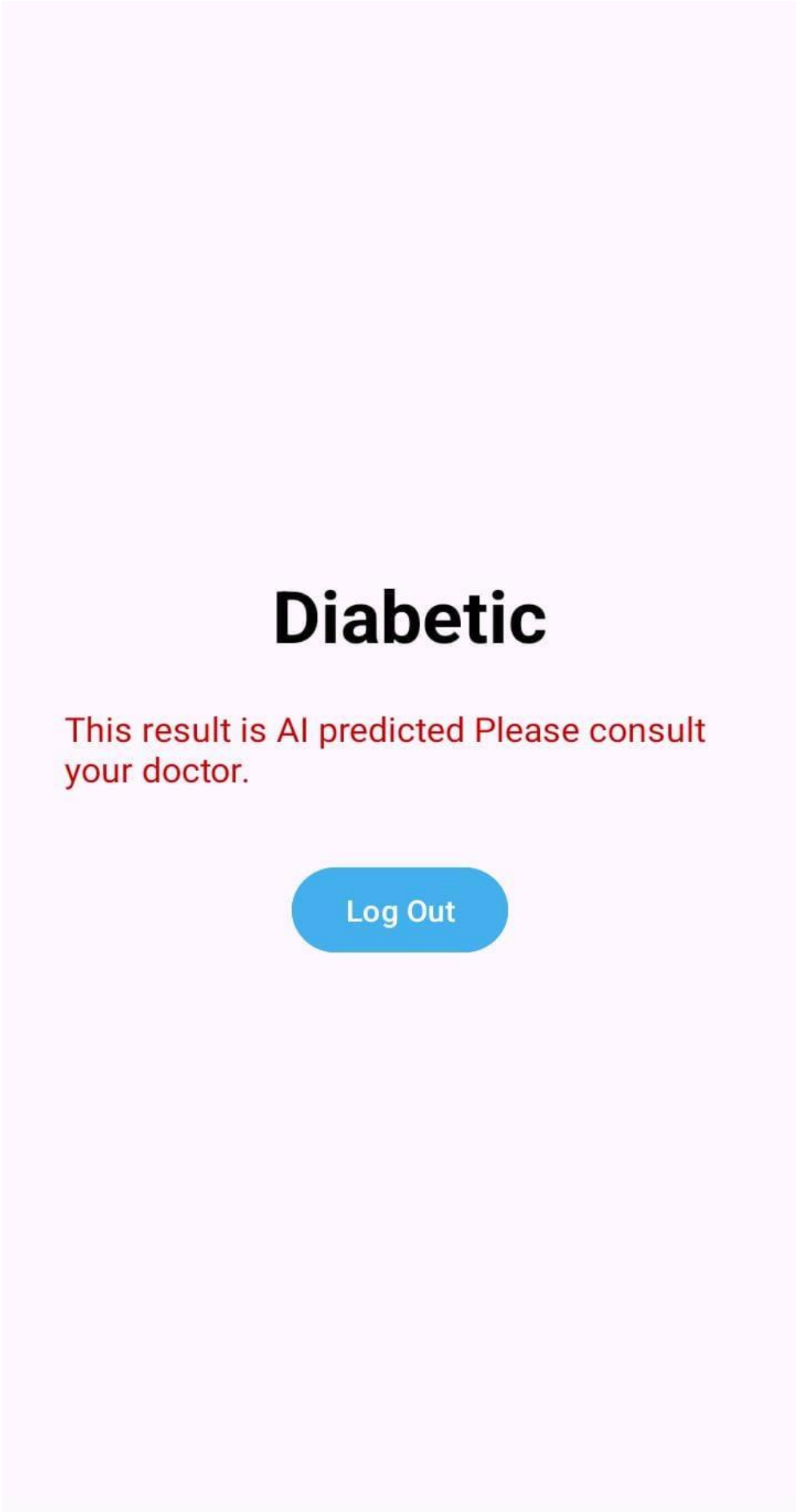
Purpose: Gathers the information from the user to detect the diabetes.

