Diabetes Management System Using Food Recognition

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SESSION 2017-2021

Diabetes Management Systems Using Food Recognition

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A DISSERTATION SUBMITTED AS A PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF BACHELOR OF COMPUTER SCIENCE

Department of Computer Science

COMSATS University Islamabad

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UNDERTAKEN

We certify that this is our own work. The work has not, in whole or in part, been presented elsewhere for assessment. Where material has been used from other sources it has been properly acknowledged. If this statement is untrue, we acknowledge that we will have committed an assessment offence and shall be liable to punishable action under the plagiarism rules of HEC.

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FINAL APPROVAL

Certified that we have read this project report submitted by Miss.(Riffat Nadeem/Seerat Shafique) and it is, in our judgment, of sufficient standard to warrant its acceptance by Department of Computer Science ,Comsats University Islamabad Attock Campus, for the (BS degree) in Computer Science.

Committee:

1. External Examiner _____

   (Examiner Name)

   Designation

   University Name

2. Supervisor _____

   (Supervisor Name)

3. Chairperson _____

   (Chairperson Name)

4. Dean/Director _____

   (Dean/Director Name)

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..

Next big thanks go to Dr. Muhammad Sardaraz as our Supervisor for this project who given us his kind attention, great advices, brilliant ideas and his guidance for helping us to complete this project from the beginning to the end.

Not forgetting to Comsats University Islamabad Attock Campus mainly the whole faculty of Computer Science and Technology for giving us chance to study here.

Riffat Nadeem

Seerat Shafique

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
STARTED ON	05-SEP-2020
COMPLETED ON	03-DEC-2020
COMPUTER USED	HAIER
SOURCE LANGUAGE	ANDRIOD (Java, Kotlin, XML) PYTHON
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[6] increase the risk of diabetes. Malnutrition leads to obesity (another risk caused by Diabetes) and other health problems.

Our application 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. Our application for this management program addresses a wide range of factors that affect the health and diet of people with diabetes by combining multiple artificial intelligence algorithms. Our application factors the diabetes management problem into sub goals: it allows users to upload an image to determine if food is recommended for use; using the Convolutional Neural Network (CNN) algorithm to recommend food; uses cognitive science to build user tracking function, user geolocation, and medication reminder.

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1. INTRODUCTION

1.1 Brief

Diabetes is a chronic sickness that happens when the pancreas doesn't deliver enough insulin or when the body can't utilize the insulin it produces. Insulin is a hormone that controls glucose. Hyperglycaemia, or high glucose, is a typical result of uncontrolled diabetes and, over the long haul, prompts genuine harm to numerous real frameworks, particularly nerves and veins. In 2014, 8.5% of grownups 18 years of age and older had diabetes worldwide. In 2016, diabetes was the immediate cause of 1.6 million deaths, and in 2012 high blood sugar was the leading cause of 2.2 million deaths.

It is clear that the WHO[1] has reviewed the literature that diabetes is on the rise worldwide in both developed and under developing countries. The vast majority of people living in both developed and under developing countries live on the ground. In addition, although there is confirmation that diabetic issues can be prevented, there are yet people with diabetes who do not have the necessary information and skills to manage and 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 real health problems such as diabetes management.

The Diabetes Management Program aims to determine the nutritional needs of user and recommends diets to fulfil these needs, inform patients to take their medicine on time, identify 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 serious, incurable disease that occurs when the pancreas does not produce enough insulin (a hormone that regulates blood glucose), or when the body cannot use insulin effectively. Elevated blood glucose, a common side effect of uncontrolled diabetes, can eventually lead to serious damage to the heart, blood vessels, eyes, kidneys, and nerves. More than 400 million people are suffering from diabetes.

Type 1 diabetes[1] (formerly known as insulin-dependent diabetes mellitus, adolescence or diabetes) is characterized by insulin production in the body. People with type 1 diabetes need daily insulin administration to control the amount of glucose in their blood. Without insulin, they cannot survive. The cause of type 1 diabetes is unknown and currently cannot be ruled out. Symptoms include excessive urination and thirst, constant hunger, weight loss, mood swings and fatigue.

Type 2 diabetes (formerly called insulin-dependent or old-fashioned diabetes mellitus) results from ineffective insulin use. Type 2 diabetes causes the majority of people with diabetes worldwide. Symptoms may be similar to type 1 diabetes, but they are usually less or less marked. As a result, the disease may go undiagnosed for several years, until complications develop. For many years, type 2 diabetes has been seen only in adults but has begun to occur in children. Impaired glucose tolerance (IGT) and dysfunction of glycaemia (IFG) are intermediate conditions with changes between normal blood glucose levels and diabetes (especially type 2), although changes are inevitable. People with IGT or IFG are at greater risk of heart attack and stroke.

