

Diabetes Management System Using Food Recognition

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Diabetes Management Systems Using Food Recognition

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UNDERTAKEN

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DEDICATION

This project is dedicated to our parents and our teachers because without their prayers and support we are unable to complete this project. They gives us strength and courage to complete this project effectively.

ACKNOWLEDGEMENT

First of all, we would like to thanks Allah SWT, the Almighty, a place where We pray and surrendered, who has given us strength and ability to complete the project on time..

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Riffat Nadeem

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PROJECT BRIEF

PROJECT NAME	DIABETES MANAGEMENT SYSTEM USING FOOD RECOGNITION
ORGANIZATION NAME	COMSATS UNIVERSITY ISLAMABAD ATTOCK CAMPUS
OBJECTIVE	MAKE EASE FOR DIABETIC PATIENTS
UNDERTAKEN BY	RIFFAT NADEEM SEERAT SHAFIQUE
SUPERVISED BY	Dr. MUHAMMAD SARDARAZ
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OPERATING SYSTEM	WINDOW 10
TOOLS USED	ANDRIOD STUDIO / PYCHARM

ABSTRACT

Now a day's diabetes is spreading fast all over the world. Every second person is patient of diabetes. The main problem for diabetic patients is to maintain their diet, because foods high in fat, calories, and cholesterol increase the risk of diabetes. Malnutrition leads to obesity (another risk caused by Diabetes) and other health problems.

Our application represent the development and execution of a software program to improve diabetes management using machine learning to indicate and rate its effectiveness in managing diabetes. Our application for this management system addresses those components that affect the health and diet of people with diabetes by merging different artificial intelligence algorithms. Our application factors the diabetes management problem into sub goals: it permit users to upload an image to find out if food is recommended for use or not; using the Mask R- CNN (Convolutional Neural Network) algorithm to recommend food; uses cognitive science to develop user tracking function, user geolocation, and medication reminder for keeping record of medicine (to take medicine on time).

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1 INTRODUCTION

1.1 Brief

Diabetes is a chronic sickness that occurs when the pancreas doesn't take sufficient insulin or when the body can't utilize the insulin it produce. Insulin is a hormone that controls glucose. Hyperglycaemia, or high glucose, is a classical result of unrestrained diabetes and, over the long haul, prompts genuine harm to numerous real substructure, especially nerves and veins. In 2014, 8.5% of grownups 18 years of age and older had diabetes worldwide. In 2016, diabetes was the instant cause of 1.6 million deaths, and in 2012 high blood sugar was the major cause of 2.2 million deaths.

It is clear that the World Health Organization (WHO) [1] has reviewed the literature that diabetes is on the rise worldwide in the two pair of developed and undergoing developing countries. The vast majority of people living in two pair of developed and under developing countries live on the ground. In addition, although there is confirmation that diabetic issues can be prevented, there are many people with diabetes who do not have the necessary information and skills to manage their condition using accessible health-care technologies and lifestyle.

Advances in technology and especially in machine learning and computer simulation have led to the emergence of applications to perform tasks that require ingenuity, learning, and adaptability are possible. Therefore, to provide solutions to actual health problems like diabetes management.

The Diabetes Management Program aims to determine the nutritional require of user and recommends diets to fulfil these needs, inform sufferer to take their medicine timely, recognize foods that are suitable for diabetics and that do not use dietary monitoring procedures.

1.2 Relevance to Course Module

It has three main modules:

1.2.1 Medicine Remainder

It is the module that is used to remain the patients to take their medicines.

1.2.2 Activity Tracker

This module keeping the track of patient's daily routine and work.

1.2.3 Calories Recommender

This module recommend the meal to the patients, which meal is good for diabetic patients and which is not by telling the calories present in it (by recognizing the food/meal).

1.3 Project Background

Diabetes is a genuine, incurable infection that happen when the pancreas doesn't make insufficient insulin (a chemical that balance blood glucose), or when the body can't utilize insulin adequately. Raise blood glucose, an ordinary side effect of unrestrained diabetes, can eventually take to genuine harm to the heart, veins, eyes, kidneys, and nerves. In excess of 400 million individuals are experiencing diabetes.

In Category 1 diabetes [2] (formerly known as insulin-subordinate diabetes mellitus, adolescence or diabetes) is described by insulin creation in the body. Individuals with Category 1 diabetes need day by day insulin organization to control the measure/amount of glucose in their blood. Without insulin, they can't endure. The reason for Category 1 diabetes is unknown and as of now can't be ruled out. Manifestations incorporate unreasonable pee and thirst, steady appetite, weight reduction, mood swings and weariness.

Category 2 diabetes [2] (formerly called insulin-reliant or old-fashioned diabetes mellitus) results from insufficient insulin use. Category 2 diabetes causes most of individuals with diabetes worldwide. Indications might be like Category 1 diabetes, yet they are usually less marked. Accordingly, the illness may go undiscovered for quite a while, until inconveniences create. For a long time, Category 2 diabetes has been seen distinctly in grown-ups however has started to happen in kids. Impeded glucose tolerance (IGT) and dysfunction of glycaemia (IFG) are middle conditions with changes between typical blood glucose levels and diabetes (particularly Category 2), although changes are unavoidable. Individuals with IGT or IFG are at greater serious danger of coronary attack and stroke.

Gestational Diabetes (GDM) is a short-term state that happens in pregnancy and conveys a drawn out hazard of Category 2 diabetes. A stated exists when blood glucose levels are better than average however beneath that of a diabetic analysis. Ladies with gestational diabetes are at greater serious danger of confusions during pregnancy and labor, just like their children. Pregnancy diabetes is diagnosed by pre-birth testing, rather than reported signs.

1.4 Problem Statement

As technology evolution is getting fast day by day so people are getting more dependent on technology. Technologies are moving toward Wireless World.

It is clear that the WHO (World Health Organization) [1] has reviewed the literature that diabetes is on the rise worldwide in two pair of developed and developing countries. The vast majority of people living in two pair of developed and developing countries sit on the ground. In addition, although there is proof that diabetic difficulties can be prevented, there are still people with diabetes who do not have the necessary awareness and skills to control their circumstances using accessible health-care technologies and lifestyle changes.

Changing way of life requires regular effort. Thus, diabetics should get hold of greater responsibility for their care and treatment using accessible technology-associated programs. Technologies such as dietary recommendations, physical task monitoring and tracing, drug awareness systems.

1.5 Deliverables

- **Android Mobile Application Interface:** An android mobile application will allow the user to evaluate the Application in the perspective of easiness and how the application look alike.
- **Image Processing through Live Camera:** A functionality of image processing that camera will detect the foods/meal and recommend the user.
- **Project Detail:** A complete Project detail that involves Software Requirements Guidelines, Software Design Guidelines, GUI Methods, Trail Cases, and other vital tasks we have assume.

1.6 Development Requirements

Following are the requirements which the user of the system must fulfil in order to run the system on their laptops or PCs.

1.6.1 OS Requirement

Android devices.

1.6.2 Application Requirements

Android studio, Android Virtual Device.

1.6.3 Other Requirements

For Mock-ups and presentation, we use MS Word, MS Power Point, and star UML.

1.7 Methodology and Software Lifecycle for This Project

- We would be using Agile Model because Requirements of Software agile Procedures after each development repetition, the customer is good to see the result and recognize if he is pleased with it or not.

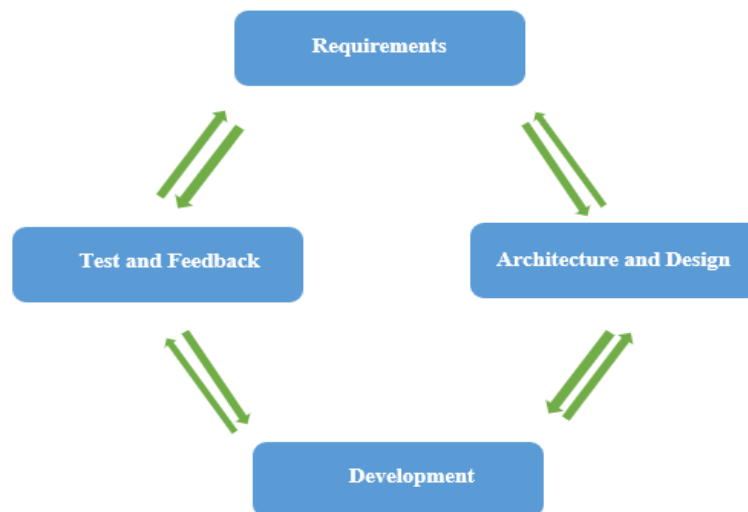


Figure 1.1 Software Lifecycle

- When the basic features have been completely developed, afterwards this is clear to increase skills levels by adding new tasks to consecutive varieties. Every additional type is generally constructed by utilize a waterfall development framework/model.

1.7.1 Rationale behind Selected Methodology

- We select this methodology because our requirements are clear so through this the development will be fast and features will be added in a systematic way.
- In this methodology we will develop application through repetitive increments that in first increment we will develop interface in second increment we will add functionalities that a system will perform.