Elements and Functions:

• The field are given for the user to enter the required information • If any data isn't given to the AI it will not proceed further and display an error

• After the submission of the data, "Check" option is selected and the data is analyzed to give the prediction**.**




Diabetic
This result is AI predicted Please consult your doctor.
Log Out

Coding Standards Document

1. Introduction

This document defines the coding standards, conventions, and best practices applied throughout the GlucoPredict project to ensure consistency, readability, security, and maintainability of the codebase. All team members are expected to adhere to these guidelines during the entire development process.

2. Purpose

The purpose of these coding standards is to:

- Promote clear, consistent, and professional coding practices.
- Reduce the risk of programming errors and technical debt.
- Simplify onboarding for new developers.
- Facilitate efficient code reviews, debugging, and long-term maintenance.

3. Programming Languages and Frameworks

The GlucoPredict project uses:

- Python 3.11 (Backend APIs and ML Model)
- TensorFlow & Scikit-learn (Machine Learning)
- Android (Java/Kotlin) (Mobile Application)
- Firebase Authentication and Firestore
- AWS EC2 and DynamoDB
- Postman (API Testing)
- Jupyter Notebook (ML Development)

4. Naming Conventions

- Python Modules & Packages: lowercase with underscores (e.g., data_preprocessing.py)
- Classes: PascalCase (e.g., RiskPredictorModel)
- Functions and Methods: lowercase with underscores (e.g., predict_risk_score())
- Variables: descriptive lowercase names with underscores (e.g., user_blood_sugar)
- Constants: UPPERCASE with underscores (e.g., MAX_THRESHOLD)
- Android Layout Files: lowercase with underscores (e.g., activity_main.xml)
- Android Activities & Classes: PascalCase (e.g., MainActivity)
- Firebase Collections: lowercase with hyphens (e.g., user-records)

5. Code Formatting

- Indentation: 4 spaces per indentation level (no tabs)
- Line Length: Maximum 120 characters
- Spacing: Use spaces around operators and after commas
- Newlines: Include a newline at the end of each file
- Avoid trailing whitespace

- Consistently structure Android XML layouts with proper indentation and line spacing

6. Comments and Documentation

- Each Python module and class must include a docstring summarizing its purpose.
- Functions should have a docstring detailing input parameters, processing, and return values.
- Inline comments should clarify why a specific operation is performed.
- Use # TODO: tags for planned improvements or pending issues.
- Android Java/Kotlin code should use single-line (//) and block comments (/* */) appropriately.

7. Error Handling

- Use try/except blocks for all interactions with external services, APIs, and file operations.
- Log exceptions with meaningful messages and context.
- Never suppress or ignore exceptions silently.
- In Android, validate user inputs before operations and handle exceptions using try-catch blocks.

8. Security Practices

- Never hard-code sensitive credentials, API keys, or tokens in source files.
- Use environment variables or Firebase/AWS security features for sensitive data.
- Sanitize and validate all user inputs at both client-side (Android) and server-side (APIs).
- Leverage Firebase Authentication and HTTPS for secure communication.
- Apply role-based access control where needed.

9. Version Control

- Use Git with clear, descriptive commit messages.
- Follow a feature-branch workflow:
  Example: feature/user-authentication, bugfix/api-timeout
- Merge branches only after code reviews and successful testing.
- Maintain an up-to-date .gitignore file for ignoring system files and secrets.

10. Code Review

- All code must be reviewed by at least one other team member before merging.
- Code reviews should focus on:
  - Code correctness, functionality, and security.
  - Adherence to these coding standards.
  - Performance optimization opportunities.
  - Readability, documentation, and naming consistency.

Project Policy Document

1. Introduction

This document outlines the key operational and procedural policies governing the GlucoPredict project. These policies are established to ensure effective teamwork, consistent project practices, secure handling of sensitive data, and high-quality deliverables throughout the project lifecycle.

2. Purpose

The purpose of this policy document is to:

- Establish clear expectations for all project participants.
- Define processes for software development, testing, documentation, and issue management.
- Promote accountability, maintain quality standards, and manage project risks effectively.