Gestational Diabetes (GDM) is a temporary condition that occurs in pregnancy and carries a long-term risk of type 2 diabetes2. A condition exists when blood glucose levels are above normal but below that of a diabetic diagnosis. Women with gestational diabetes are at greater risk of complications during pregnancy and childbirth, as are their babies. Pregnancy diabetes is diagnosed by prenatal testing, rather than reported signs.

1.4 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.

1.5 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 various reasons suggested to explain why, despite providing an education and management program for diabetics, many people are unable to achieve the desired clinical outcomes. To develop an application, that is faster easy to use, simple, handy, effective and advanced application that is time saving.

The terms used in combination include ‘type 2 diabetes mellitus’, ‘self-care’ and ‘patient follow-up’. It is therefore important to identify barriers to self-care from the perspective of providers and patients because they work as a team to achieve healthy goals.

Diabetes-related complications were common among patients and providers perceived these disorders. However, providers report that they do not have the resources to manage patients' mental health problems, and only a few patients (10%) report receiving psychotherapy.

1.6. Methodology and Software Lifecycle for This Project

- We would be using Agile Model because Requirements of Software agile methodology after every development iteration, the customer is able to see the result and understand if he is satisfied with it or he is not.

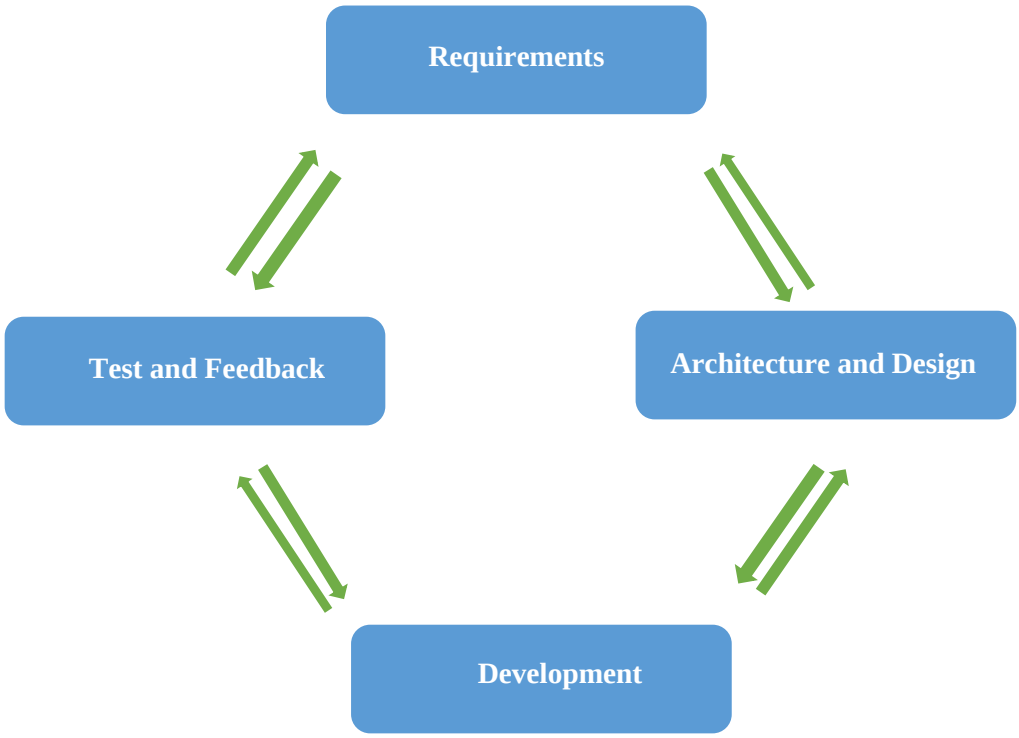

Figure 1.1 Software Lifecycle

- Once the core features have been fully developed, then this is refined to increase skills levels by adding new functions to successive versions. Each additional type is usually constructed using a waterfall development model.

1.6.1 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.

2 PROBLEM DEFINITION

2.1 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[2] has reviewed the literature that diabetes is on the rise worldwide in both developed and developing countries. The vast majority of people living in both developed and developing countries sit on the ground. In addition, although there is evidence that diabetic complications can be prevented, there are still people with diabetes who do not have the necessary knowledge and skills to manage their condition using available health-care technologies and lifestyle changes.

Changing lifestyles requires deliberate effort. Therefore, diabetics should take greater responsibility for their care and treatment using available technology-related programs. Technologies such as dietary recommendations, physical activity monitoring and tracking, drug awareness systems.