1.8 Structure of the Report

In the coming chapters of the report we will discuss about related work, requirement analysis, design and architecture, implementation and testing of the system. Chapter 2 is completely based on literature review of our system and the related work (those current system that are working on diabetic management). We will discuss the features of these systems and their interface too. While in chapter 3 we will discuss the requirements and its two types functional and non-functional requirements and also discuss which are the functional and non-functional details of our system also in details .In chapter 4 we will discuss about design and architecture of our system and explain all its working using different types of diagram like (block diagram, sequence diagram, activity diagram etc.). Chapter 5 is about implementation of our system that how and which tools and techniques we used to develop our system. And also contains the information about complete interface of our application with detailed description of working. Chapter 6 is about testing in which we discuss testing and different types of testing and then also discuss the checking/testing and evaluation of our application too in the context of those types. And then last chapter 7 accommodate the closure and later activities.

2 RELATED WORK

2.1 Introduction

There are different applications on Diabetes i.e. Diabetes management & blood sugar tracker app, mySugr-Diabetes App & Blood Sugar and Freedom from Diabetes.

In **Diabetes management & blood sugar [3]** tracker application trace nearly each and every features of the diabetes cure and give you explained description, graphs and figures. User can forward the detail report to their administrator doctor thorough Email. Diabetes as well as provides you many tools, Thus user can discover direction in blood sugar volume and permit perception in which user gain an perception regarding usual and extend insulin boluses utilize its most productive, top-notch Bolus Counsellor . Now moreover it has a huge dietetics database, to assist you keep track of your food absorption and nutrition details, also exercise schedule. Neither forget further examine with our easy but strong reminders system. Diabetes Management [3] can examine the merit from the imported details from many glucometers and insulin pumps through the exported files from their perspective diabetes management software systems. It also assists Wear OS smart watches.

The **mySugr-Diabetes App & Blood Sugar app [4]** is you're true-hearted and for no charge diabetes chart, that remain your diabetes data below control. Along with one app you'll have Easy and customize dashboard (diet, meds, carb intake, blood glucose levels and more). Bolus Calculator with precise insulin dose suggestion (restricted to some countries using mySugr PRO). Identify clear blood sugar level graphs/charts. Estimated HbA1c at top, no longer surprises. Daily, weekly, and monthly details which you can share straight with your doctor. Safe & Secure data backup (take up with constancy compliance, quality/features, and safety). This Application attributes is auto-logs your data & additionally you can fetch your daily therapy information like meals, your diet and carb intakes. As well, any medications you grasp, blood glucose and insulin levels/volume. This application combinations is

- Steps, Tasks.
- Blood pressure
- CGM (**Continuous Glucose Monitoring**) data
- Weight.

The **Freedom from Diabetes [5]** App is a dedicated/genuine accomplice on your journey of adjusting diabetes! This App gives you training, motivation and help to diabetics all over the world, between a simple, individual by wait associated with an expert group of specialists, dieticians, and guides. Free clients, get every day messages related to food, work out, suitable action, opportunity story, and so on they can hold a record of their glucose levels and other fundamental like BP and weight. They likewise give to convey. The Freedom [5] Doctor for a restricted timespan. Paid clients, can speak with an assigned specialist and send their glucose levels, diet and exercise subtleties. They can likewise speak with an assigned doctor to find support and good partner at whatever point required. In this chapter we will discuss about the literature review of our work, also discuss some related work.

2.2 Literature Review

An app is a phone program based on knowledge-able information. This research has focused on the development of a recommendation system that integrates artificial intelligence strategies and forms a knowledge base.

Patients found the program useful and satisfied with the application. This program is believed to be able to help diabetics eat healthy foods that lead to a better quality of life.

2.3 Analysis from Literature Review

To develop an application, that is faster easy to use, simple, handy, effective and advanced application that is time saving. There are different reasons proposed to clarify why, in spite of giving a training and the education program for diabetics, numerous individuals can't accomplish the ideal clinical results. To develop an application, that is faster easy to use, simple, handy, effective and advanced application that is time saving.

The terms utilized in blend include 'type 2 diabetes mellitus', 'self-care' and 'patient development'. It is accordingly essential to recognize hindrances to self-care from the point of view of suppliers and patients since they function collectively to accomplish sound objectives. Diabetes-related confusions were regular among patients and suppliers saw these issues. Notwithstanding, suppliers report that

they don't have the assets to deal with patients' psychological well-being issues, and a couple of patients (10%) report accepting psychotherapy.

2.4 Current System

Following are the related current systems of our project.

2.4.1 Diabetes management & blood sugar tracker app

This app can

- Practically all parts of diabetes
- Keep diabetes under control and provide detailed report charts

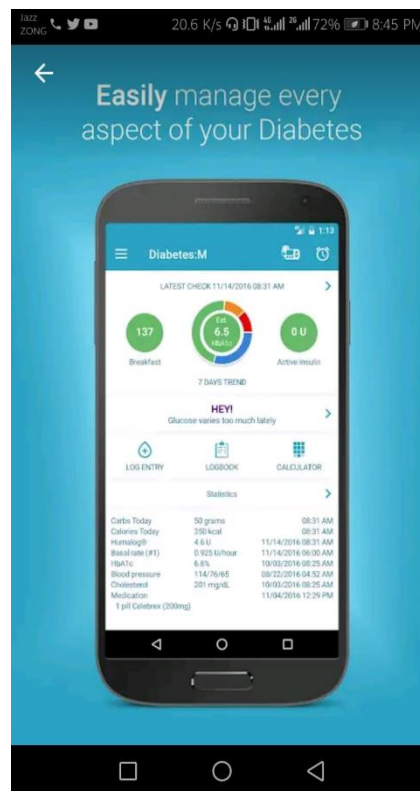


Figure 2.1 Interface of Diabetes Management app

This figure 2.1 that this application tracks pretty much every part of diabetes treatment and gives you definite reports, outlines and insights. You can email your directing doctor by email. Diabetes: Management [3] additionally gives you an assortment of instruments, so you can decide your blood glucose levels and allow user to gain understanding into ordinary and long condition insulin bolus utilizing its exceptionally compelling Bolus Advisor.

This is based on huge database of diets, assist user to remain track of their food and diet details, and exercise time. Always remember alternative check with our easy but strong reminders program.

2.4.2 mySugr-Diabetes App & Blood Sugar

The mySugr Diabetes App is your devoted and free diabetes logbook, which monitors your diabetes information. With one application you'll have:

- Blood sugar tracer
- Carb logger
- Insulin calculator
- Estimated HbA1c

Adding the mySugr Diabetes [4] App to your every day schedule with diabetes (Type 1, Type 2, or Gestational diabetes) will make your life simpler. It auto-logs your information in addition to you can gather your day by day treatment data, for example,

- Meals
- Diet
- Medicine
- Blood glucose levels
- Insulin level

This Figure 2.2 show that monitors your diabetes information. From one application you'll have Blood sugar tracker, Carb logger, Insulin calculator and Estimated HbA1c. Also adding the mySugr Diabetes [4] App to your day by day schedule with diabetes (Type 1, Type 2, or Gestational diabetes)

will make your life simpler. It auto-logs your information in addition to you can gather your day by day treatment data, for example, Meals, Diet, Medicine, Blood glucose levels and Insulin levels.



Figure 2.2 Interface of mySugr-Diabetes

2.4.2.1 App features

- Simple and customized dashboard (food, awards, carb diet, food, glucose levels and many more).
- Clear glucose graphs.
- Rated HbA1c initially, done amazing.
- Motivating difficulties and give feedback.
- Daily, weekly and monthly medical details.
- Explained reports from your doctor/physician.
- Safe information security (work as with law, quality and security).

2.4.3 Freedom from Diabetes

This application can gives

- Education
- Creativity
- Help to registered diabetic patients

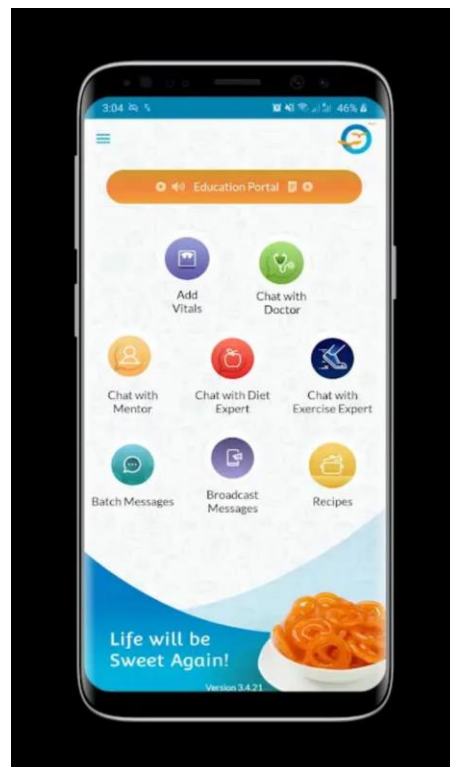


Figure 2.3 Interface of Freedom from Diabetes app

In Figure 2.3 shows that this application gives training, motivation and backing for diabetics all throughout the planet, through a straightforward, exceptional methodology by keeping in contact with an expert team to specialists, and dietitians. Free clients, get every day messages identified with diet, work out, legitimate work, opportunity issue, and so on they can track glucose levels and other significant things like BP and weight. They additionally counsel a Freedom [\[5\]](#) Doctor temporarily.