3. Scope

This policy applies to:

- All project contributors, including developers, ML engineers, testers, and academic supervisors.
- All activities related to system design, AI model development, mobile app implementation, testing, deployment, and documentation.

4. Communication Policy

- All communication within the team must be clear, professional, and properly documented.
- Primary communication channels:
    - Email: For official updates, decisions, and deliverable submissions.
    - WhatsApp/Instant Messaging: For daily coordination and quick queries.
    - Weekly meetings: For progress reviews, sprint retrospectives, and planning.
- Major project decisions must be recorded in meeting minutes or shared documentation.

5. Code Management Policy

- All source code must be maintained in the designated GitHub repository.
- Commits should be made frequently with clear, descriptive messages.
- New features and fixes must be developed in separate feature branches.
- Merging into the main branch requires peer review and supervisor approval.

6. Testing Policy

- Each feature and module must be tested against its defined test cases before marking it complete.
- Mandatory testing types:
  - Unit Testing
  - Integration Testing
  - System Testing
  - User Acceptance Testing (UAT)
- All test results must be documented and shared within the team.
- No code or feature is considered complete until it successfully passes all relevant tests.

7. Documentation Policy

- All software modules, APIs, and ML models must be thoroughly documented.
- Documentation must be updated whenever changes are made to the system.
- User manuals, API references, and final reports should be maintained consistently throughout the project lifecycle.

8. Issue and Risk Management Policy

- All project issues, bugs, and risks must be logged in a shared issue tracking system or document.
- Each issue must be assigned an owner, priority level, and expected resolution timeline.
- Critical issues and risks must be escalated to the project supervisor immediately for timely resolution.

9. Security and Confidentiality Policy

- Sensitive data such as user health records, login credentials, and API keys must be securely stored and never hard-coded into source files.
- Access to cloud services (AWS, Firebase) and production environments is restricted to authorized developers.
- No team member may share confidential project information, data, or reports with external parties without supervisor approval.

10. Compliance and Review

- All team members are expected to fully comply with these policies throughout the project duration.
- Policies will be reviewed at key milestones and updated when necessary.
- Any non-compliance may result in corrective action or, in serious cases, removal from the project team.

User Manual Document

1. Introduction

Welcome to GlucoPredict, an AI-powered mobile application designed to help users predict their risk of developing diabetes based on personal health data. This user manual provides clear instructions for using the main features of the application.

2. System Requirements

- Android smartphone (Android 8.0 or higher)
- Stable internet connection
- Valid GlucoPredict user account

3. Accessing the Application

1. Install the GlucoPredict app from the provided APK file or Play Store link.
2. Open the app on your device.
3. Log in using your registered email and password.
4. If you're a new user, tap Sign Up and complete the registration form.

4. Dashboard Overview

After logging in, you'll arrive at the Dashboard, which includes:

- Summary of your health data submissions and prediction history.
- Quick action buttons to:
    - Enter new health data
    - View prediction history
    - Download your reports

5. Entering Health Data

1. Tap Predict Risk from the Dashboard.
2. Enter the following details:
    - Age
    - Gender
    - Weight (kg)
    - Height (cm)
    - Blood Sugar Level (mg/dL)
    - Family History of Diabetes (Yes/No)
3. Tap Submit to send your data for risk prediction.

6. Viewing Prediction Results

1. After submitting data, your Risk Prediction Result will display instantly.
2. View your diabetes risk percentage and personalized health advice.
3. Optionally, tap Download Report to save a copy of your result.

7. Viewing Prediction History

1. Tap Prediction History from the Dashboard.
2. View a list of your previous health predictions with date and risk percentage.
3. Tap any record to view detailed results or download reports.

8. Managing Your Profile

1. Go to Profile Settings from the menu.
2. Edit your name, email, and password.
3. Upload or change your profile picture.
4. Tap Save Changes to update your details.

9. Logging Out

- Tap the Logout button in the navigation menu to safely end your session.