2.2 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 REPORT:** A complete Project Report that includes Software Requirements Specification, Software Design Specification, GUI Methods, Test Cases, and other major tasks we have undertaken.

2.3 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.

2.3.1 OS Requirement

Android devices.

2.3.2 Application Requirements

Android studio, Android Virtual Device.

2.3.3 Other Requirements

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

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

- Track and almost all aspects of the diabetes treatment
- Keep diabetes under control and provide detailed report charts

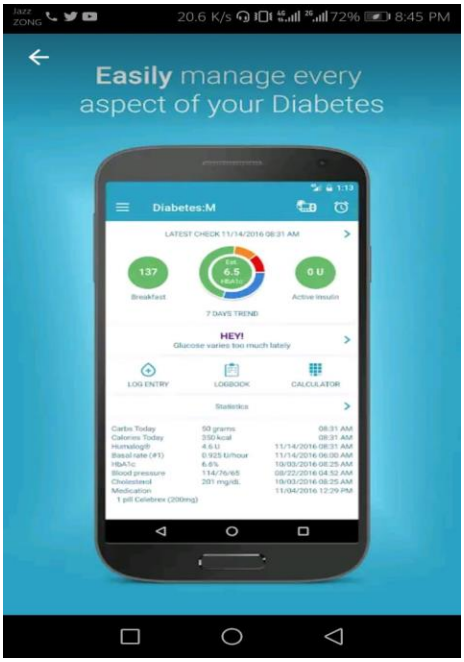

Figure 2.1 Interface of Diabetes M app

The application tracks almost every aspect of diabetes treatment and provides you with detailed reports, charts and statistics. You can email your presiding physician by email. Diabetes: M[3] also provides you with a variety of tools, so that you can determine your blood glucose levels and allow you to gain insight into normal and long-term insulin bolus using its highly effective Bolus Advisor.

It also has a large database of diets, to help you keep track of your food and diet details, and exercise time. Never forget another check with our simple but powerful reminders program.

2.4.2 mySugr-Diabetes App & Blood Sugar

The mySugr Diabetes App is your loyal and free diabetes logbook, which keeps your diabetes data under control. With one app you'll have:

- Blood sugar tracker
- Carb logger
- Insulin calculator (EU only)
- Estimated HbA1c

Adding the mySugr Diabetes[4] App to your daily routine with diabetes (Type 1, Type 2, or Gestational diabetes) will make your life easier. It auto-logs your data plus you can collect your daily therapy info such as:

- Meals
- Diet
- Meds
- Blood glucose levels
- Insulin levels

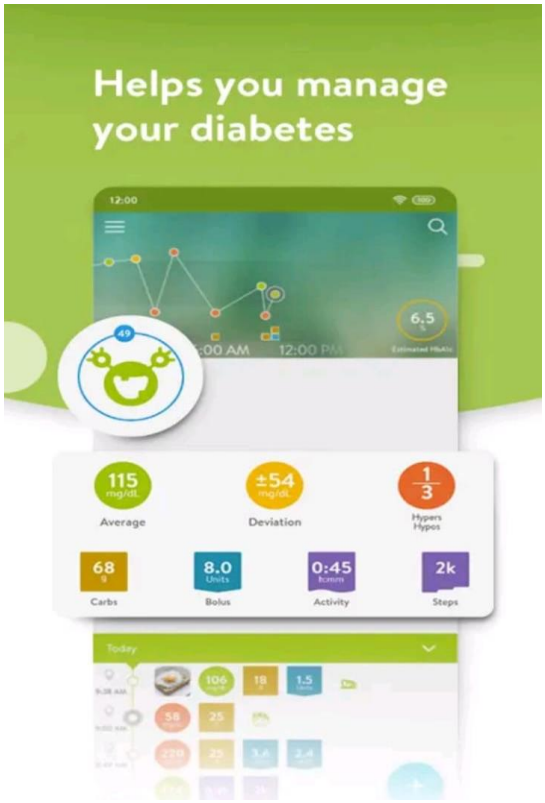

Figure 2.2 Interface of mySugr-Diabetes app

2.4.2.1 App features

- Simple and personalized dashboard (food, medals, carb diet, food, blood sugar levels and more).
- Clear blood sugar graphs.
- Rated HbA1c at a glance, no longer surprising.
- Motivating challenges and feedback.
- Daily, weekly and monthly medical analysis.
- Detailed reports from your doctor.
- Secure data security (built in accordance with law, quality and security).