Paid clients, can contact their assigned specialists and present their glucose levels, diet subtleties and exercise data. They can likewise contact their doled out instructor for help and moral help when required.

2.5 Summary

In this chapter we discussed about Literature Review and its analysis in which we explain that why this app is necessary and what are the basic needs of the patients related to their diabetes. The system is basically focused on the development of a recommendation system that integrates artificial intelligence strategies and forms a knowledge base. And to develop an application, that is faster easy to use, simple, handy, effective and advanced application that is time saving. And we also discussed about some related works which are similar to our application and also we discussed their features and their functionality. We extend some features of these apps and also introduce new features too in our application.

3 REQUIREMENT ANALYSIS

3.1 Introduction

Software Requirement Analysis (SRA) not an ordinary document because it provides a basic understanding of functional as well as non-functional requirements. We can consider it as the starting point of the project because it serves as a written contract between the client and the organization about the features and the functionalities of the project. With the help of SRA, both clients and organization make clear to each other about deliverable project.

The two main types of requirements are: 1 Functional Requirement (FR) 2 Non-Functional Requirement (NFR).

Functional requirements will tell us the behaviour of our system functionalities and tasks that our system will perform. Functional requirements are those functionalities that software must offer. it describe the basic behaviour of the software.

Non-Functional requirement (NFR) that requirement specifies the methods which can be utilize to conclude system performance, relatively than particular conduct. They occur compared to performance requirements that define a specific behaviour or activities.

3.2 Use Case Diagram

We are going to discuss the interaction of different actors with the proposed system, and the functional (FR) and non-functional requirements (NFR) of our system. Based on these functional and non-functional requirements, we will develop our project. We will also create a use case diagram and a detail description of those use cases. It will provide interaction between the system and user of the system.



Figure 3.1 Use case Diagram of our System

3.3 Detailed Use Case

In Figure 4.1, we discuss detailed use case diagram of our system. Here is the explanation of this:

3.3.1 Activity Tracking

User can:

- Allow permissions to access location
- Start tracking
- Stop tracking.
- check weekly and daily tracking progress

3.3.2 Medicine Reminder

User can:

- Creating notification

- Setting time for medicine reminder
- Setting the time which notification appear before time of medicine
- Incrementing and decrementing the interval
- Deleting reminder

3.3.3 Calories Recommender

User can:

- Allow permissions to access gallery and Photos
- Take picture
- Upload Picture
- View Details of food

3.4 Functional Requirements

The functional requirements of our system include Activity Tracking, Medicine Reminder, and Calories Recommender.

3.4.1 Activity Tracking

Table 3.1 Activity Tracking

Title	Activity tracking
Summary	This function is use for keeping track of the user location, also providing summary of daily and weekly tracking progress of user.
Rationale	Every user can use.
Pre-Requisite	<ul style="list-style-type: none">• User must allow permission to access his location.• User must start tracking and stop tracking
Priority	Medium

3.4.2 Medicine Reminder

Table 3.2 Medicine Reminder

Title	Medicine Reminder
Summary	This function is use for medication reminder.
Rationale	Every user can use.
Pre-Requisite	<ul style="list-style-type: none">• User can add record about their medicine• User can set timings of notifications.
Priority	Medium

3.4.3 Calories Recommender

Table 3.3 Calories Recommender

Title	Calories Recommender
Summary	This function is use for detection of food images and calculating calories from given food picture and recommending the food intake.
Rationale	Every user can use.
Pre-Requisite	<ul style="list-style-type: none">• User must allow permissions to camera to access gallery and photos.• User must initiate the camera for food detection.
Priority	High

3.5 Non-Functional Requirements

Non-operative requirement (NFR) that requirement which can be utilize to conclude system performance, relatively than particular conduct. They occur compared to performance requirements that define a specific behaviour or activities.

Table 3.4 Non-Functional Requirement

Efficiency	Our App will be resource efficient, should not take too long to start. User can complete his task without any help and the number of transactions will be completed without errors.
Learnability	Our App interface will be very simple and easier navigation so that novice and expert both users can use it easily.
Maintainability	Any kind of change in features and design will be easy for admin.
Reliability	Our app will work without errors and app will be reliable enough to use.
Usability	Our app will be user friendly and easy to use for every kind of user.
Availability	Our app will be available 24/7 so that user can use it anytime with ease.
Performance	If user will perform any task, then the response will be very fast.
Understandable	The design and overall architecture of the application will be easily understandable.

3.6 Summary

In this chapter we discussed about types of requirements (Functional and non-functional). We also discussed about our system Functional and Non-Functional Requirements too in details. We create a use case diagram and explain a detail description of those use cases. It will provide information of interaction between the system and user of the system.

4 Design and Architecture

4.1 Introduction

A **System Architecture** is the calculated model that characterizes the construction, conduct, and more perspectives on a framework [6]. An engineering depiction is fixed specification and specifications of a framework, organized such that help thinking about the constructions and conduct of the framework. Architecture likewise turn on how the components and parts inside a framework interconnect with one another. Architecture also pivot on how the elements and components within a system interconnect with each other.

While the **software configuration** gives a **configuration plan** that explain the components of a framework, how they fit, and work together to satisfy the necessity of the framework.

The Main goal of the design is to explain prerequisites that influence the construction of the application. A portion of different objectives are as per the following

- Describe/show design of the framework, however hide its execution description.
- Explain all use cases and situations/scenarios.
- Handle both functional and quality requirements.

So in this chapter we will discuss System Architecture of our application using block diagram and also describe the process/flow representation using DFD Levels (DFD Level 0 and DFD Level 1). DFD identifies the cycles that are utilized in a system to move information from the contribution to the document/file storage and describe age and identifies the processes that are used in a system to transfer data from the input to the file storage and will also describe the design model of our application with detail description using sequence diagram and activity diagram.

4.2 System Architecture

In Figure 4.1 the diagram of system architecture of our project is shown. The main functions of our systems include activity tracking, medicine reminder and calories recommender. The user can easily access all these modules and used the functionality of them. First of all in the figure below if user click on Activity Tracking module a google map and two buttons display to user on screen. If user click on tracker button to start, than tracker start tracking to user and if user click to stop than tracker stop tracking. And if user click measurement button than the daily and weekly tracking

progress is displayed on user screen for view. If the user click on Medicine Reminder module than again two buttons and some interface display on a user screen. Add button is for adding record about user medicine, so user can use it for adding their medicines record and record is display on screen to user. And second button is setting button, from their user can easily setts the time of notification.

Third one is if the user click on Calories Recommender module than user can capture picture by using camera and upload it. After uploading, detection start, different algorithms will be applied on picture to detect food. After the detection of food, the system will show details about food, which will tell that how much calories present in food. This represents the overall structure of our project, which is shown in below figure in the form of block diagram, the icons represent user and camera respectively.

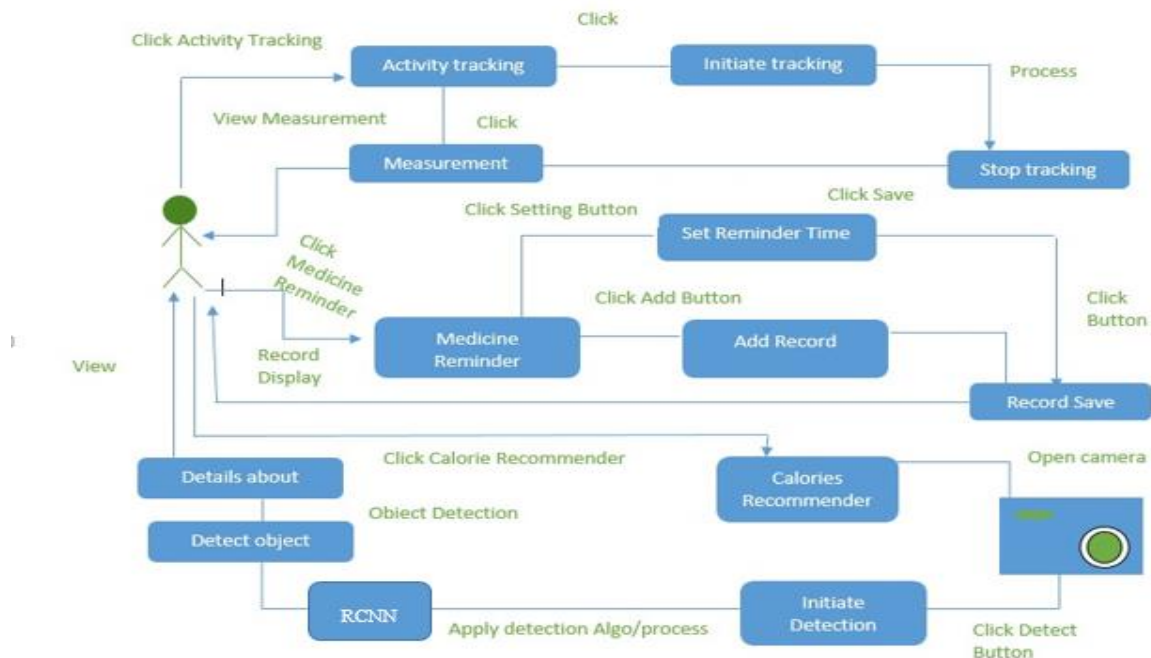


Figure 4.1 Block Diagram of our System

4.3 Process Flow/Representation

DFD represents the cycles that are associated with a system to move information from the contribution to the document/file storage and reports age. Following is an information stream diagram of our system which includes level 0, and level 1 information flow charts of this system.