A5. FLYER & POSTER DESIGN

A6. COPY OF EVALUATION COMMENTS BY JURY FOR PROJECT – I END SEMESTER EVALUATION

Saeed Ahmed	Please follow the instruction of your supervisor
Aamir Hussain	Satisfactory
Aijaz Ali	Clear your concept about what you wrote in your presentation.
Umer Farooq	Good One

A7. MEETINGS' MINUTES & Sign-Off Sheet

Below is the link to all the minutes of meetings for FYP-2:
https://drive.google.com/drive/folders/1KP7Y1TN1iUdI896-ECjaIhHljmhMTJ3X?usp=sharing

A8. DOCUMENT CHANGE RECORD

Date	Version	Author	Change Details
13/01/2025	1.0	Muhammad Hassan bin Sabih	Completed Chapter 1-3
1/6/2025	2.0	Muhammad Hassan bin Sabih	Completed the Chapter 4-7
2/6/2025	2.1	Muhammad Hassan bin Sabih	Proof – checking

A9. PROJECT PROGRESS

FYP – I

FYP Fortnightly Sign-Up Sheet

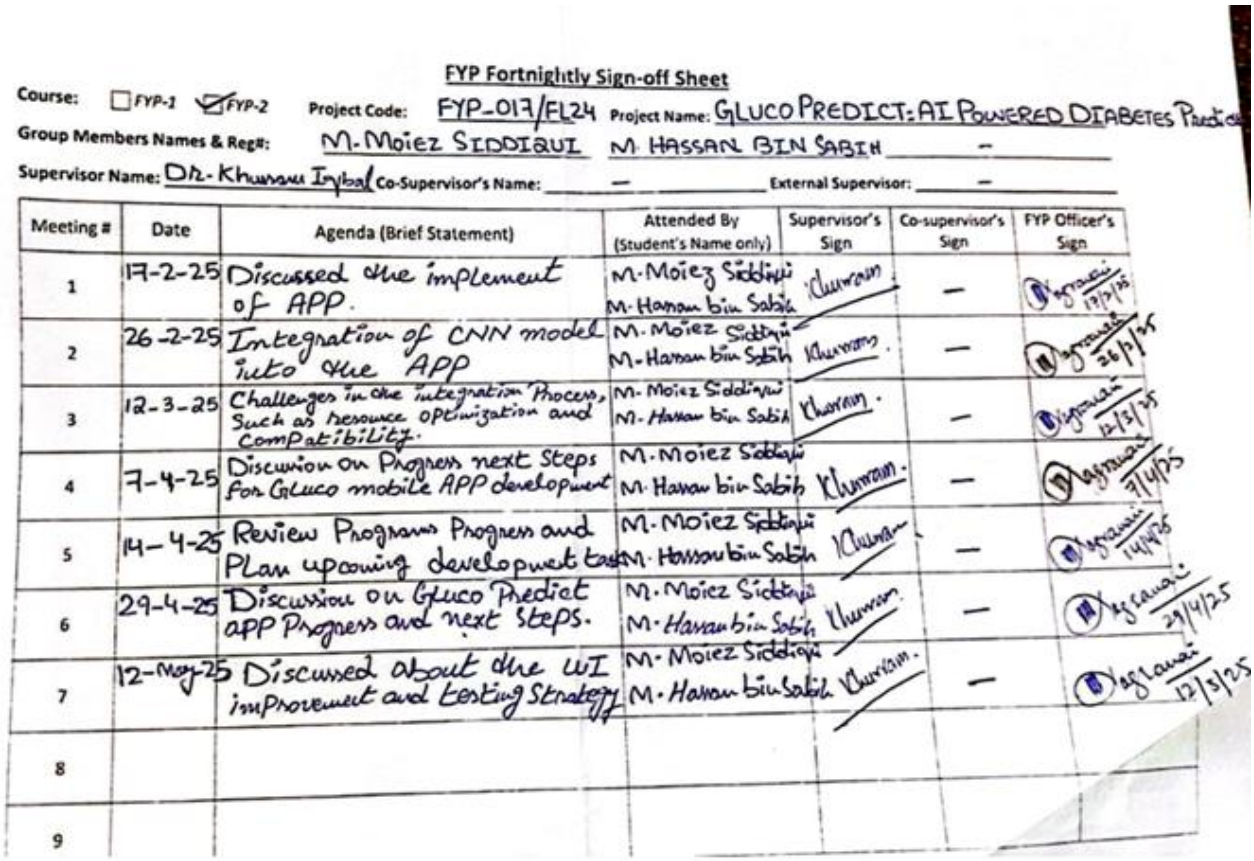
Course: • FYP-1 • FYP-2 Project Code: FYP-017/FL24 Project Name: GLUCO PREDICT: AI-POWERED DIABETES