2.4.3 Freedom from Diabetes

This app can provides

- Education
- Inspiration
- Support to registered diabetic patients

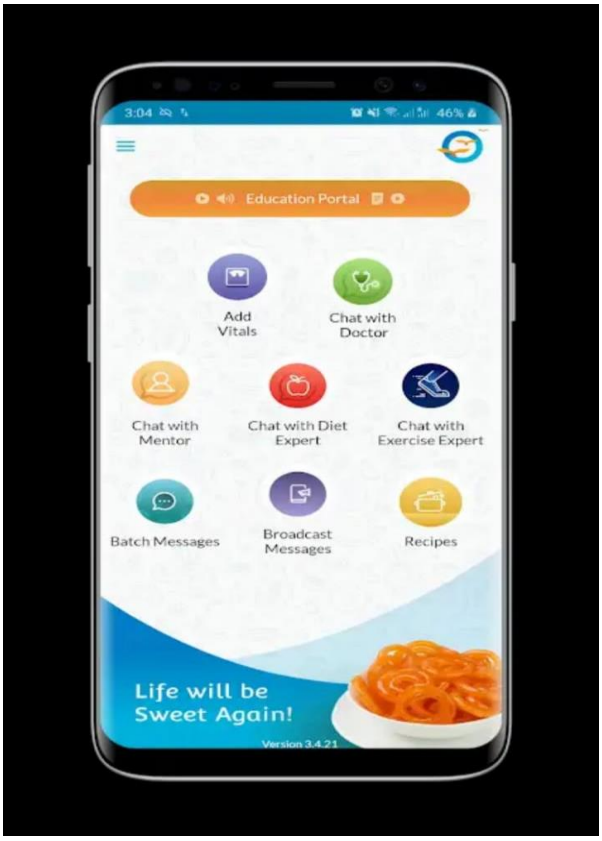

Figure 2.3 Interface of Freedom from Diabetes app

This app provides education, inspiration and support for diabetics around the world, through a simple, unique approach by staying in touch with a team assigned to doctors, and dietitians.

Free users, receive daily messages related to diet, exercise, proper work, freedom issue, etc. They can keep a record of blood sugar levels and other important things like BP and weight. They also consult a Freedom[5] Doctor for a limited time.

Paid users, can contact their designated doctors and submit their blood sugar levels, diet details and exercise information. They can also contact their assigned counsellor for help and ethical support when needed.

3 REQUIREMENT ANALYSIS

3.1. Use Case Diagram

We are going to discuss the interaction of different actors with the proposed system, and the functional and non-functional requirements 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.

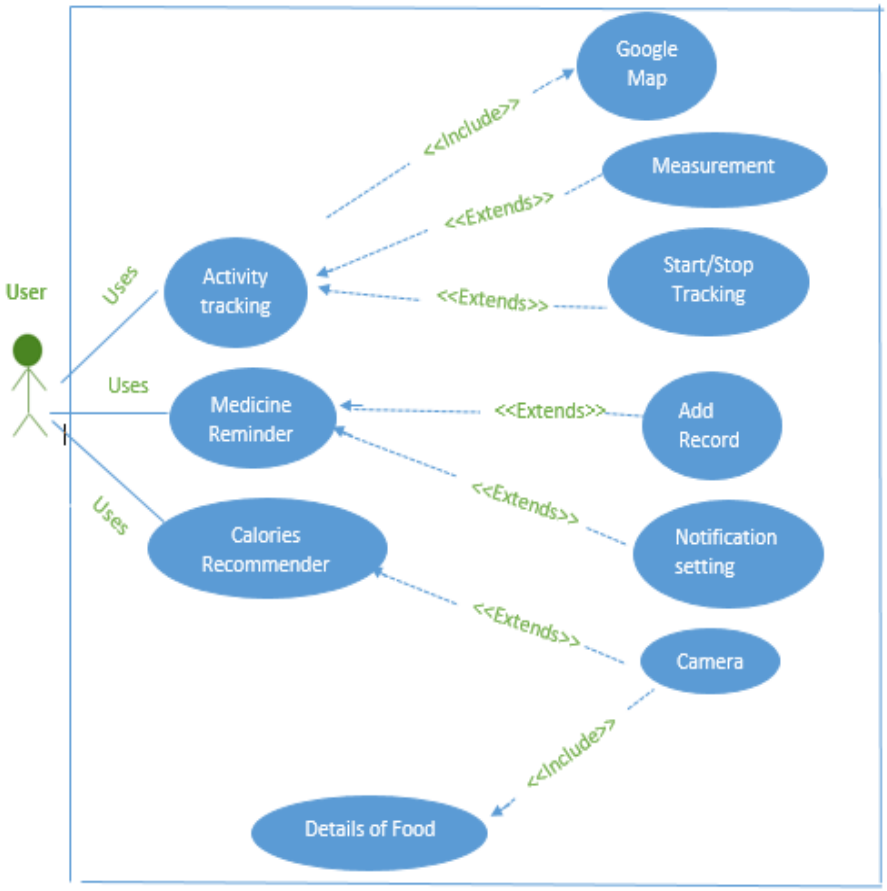

Figure 3.1 Use case Diagram of our System

3.2. Detailed Use Case

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

3.2.1: Activity Tracking

User can:

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

3.2.2: 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

3.2.3: Calories Recommender

User can:

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

3.3 Functional Requirements

Functional requirements will tell us the behaviour of our system functionalities and tasks that our system will perform. Functional requirements are those requirements that our system must do. The functional requirements of our system include Activity Tracking, Medicine Reminder, and Calories Recommender.

3.3.1 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	• User must allow permission to access his location. • User must start tracking and stop tracking
Priority	Medium

3.3.1 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	• User can add record about their medicine • User can set timings of notifications.
Priority	Medium

3.3.2 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	• User must allow permissions to camera to access gallery and photos. • User must initiate the camera for food detection.
Priority	High

3.4. Non-Functional Requirements

Non-operative requirement (NFR) that requirement specifies the methods that can be used to judge system performance, rather than specific conduct. They are compared to performance requirements that define a specific behaviour or activities.

3.4.1. 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.
Understandability	The design and overall architecture of the website will be easily understandable.

4. Design and Architecture

4.1 System Architecture

In Figure 4.1 the system architecture diagram 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.

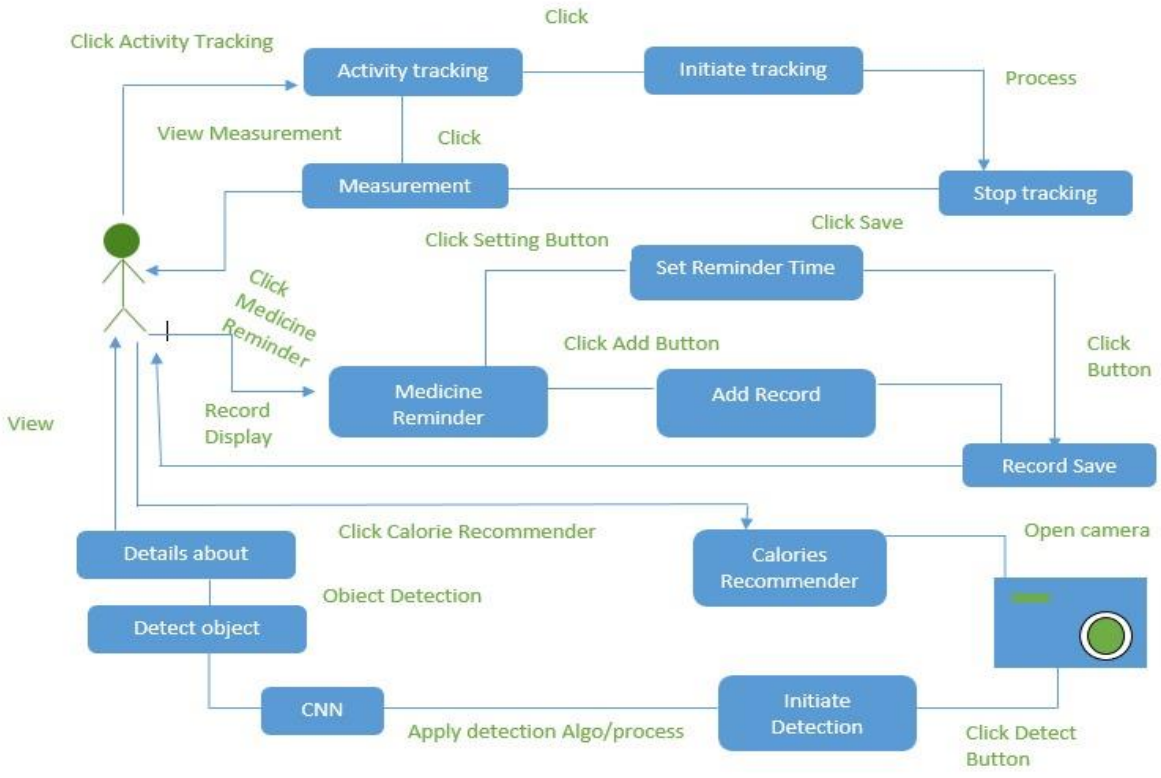

Figure 4.1 Block Diagram of our System

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**.**

4.2 Process Flow/Representation

Following is a data flow diagram of our system which includes level 0, and level 1 data flow diagrams of the system.

4.2.1 DFD level 0

Figure 4.2 shows the level 0 data flow diagram of our system. The 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.