4.3.1 DFD level 0

Figure 4.2 represent the level 0 data flow chart of our system. In which user can request the system to use camera. The system will send a request to the system for food detection after uploading the picture of food. When the food is being detected the system will request to generate details report on food Detection. The system will then shows the details to the user about the detection of food in that way.

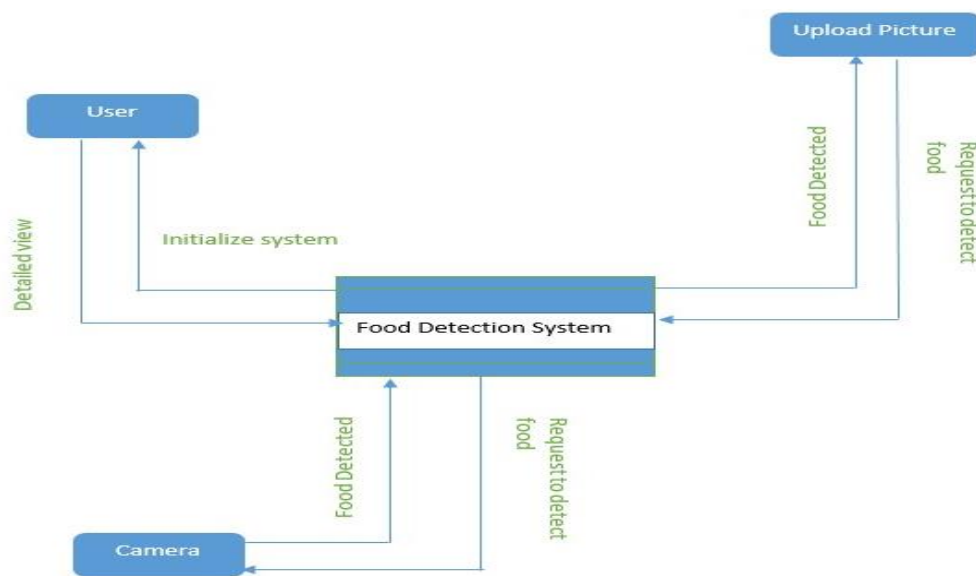


Figure 4.2 DFD Level 0

4.3.2 DFD LEVEL 1

Figure 4.3 shows the data flow diagram level 1 of our system. It is more detailed than level 0. After successfully capturing the picture, the user can upload the picture of the food on the system, the

process starts when the user will click on Initialize/detection button on the application. After that the detection process completed the details about the food detection shown to user.

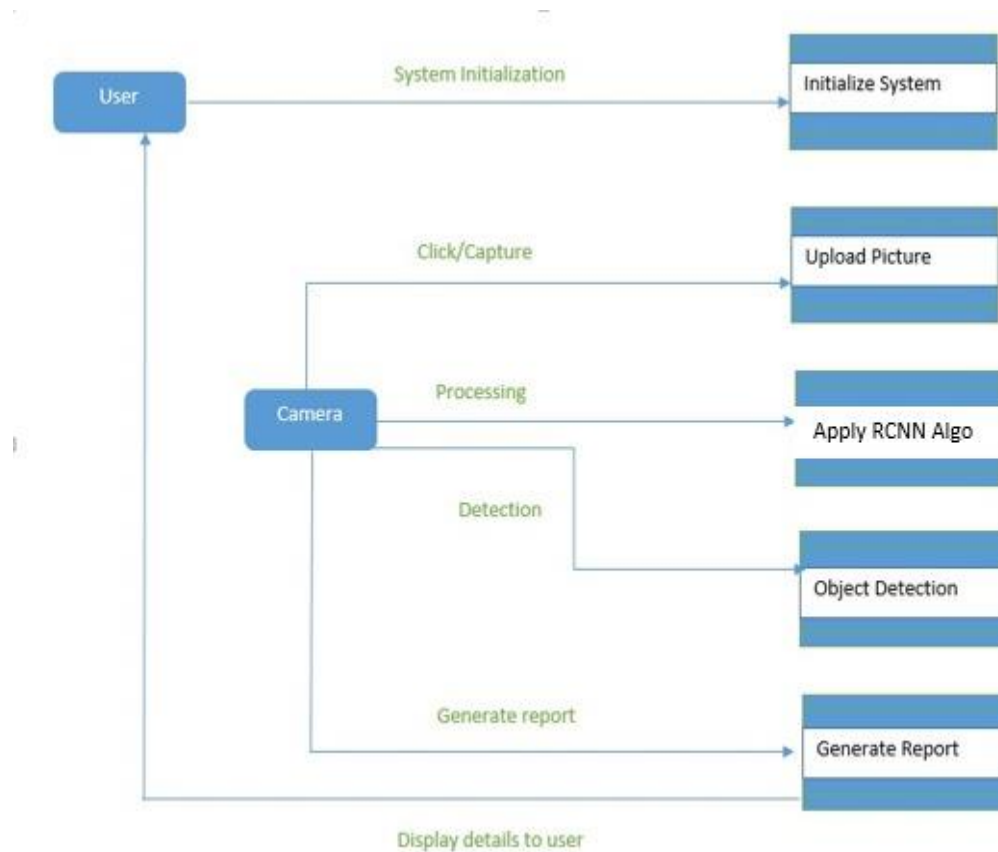


Figure 4.3 DFD Level 1

4.4 Design Models [along with descriptions]

Following models are design models of our system.

4.4.1 Sequence Diagram

Sequence diagrams is a diagram that represent how and in what request the articles in a system work.

Figure 4.4 shows the sequence diagram calories recommender module. The user will send a message to the application for initializing the system by clicking on the Camera button. The application will send the request for using the camera.

The application will send a message to the camera to detect food that comes in the way. The system will send a message to the camera to upload image of the food. The camera will upload the food image. The system will apply algorithms on that image and will generate the detailed report about food calories present in it and view to the user on screen.

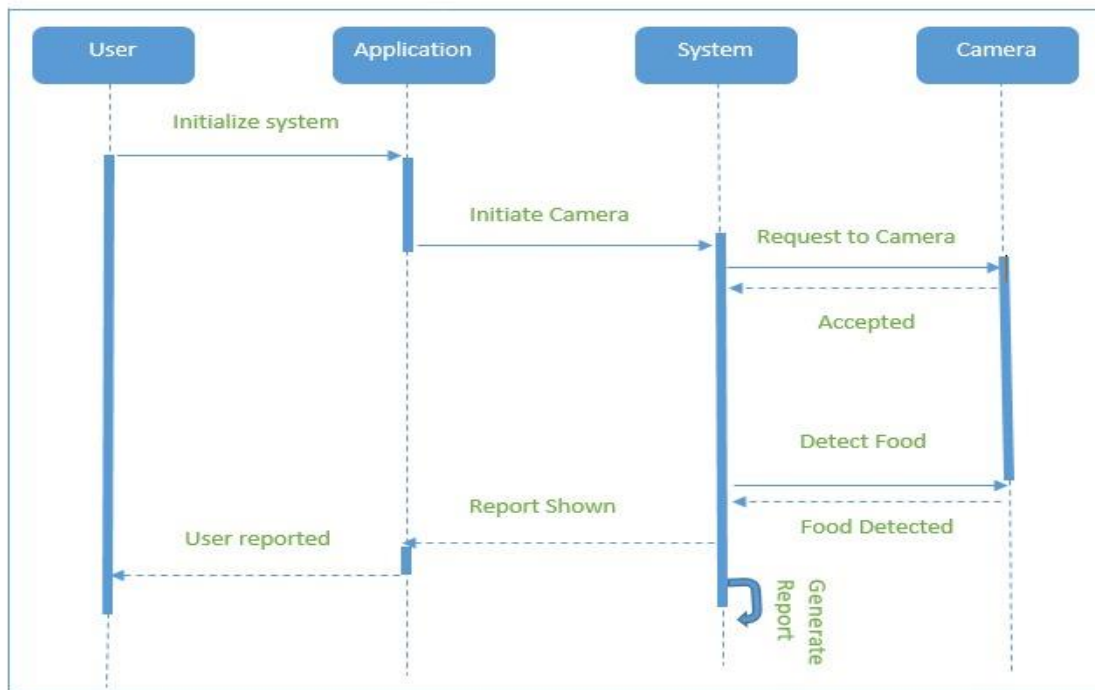


Figure 4.4 Sequence Diagram of Calories Recommender

4.4.2 Activity diagram

Activity diagram is another critical behavioural graph in UML (Unified Modelling Language) diagram to represent energetic parts of those system. Activity diagram is basically a high level adaptation of flow chart that displaying the stream beginning with one activity then onto the following activity.

UML graph to address dynamic pieces of those framework. Movement outline is essentially a general transformation of stream chart that showing the stream beginning with one activity then onto the following activity.

