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Conception and realization mobile application for diabetes monitoring Case : patient

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بسم الله الرحمن الرحيم

I dedicate this modest work to all my family especially, my idol in life, my mother.the first man in my life, My best friend to my father.

Special mention to my backup team, my sisters Siham, Zahra, wessal, oumaima and jory. My brothers khaled and youcef, for being there for me and for everything, i couldn't do it without them. Special dedication to my best friend and twin to khaoula, for all the support, love and encouriging i got . Last and not least, to my collegues, my friends in the campus, thank you for the wonderfull journey.

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ABSTRACT

Abstract

It is always difficult, when you have an idea of application, to know which tools to use to realize it. Nowadays, it has become essential to provide an application on the largest existing platforms (ie IOS and Android) but it is however not conceivable to create an application for every target platform.

Among the most used and popular applications are telehealth and telemedicine applications in times that provide services that require medical care.

The purpose of the thesis is to create "Healthy" a mobile android application for monitoring diabetes."Healthy" is an interface between the patient and his dietitian and his diabetologist in order to make the access to the medical care easier and remotely.This is going to be theoretically explained and then practically.

Key words :

Mobile Application, Smartphone, Android, Diabetes monitoring, Blood sugar, Java.

Résumé

Il est toujours difficile, quand vous avez une idée d'application, de savoir quels outils utiliser pour la réaliser. Aujourd'hui, il est devenu essentiel de fournir une application sur les plus grandes plates-formes existantes (c'est à dire IOS et Android), mais il n'est cependant pas concevable de créer une application pour chaque plate-forme cible.

Parmi les applications les plus utilisées et les plus populaires sont la télésanté et la télémédecine applications dans les moments qui fournissent des services qui nécessitent des soins médicaux.

Le but de ce mémoire est de créer "Healthy" une application mobile Android pour le suivi du diabète."Healthy" est une interface entre le patient et son diététicien et son diabétologue afin de rendre l'accès aux soins médicaux plus facile et à distance. Cela va être expliqué théoriquement et ensuite pratiquement.

Mots clé :

Application mobile, Smartphone, Android, Suivi Diabetes, Glucose, Java.

ملخص

من الصعب دائما، عندما يكون لديك فكرة عن التطبيق، أن تعرف أي أدوات للاستخدام لتحقيق ذلك. في الوقت الحاضر، أصبح من الضروري توفير تطبيق على أكبر المنصات الحالية ولكن من غير الممكن تصور إنشاء تطبيق لكل منصة مستهدفة.

ومن بين التطبيقات الأكثر استخداماً والأكثر شعبية تطبيقات الصحة عن بعد والتطبيب عن بعد في الأوقات التي تقدم الخدمات التي تتطلب الرعاية الطبية.

الغرض من الأطروحة هو إنشاء "صحي" تطبيق الروبوت المحمول لمراقبة مرض السكري." صحي" هو واجهة بين المريض وأخصائي التغذية له وأخصائي السكريات له من أجل جعل الحصول على الرعاية الطبية أسهل وعن بعد. هذا سوف يتم شرحه نظرياً ومن ثم عملياً.

كلمات مفتاحية :

تطبيق للهاتف, هاتف ذكي, أندرويد, مرض السكري, نسبة السكر في الدم, الجافا.

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LIST OF ABBREVIATION

- WHO : World Health Organization.

- NGSP : National Glycohemoglobin Standardization Program.

- DCCT : Standardized to the Diabetes Control and Complication Trail.

- SDK : Software Developpment Kit.

- API : Application Programming Interface.

- DB : Data Base.

- UML : Unified Modeling Language.

- IDE : Integrated Development Environment.

- ADB : Android Debug Bridge.

- RDN : Registered Dietitian Nutritionists.

- ICT : Information and communications technology.

During this challenging time and with the spread of the COVID-19 pandemic, it has become increasingly clear the primary need for technology (iOS and android platforms, AI,. . .) to preserve and protect public health. Diabetics are one of the sections affected during this quarantine, medical appointments are associated with costs just like dieticians, and the economic impact of diabetes should not be underestimated. As access to health care is too expensive for some people, it becomes necessary to find a new way.