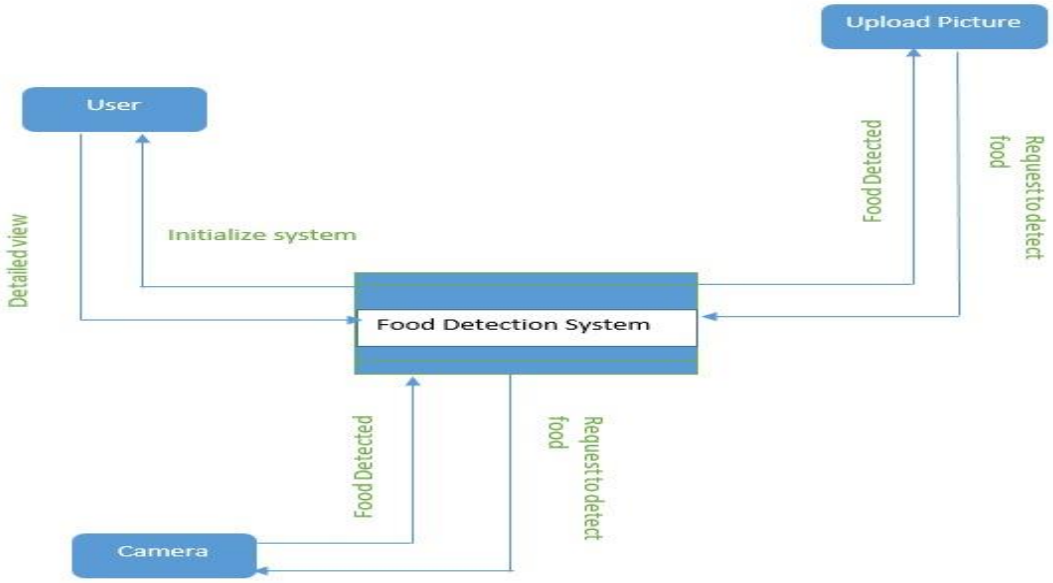

Figure 4.2 DFD Level 0

4.2.2 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.