Figure 4.5 shows the Activity graph of the client. The user will click on three different button. If the user will click on Activity Tracking button, the permission to access location message is shown to user to get permission if it is not given to user. After that the user can start tracking and stop tracking, the user is being tracked and time used and distance covered is also calculated.

If the user will click on Medicine Reminder button, the user can see user medication record schedule of medication. The notification sent to user based on schedule. If the user will click on Calories Recommender button, user click on camera the system will show permission to access gallery and Photos messages to user to get permission if it is not given to user. Then user will upload picture and the system start detection. After detection the detailed shown to user about food.

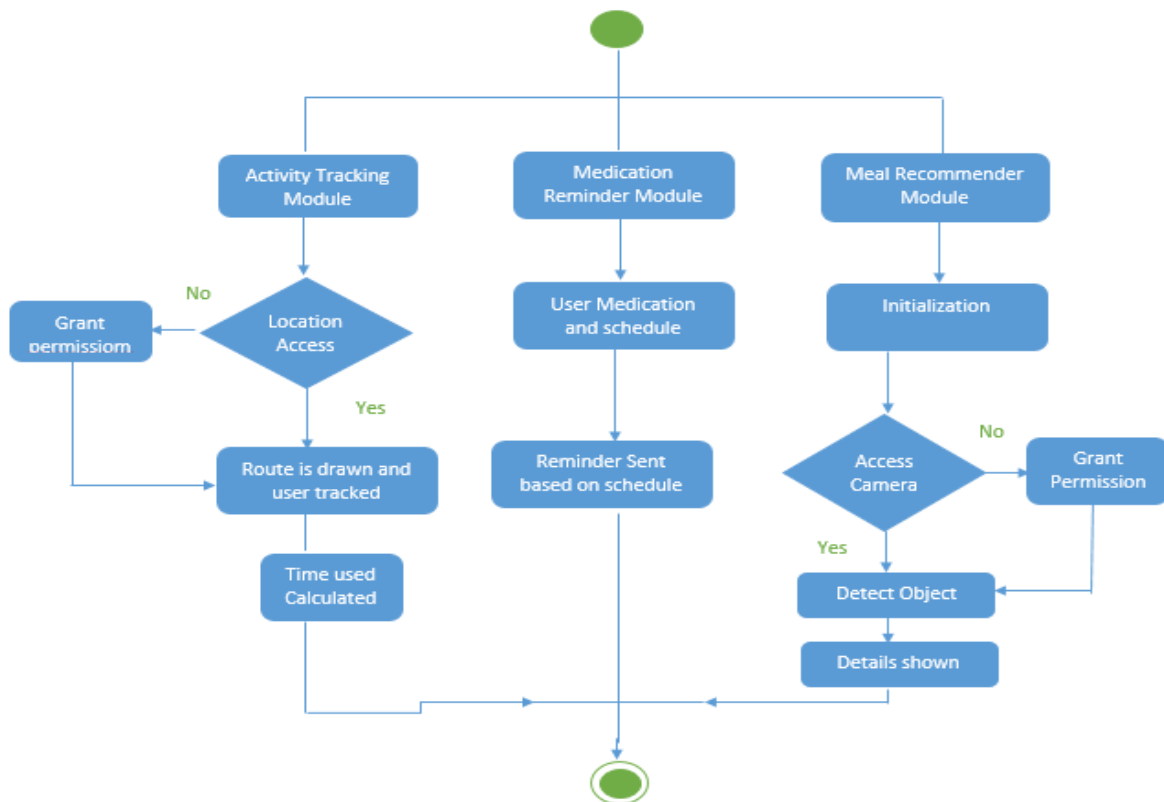


Figure 4.5 Activity Diagram of our System

4.4.3 Class Diagram

The Class Diagram is the fundamental design square of thing arranged showing. It is used for general determined exhibiting of the construction of the application, and for definite showing making a translation of the models into programming code. Class Diagrams can moreover be used for information demonstrating.

Figure 4.6 shows the classes and connections among client and action tracker class and calories recommender class.

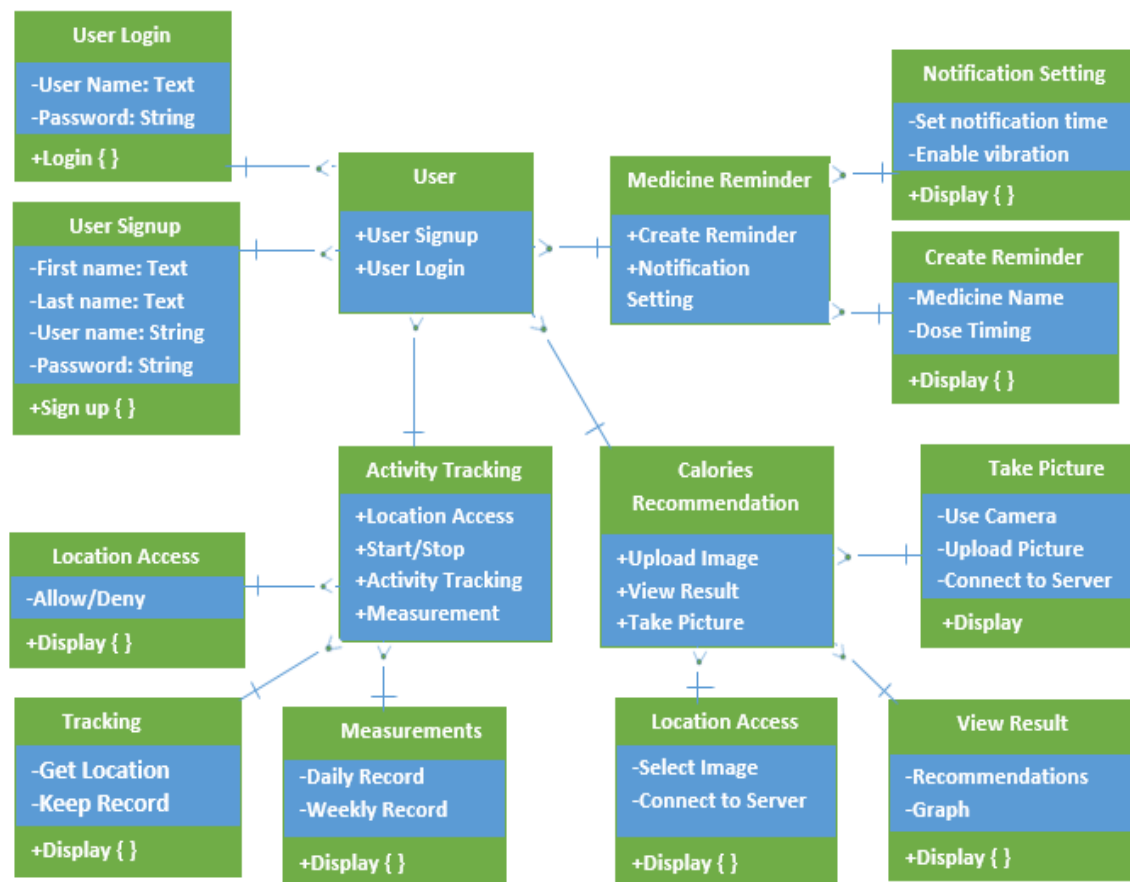


Figure 4.6 Class Diagram

4.5 Summary

In this chapter we discussed about System architecture of our application in details and we elaborate it with a diagram. We also discussed numerous levels of DFD's (DFD Level 0 and DFD level 1) and also we explain working of the system with the help of sequence diagram (that tell in what order the object are placed in system), Activity diagram (that tells the flow of system from one activity to other) and class diagram (which is used for data modelling it tells how data organize in our system).

5 Implementation

5.1 Introduction

In this chapter the whole implementation of the idea of this project is explained. This is the most important portion because this portion explains that how we will convert our idea into real world project. Here we will explain the technologies that we used and moreover how we used them to implement this idea.

5.1.1 Algorithm

There are five algorithm implemented in this project. The detailed overview ad the various outcomes are shown below.

5.1.1.1 Dataset

In our Project dataset is taken from Kaggle. All the images used are RGB images and are in (.JPG) format. It contain 13 classes. All the images are placed in folder corresponding to the food type.

The 13 classes are given below:

- BG (Plate)
- Pudding/custard
- Smashed Potatoes
- Carrots
- Spinach
- Beans
- Pizza
- Pasta
- Oranges
- Bread
- Yogurt
- Scallops
- Veal Breaded Cutlet



Figure 5.1 Split Dataset

5.1.1.2 Classification

There are many classifiers that are used in literature to classify Food Recognition into many other different types like Artificial Neural network (ANN), K-Nearest Neighbour (KNN), Convolutional Neural Network (CNN), Support Vector Machine (SVM) and Region with CNN features (R-CNN).

In our project we use Region with CNN Features (R-CNN) classifier to classify food recognition. Our project Model is working/Train on dataset, Input Image, Extract Region Proposals, Computes CNN features, Classify Regions and show the results.