Group Members Names & Reg#: M. Moiez Siddiqui M. Hassan bin Sabih

Supervisor Name: Dr. KHURRAM IQBAL Co-Supervisor's Name: –

Meeting #	Date	Agenda (Brief Statement)	Attended By (Student's Name only)	Supervisor's Sign	Co-supervisor's Sign	FYP Officer's Sign
1	11 Sep 2024	Overview of the data sets considered for the project.	Moiez Hassan		–	19/9/24
2	26 Sep 2024	Working on the preprocessing of the gathered Data	Moiez Hassan		–	26/9/24.
3	10 oct 2024	We have reviewed objectives, progress and challenges from the week	Moiez Hassan		–	10/10/24.
4	24 Oct 2024	Type of Database used. SqL Data processing	Moiez Hassan		–	24/10/24
5	12-Nov 2024	Design Approach and Key features.	Moiez Hassan	12-11-24	–	12/11/24
6	26-Nov 2024	Train model on gathered dataset.	Moiez Hassan	26-11-24		26/11/24
7	12-Dec 2024	Begin model development and Evaluation	Moiez Hassan			12/12/24
8						
9						

FYP – II



FYP Fortnightly Sign-off Sheet

Course: ☐ FYP-1 ☑ FYP-2 Project Code: FYP-017/FL24 Project Name: GLUCO PREDICT: AI POWERED DIABETES Predic

Group Members Names & Reg#: M. Moiez Siddiqui M. HASSAN BIN SABIH

Supervisor Name: Dr. Khurram Iqbal Co-Supervisor's Name: — External Supervisor: —

Meeting #	Date	Agenda (Brief Statement)	Attended By (Student's Name only)	Supervisor's Sign	Co-supervisor's Sign	FYP Officer's Sign
1	17-2-25	Discussed the implement of APP.	M. Moiez Siddiqui M. Hassan bin Sabih	Khurram	—	17/2/25
2	26-2-25	Integration of CNN model into the APP	M. Moiez Siddiqui M. Hassan bin Sabih	Khurram.	—	26/2/25
3	12-3-25	Challenges in the integration Process, Such as resource optimization and compatibility.	M. Moiez Siddiqui M. Hassan bin Sabih	Khurram.	—	12/3/25
4	7-4-25	Discussion on Progress next steps for GLuco mobile APP development	M. Moiez Siddiqui M. Hassan bin Sabih	Khurram.	—	7/4/25
5	14-4-25	Review Programs Progress and Plan upcoming developmet task	M. Moiez Siddiqui M. Hassan bin Sabih	Khurram	—	14/4/25
6	29-4-25	Discussion on Gluco Predict app Progress and next steps.	M. Moiez Siddiqui M. Hassan bin Sabih	Khurram.	—	29/4/25
7	12-May-25	Discussed about the UI improvement and testing Strategy	M. Moiez Siddiqui M. Hassan bin Sabih	Khurram.	—	12/5/25
8						
9						

GlucoPredict

ORIGINALITY REPORT

18%	12%	2%	15%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Higher Education Commission Pakistan Student Paper	11%
2	www.caedes.net Internet Source	2%
3	dspace.iee.ihu.gr Internet Source	<1%
4	H L Gururaj, Francesco Flammini, V Ravi Kumar, N S Prema. "Recent Trends in Healthcare Innovation", CRC Press, 2025 Publication	<1%
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Exclude bibliography	On		