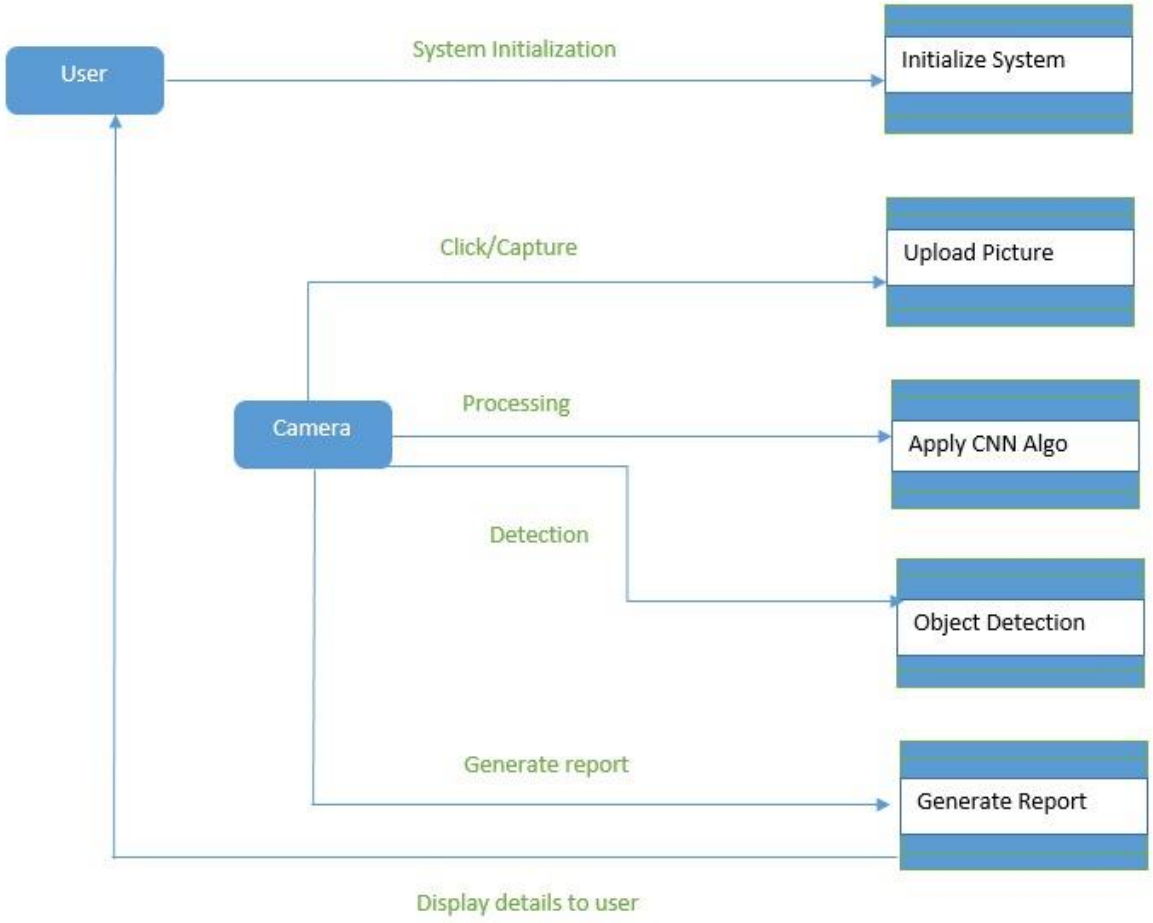

Figure 4.3 DFD Level 1

4.3 Design Models [along with descriptions]

Following models are design models of our system.

4.3.1 Sequence Diagram

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.

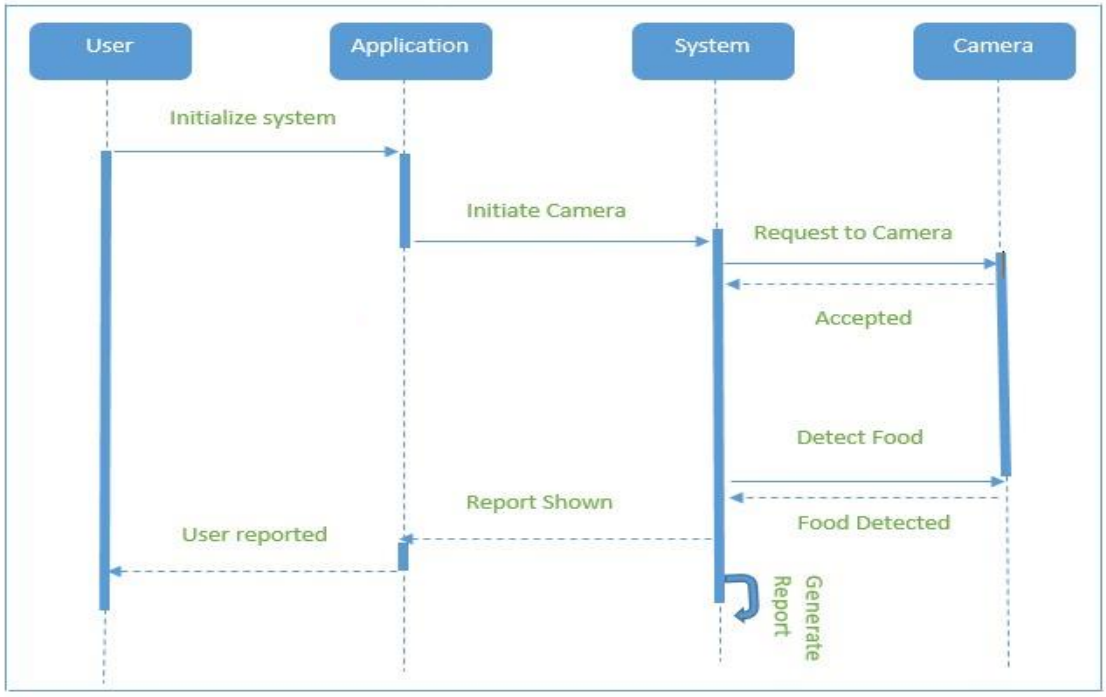

Figure 4.4 Sequence Diagram of Calories Recommender

4.3.2 Activity diagram

Figure 4.5 shows the activity diagram of the user. 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.