5.1.2 R-CNN Architecture

A simple approach which is used to resolve issue is take distinct areas/regions of interest from the picture, and utilize a CNN to characterize the existence of the item inside that areas/regions. The issue with this planned is that the things of interest may include diverse semantic or nonlinear areas inside the picture distant feature proportions. Consequently, you would need to choose a tremendous amount of districts and this could estimating explode. Thusly, calculations like R-CNN, YOLO and so on have been proposed/made to discover these circumstances and discover them quick. By solving the issue of picking countless areas/regions, Ross Girshick et al [7] proposed a strategy in which we utilize discriminatory hunt to take out only 2000 areas from the picture and Ross Girshick called them areas/regions proposition. Subsequently, presently, rather of attempting to group countless areas/regions, you can simply work with 2000 locales.

5.1.2.1 Selective Search

- Create beginning sub-segmentation, we create many user/candidate regions.
- Utilize greedy algorithm to repeatedly combine homogenous regions into larger ones.
- Utilize the generated regions to make the final candidate region plan.

5.1.3 Food-item Identification

To identify what's on the plate, we need to instance-segment the given food picture into the workable food classification/arrangement. Occasion/ Instance Segmentation identifies separate pixel in the predefined picture into potential classes like Foods thing for our situation. Stated the issue of occasion/ Instance division, the design of R-CNN would be a coordinating with arrangement.

- R-CNN extract a picture and lets out three yields, covers of the recognized things, bouncing boxes and classes for each mask detected.

5.1.4 External API

We haven't used any external API. We have used "Flask" which is a web frame work and is for python. It not just manage HTTP requests but also render template but we have concern only with request, we used it to make an API for communication of our backend and front-end. As our back-

end is in python so we don't need any external API. We achieve this functionality by Flask. We also integrate google map API by using its different methods like on connected on disconnected to access google map on our application for activity tracking module.

5.2 Interface of the application

5.2.1 Splash Screen

Figure 5.2 shows the splash screen of our application and this screen appears for only few Nano second and then disappear.



Figure 5.2 Splash Screen

5.2.2 Registration Page

Figure 5.3 shows the home page of our application. This layout will appear when the user will visit our application. The home page of our application will display two option such as Get started, I already have an account. If user is new on our application then he/she have to register themselves

so he/she click on Get Started button and if the he/she is not new then he/she login themselves by clicking on I already have an account.



Figure 5.3 Registration Page

5.2.3 Sign up Page

Figure 5.4 shows the Signup page of our app. If any user want to use our application then he or she first have to login to our application. If he or she is new on our application then he or she have to sign up and it is available on our sign up page. There are some information which the user has to provide to our application which includes his First Name, Last Name, User Name, and Password.

The image shows a registration form titled "REGISTER" centered on a light gray background. At the top, a blue banner with white wavy patterns contains the word "Welcome". The form itself is a white rounded rectangle. It contains four input fields: "First Name", "Last Name", "User Name", and "Password", each with a blue underline. Below these fields is a prominent blue button with the word "REGISTER" in white capital letters. At the bottom of the form, there is a link that reads "Already have an account? Sign In" in blue text.

Figure 5.4 Signup Page

5.2.4 Login Page

Figure 5.5 shows the Login page of the application. On this page user will only have to enter his User name and password. He will remain login until he does not logout. At the end we have provided create an account option so that anyone who has not account can create account directly from here. And this will automatically return him to sign up page.

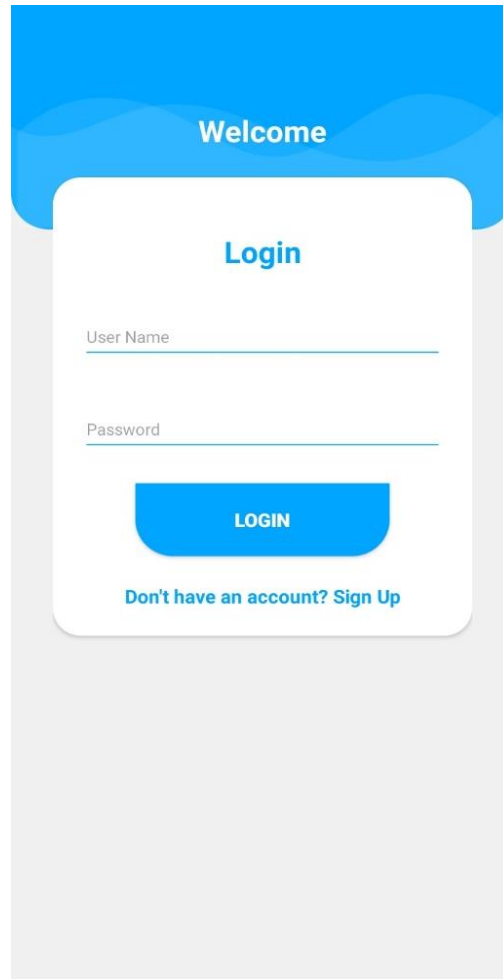
A mobile application login screen. At the top, a blue header with white wavy patterns contains the word "Welcome" in white. Below this is a white rounded rectangle with a blue "Login" title. It features two input fields: "User Name" and "Password", each with a blue underline. A blue "LOGIN" button is centered below the fields. At the bottom of the white box, a link reads "Don't have an account? Sign Up". The background is a light gray gradient.

Figure 5.5 Login Page

5.2.5 Home Page

Figure 5.6 shows home page of application. At home page he or she can view four button i.e., Calories Recommender, Medicine Reminder, Activity Tracker and Logout. On this page, if user want to take any calculate calories of their food then he/she can use option of Calories Recommender. If user want to keep record of their medicine and also want to set reminder for it then he/she can use option of Medicine reminder. If user want to keep Track of their daily walking and running activities then he/she can use option of Activity Tracker. If user want to logout then he/she click on logout button.

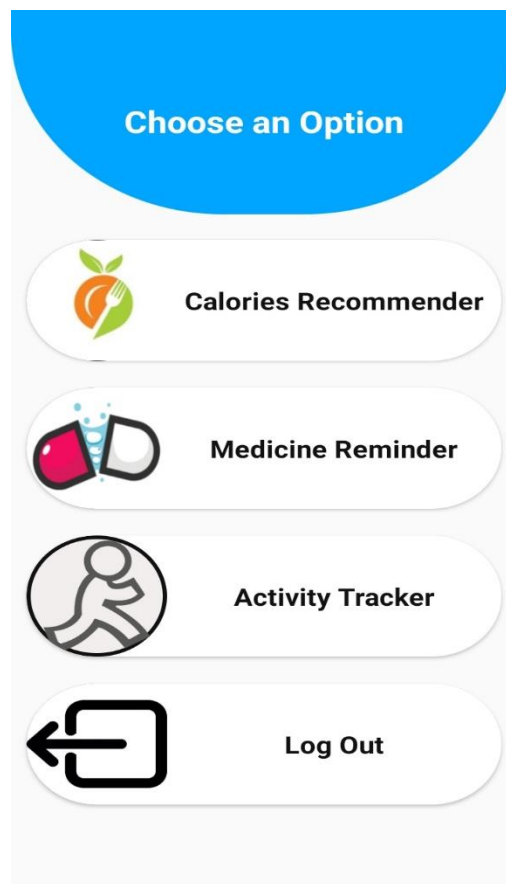


Figure 5.6 Home Page

5.2.6 Calories Recommender

Figure 5.7 shows the interface of calories recommender. When user choose option of calories recommender then this page appear to user.

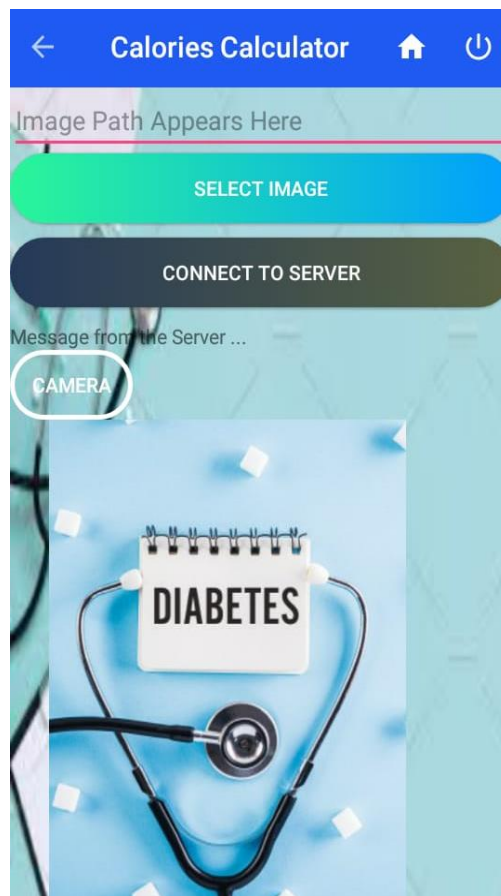


Figure 5.7 Calories Recommender

5.2.6.1 Select Image

In Figure 5.8

- User can select image of food from gallery for which he want to calculate the calories by clicking on select image button.
- After selecting the image, the path of the image appear in the textbox here and selected Image is also appears on screen.

- We use camera for taking pictures of food and can also can check calories of that image.

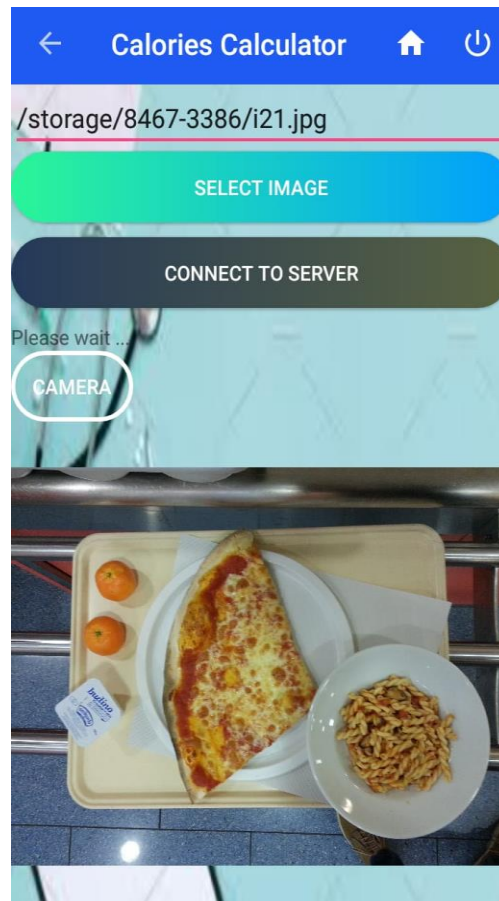


Figure 5.8 Selecting Image

5.2.6.2 Connect to Server

- After selected image user click on the button of Connect to server.
- A message from server is displayed on the screen “Please wait” as shown above in Figure 5.7. While the Processing server connect to rest API.

5.2.6.3 Result, Options and view scores

In Figure 5.9 user after detection can see the result. Then by clicking on view scores button as in figure 5.10 user can also see either this food is recommended or not. By clicking on graph icon user can see the graph of that calories intake record as shown in figure 5.11.



Figure 5.9 Result

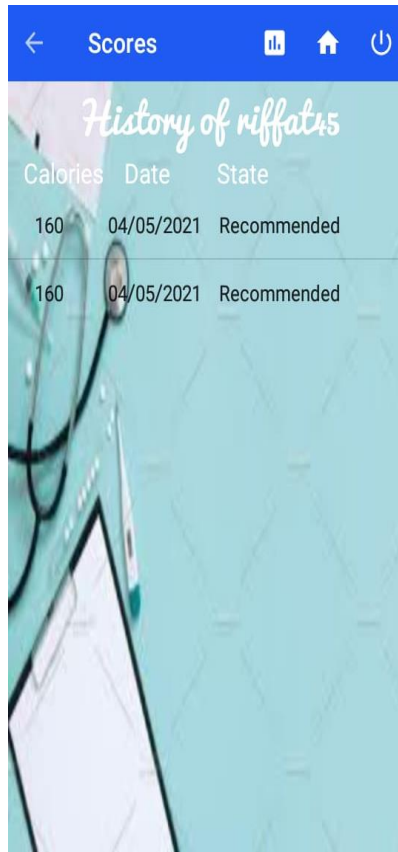


Figure 5.10 Score

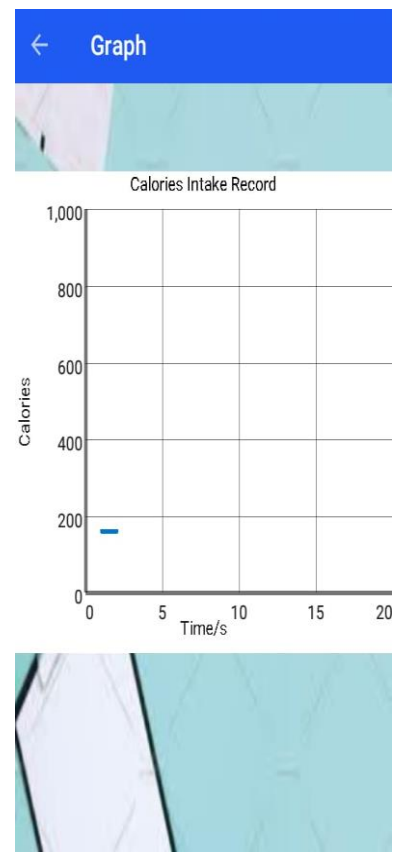
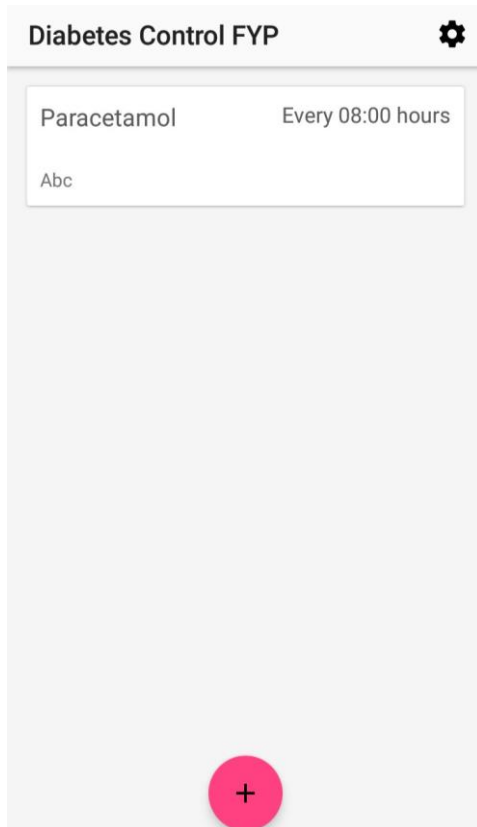
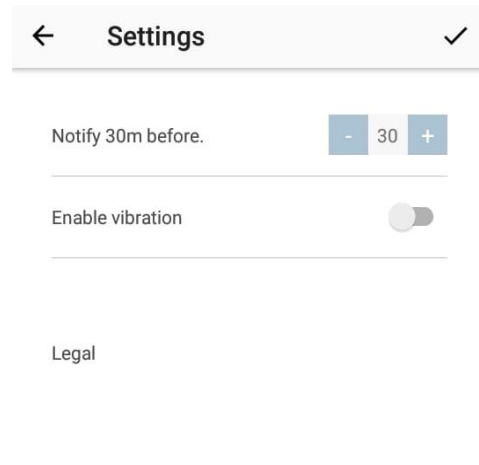


Figure 5.11 Graph

5.2.7 Medicine Reminder

- When user click on medicine reminder option this interface appears to user as shown in Figure 5.12. Whenever user want to add a record of their medicine then he/she click on add button.
- In Figure 5.13 User can also set a reminder or notification by using setting option.

**Figure 5.12 Medicine Reminder****Figure 5.13 Notification Setting**

5.2.7.1 Create, Delete & Edit Reminder

- Figure 5.14 shows that user can create reminder by putting the reminder name and writes Details of Medicine in notes and set timer/reminder which is frequency in hours and then click on the create button.
- Figure 5.15 shows that user can edit the reminder and by clicking on Tick option they can update the reminder.
- User can delete the reminder by just clicking on the delete button as shown in figure 5.15.

← New reminder

Reminder name

Notes

Frequency in hours

07 59

08 : 00

09 01

Create

Figure 5.14 Create

← Paracetamol ✓

Paracetamol

Abc

Frequency in hours

07 59

08 : 00

09 01

Delete

Figure 5.15 Edit and Delete

5.2.8 Activity Tracking

In Figure 5.16 user can keep track of his walking and running activity. For this

- First of all user need to start the activity tracking by clicking on start button.
- Then user can also pause the tracking activity by clicking on pause/stop button.