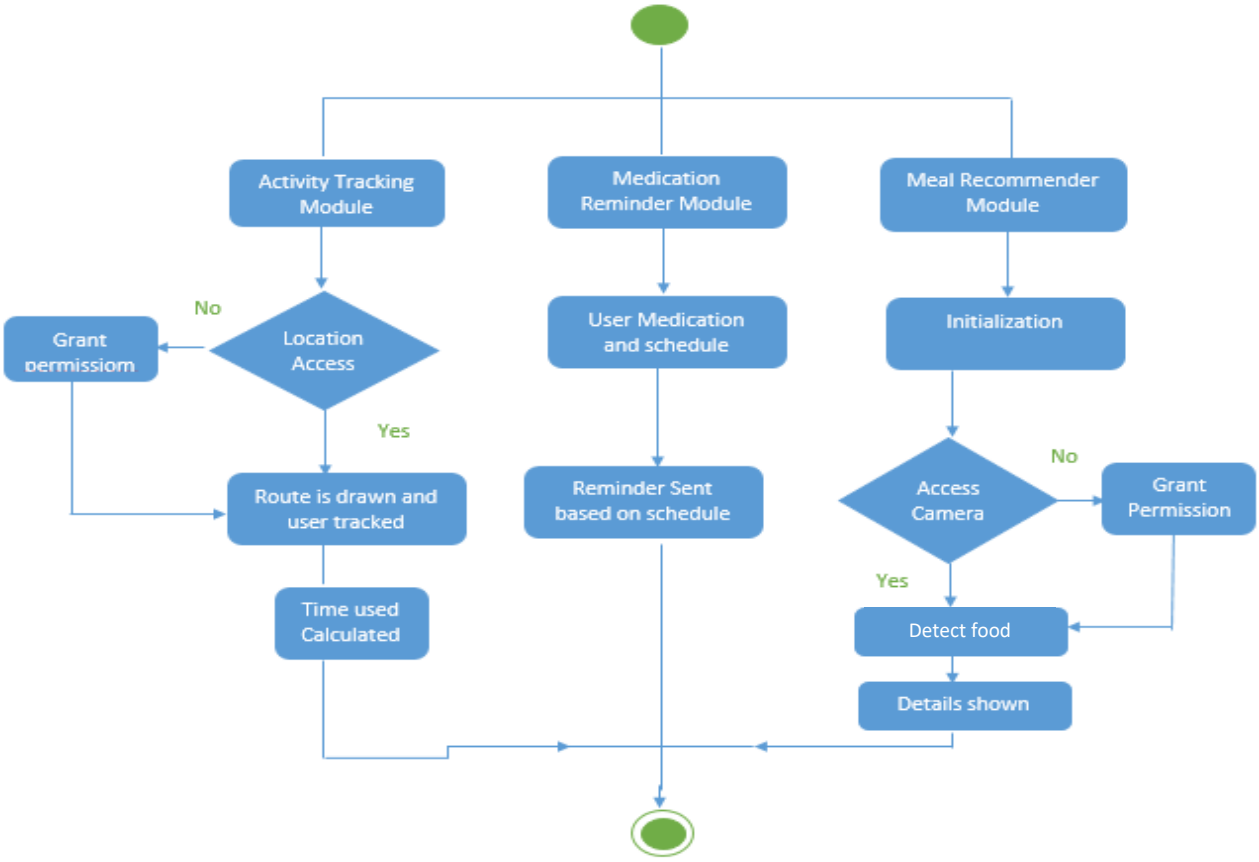

Figure 4.5 Activity Diagram of our System

4.3.3 Class Diagram

Figure 4.6 shows the classes and relationships between user and activity tracker class and calories recommender class.

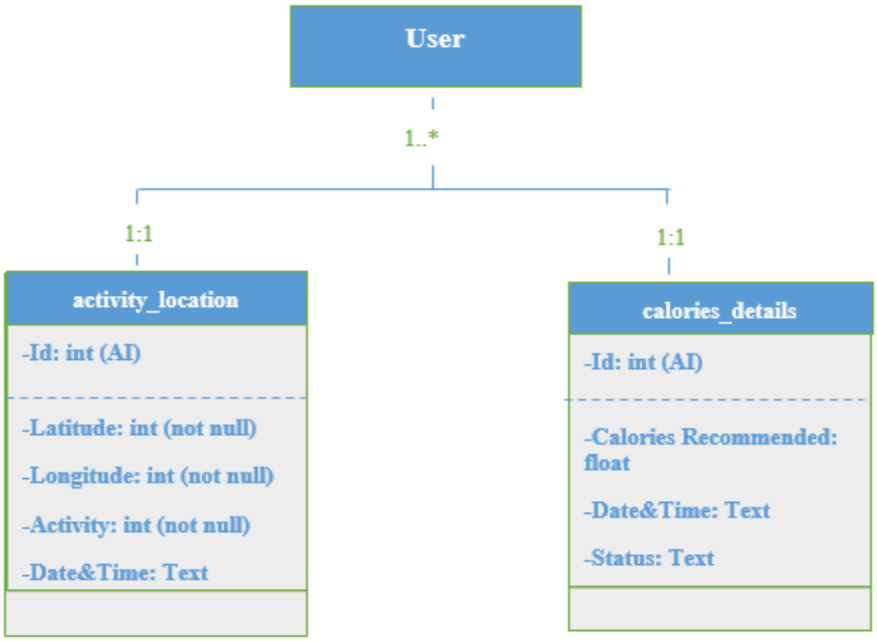

Figure 4.6 Class Diagram

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