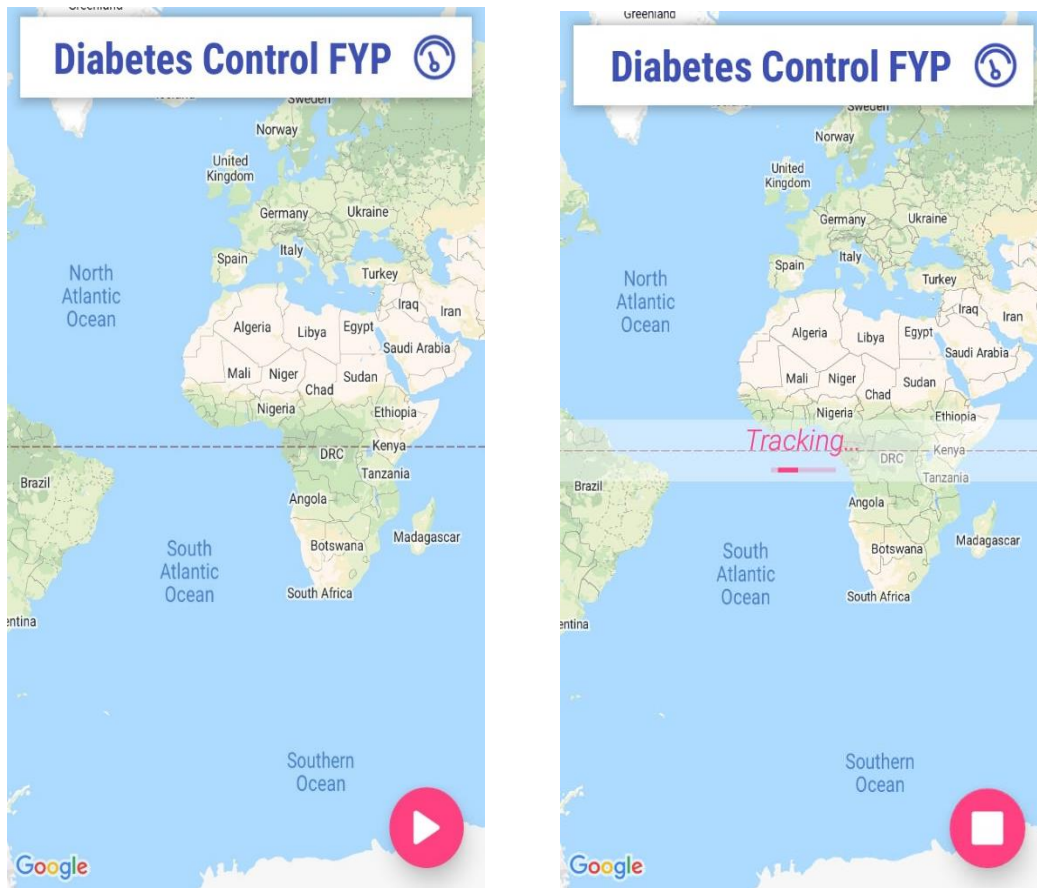


Figure 5.16 Activity Tracker

5.2.8.1 Measurements

In Figure 5.17 user can check the daily and weekly routine track of their exercise and covered distance on measurement section.



Figure 5.17 Measurements

5.3 Summary

In this chapter we discussed about the technologies and tools which we used for designing our system. We also share the screen shots of our application and explain the working of each and every module in detailed.

6 Test and Evaluation

6.1 Introduction

Testing is defined as to finding how something works well and it is used to reassure the quality and standard of product, system and capacity of any website or software in computer or mobile. Testing should be carried out throughout the entire cycle (initial to final). There are two basic foundations of testing.

- Black Box Testing
- White Box Testing

Black box testing is indicated as Behavioural testing. Black box testing is a technique, in which its main focus is on the functionality of whole system and also checks the internal mechanism of the system and creates the output-generated results its focal point. In other words, it focuses on the general results of the system. It is often used for validation.

White box testing is additionally mentioned as structural testing and glass box testing. On contrary to the black box testing, this testing examines mechanism of the system. It is often used for verification. There are several types of testing:

1. Unit testing lies under category of white box testing. In unit testing, tester examines the single unit or groups of similar units. Unit testing is likewise characterized as a sort of programming testing where singular parts of a product are tried. The tester use the unit testing to examine that the unit he or she has chosen produce the expected results or not. The modules that are used in our application are tested and are working completely correct.
2. Integration Testing is applied after unit testing when all units are tested and all components or modules are combined for testing and then tests are applied. This testing may lie under both black box testing and white box testing.
3. System testing is applied by placing whole system completely in different environment to check whether it still works correctly or not. It lies under the category of black box testing. In short it examines the whole system.

So in this chapter we will test our application from different aspects of testing.

6.2 Unit Testing

The main reason of this testing is to check that each function of application working properly/not.

6.2.1 Test Case for User Signup

Test Case: User Signup

Application Name: Diabetes Management System Using Food Recognition

Description: User must be signup successfully

Table 6.1 Signup

S.No.	Action	Required Result	Actual Result
1	Click on Get started button	User signup form has to appear	User signup form appear.
2	Enter details. If user enter invalid info.	Registration is not successful.	Registration not successful.
3	Enter valid details	Registration is successful.	Registration successful.

6.2.2 Test Case for User Login

Test Case: User Login

Application Name: Diabetes Management System Using Food Recognition

Description: User must be able to login successfully

Table 6.2 User Login

S.No.	Action	Required Result	Actual Result
1	Click on the login button	Display the user login form	Login form appeared
2	User enter wrong info.	Enter the correct information	Enter the correct info.
3	User enter information.	Login successfully	Login successfully

6.2.3 Test Case for Calories Recommendation

Test Case: Calories Recommendation

Application Name: Diabetes Management System Using Food Recognition

Description: User must be used calories recommendation

Table 6.3 Calories Recommendation

S.No.	Action	Required Result	Actual Result
1	Click on the calories recommendation option	Display the calories recommendation form	Calories Recommendation form appeared
2	Click on select image button	Mobile gallery display to user	Mobile gallery is open to user to upload picture from it
3	After selecting the image	The path of the image appear in the textbox here	Selected Image is appears on screen.
4	Click on connect server Button	A message from server is displayed on the screen.	A message from server is appears on the screen
5	Click on view Scores Button	Display the details either food is recommended or not	Scores is appears Successfully to the user
6	Click on Graph icon	Graph is display for recommended food or not	Graph is appears on user screen.

6.2.4 Test Case for Medicine Reminder

Test Case: Medicine Reminder

Application Name: Diabetes Management System Using Food Recognition

Description: User must be used Medicine Reminder

Table 6.4 Medicine Reminder

S.No.	Action	Required Result	Actual Result
1	Click on create reminder button	Reminder form displayed to the user screen which take information of medicine from user.	Reminder form appears to the user screen which take information of medicine from user.
2	Click on created reminder	Reminder form displayed to the user screen on which use can edit the information of medicine reminder.	Reminder form appears to the user screen on which use can edit the information of medicine reminder.
3	Click on Delete reminder button	Reminder form displayed to the user screen on which use can delete the information of medicine reminder.	Reminder form appears to the user screen on which use can delete the information of medicine reminder.
4	Click on setting option	Display reminder setting to the user	Setting is appeared to user

6.2.5 Test Case for Activity Tracker

Test Case: Activity Tracker

Application Name: Diabetes Management System Using Food Recognition

Description: User must be used Activity Tracker

Table 6.5 Activity Tracker

S.No.	Action	Required Result	Actual Result
1	Click on start/play button	The progress of Activity tracking is displayed to the user.	The progress of Activity tracking is displayed to the user.
2	Click on stop/pause button	The activity tracking is stop or pause	The activity tracking is stop or pause
3	Click on Measurements option	Daily and weekly activity displayed on the screen	Daily and weekly activity appears on the screen

6.3 Integration Testing

The main purpose of this testing is to check functions after integrating them.

6.3.1 Test Case for Single user

Test Case: Single user

Application Name: Diabetes Management System Using Food Recognition

Description: Single user first login successfully and then can perform all functionalities.

Table 6.6 Single User

S.No	Action	Required Result	Actual Result
1	Click on the login button	Login successfully	Login successfully
2	Click on Calories recommendation option	Calories of food Calculated successfully.	Calories of food Calculated successfully
3	Click on medicine Reminder option	Reminder is created successfully.	Reminder is created successfully.
4	Click on Activity Tracking option	Activity is tracked Successfully.	Activity is tracked Successfully.

6.4 System Testing

The central purpose of this testing is to test functions of whole system.

Test Case: Whole System

Application Name: Diabetes Management System Using Food Recognition

Description: System can work properly.

Table 6.7 Whole System Testing

S.No.	Action	Required Result	Actual Result
1	Click on signup	Signup successfully	Signup successfully
2	Click on login	Login successfully	Login successfully
3	Click on Calories recommendation option	Calories of food Calculated successfully.	Calories of food Calculated successfully
4	Click on medicine Reminder option	Reminder is created successfully.	Reminder is created successfully.
5	Click on Activity Tracking option	Activity is tracked Successfully.	Activity is tracked Successfully.
6	Click on logout button	Logout successfully	Logout successfully

6.5 Summary

In this chapter we discussed about testing and its two basic foundation white box testing and black box testing and also discussed several types of testing too. And also describe the complete description of our system working according to those testing types either our system work properly or not.

7 Conclusion

7.1 Conclusion

This report describes the development and implementation of a software program to improve diabetes management using machine learning and to demonstrate and evaluate its effectiveness in managing diabetes.

After implementing and testing of whole system we can conclude that our application allow users to upload an image to find out if food is recommended for use or not. By using the Mask R- CNN (Convolutional Neural Network) algorithm, a supervised machine learning model for food recommendation system for diabetics in which instance Segmentation identifies separate pixel in the specified picture into possible classes like Foods item in our case while the R-CNN extract an image and spits out three outputs, masks of the identified items, bounding boxes and classes for each mask detected. Also we uses cognitive science to develop user tracking function, user geolocation and keep record of route, and medication reminder for keeping record of medicine. These integrated technologies present advanced solutions for the effective management of diabetes.

Food recognition model achieved the Training Accuracy of 95% and Testing Accuracy of 93.6% for specific calorie intake.

7.2 Future Work

In future, we will further improve our application by adding a platform where a user can easily consult to a doctor and find solution related to their health. In the future our application tracks the client's walk and remains it record however doesn't relate the saved way to the calories consumed. Later on, the calories consumed would be resolved.

Appendix A

List of References

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- [3] <https://play.google.com/store/apps/details?id=com.mydiabetes>
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- [5] <https://play.google.com/store/apps/details?id=com.ffdi>
- [6] https://en.wikipedia.org/wiki/Systems_architecture#cite_note-1
- [7] <https://arxiv.org/pdf/1311.2524.pdf>