A smartphone could be used to achieve this function with the right application smartphone are capable of helping people with their health care.

The reason to prefer mobile application development over classic desktop development is the fact that mobile usage grows and grows faster each year while the usage of large desktop devices decreases.

Fast pace of the evolution of modern technology has increased the speed of progress in mobile programming as well. The software required by mobile devices that was not so long ago needed to write from scratch, has become widely available in the form of mostly free-source blocks of code. This has broadened the options and possibilities of what an Android programmer can achieve. The speed of the evolution of the Android platform has reached such levels that even normally short periods of time such as a year or two could mean tremendous differences between the Android releases. It is nearly impossible, but still important, to track this evolution thoroughly as the advancement fastens each year.

Mobile development is experiencing very huge extension, android applications are used in all fields as: social media, online shopping, games, marketing, medicine, etc. with the aim of facility and improving accessibility to health care by making data travel rather than patients and expertise instead of experts through data transfers.

It is in this context that our project is situated, after a study on mobiles applications techniques and its development tools, we developed "Healthy" which is a diabetes monitoring android

application , an interface between the patient and his doctor, by trucking blood sugar levels (the concentration of glucose in the blood) and comparing it with the normal levels, and that will helps with collecting data for future studies. For achieving our project final goals, our memory is composed of three chapters which are structured as follows:

- The first chapter consists an introduction and definition

- The second chapter concern the analysis and conception of our application .

- In the last chapter we present the app implementation,and description for the patient activities, finally we will have a general conclusion.

CHAPTER 1

INTRODUCTION AND DEFINITION

1.1 Introduction

The project is based on monitoring diabetes. The use of the telemedicine with diabetes made the access to medical care easier, it is therefore not intended to replace face to face doctor's visit.

Our main objectives of "Healthy":

- Improving self-care, by changing old ways of pen and paper for tracking daily blood sugar level and manually comparing it to normal state. Using this Application can motivate patients and make these routine methods easier and efficient.

- Saving expensive costs and precious time: in this difficult situation, appointment with doctor and dietitian can be expensive and a lot of time can be lost while waiting for an appointment or while waiting for the consultation in the waiting room, using "Healthy" can save time and help collect data and share it with medical staff,it can also update shared data ans save money by reducing the number of medical tests and the number of doctor visits.

- Support Studies and research: one of the main goals of "Healthy" app is to collect data from tests results of patients, which can help researchers to gather valuable information to create studies, improve old treatment and maybe creating new effective one.

In the first part of this chapter, we present an overview of the Android mobile app, the operating system and the used database Firebase. In the second part, we will give an overview of telemedicine and diabetes with statistics and show diabetes symptoms, diagnosis, types and treatment.

1.2   Mobile application

1.2.1   Definition

A mobile application, also referred to as a mobile app or simply an app, is a computer program or software application designed to run on a mobile device such as a phone, tablet, or watch. "Apps are generally downloaded from application distribution platforms which are operated by the owner of the mobile operating system, such as the App Store iOS (Apple platform) or Google Play Store (Google platform /Android)".[1]

1.2.2   The objectives of mobile application

A smartphone application can be effective to use an already existing service, to communicate, find information, exchange...
Today there is a very wide variety of mobile applications:

- Entertainment (games apps, music apps ...etc.).

- Communication (social networks apps, Email).

- Commerce (online stores, online shopping).

- Medical apps.

- weather forecast.

- GPS apps.

1.2.3   The types of mobile application

1- Native application

native app are developed for a single mobile operating system."Main advantage of native apps is high performance and ensuring good user experience as developers use native device UI. Moreover, an access to wide range of APIs that puts no limitation on app usage. Native applications are distinctly accessible from app stores".[2]

2- Web application

web app are software applications that behave in a fashion similar to native applications. "Web apps use a browser to run and are usually written in HTML5, JavaScript or CSS. These apps redirect a user to URL and offer "install" option by simply creating a bookmark to their page".[2]

3- Hybrid application

Hybrid app are built using multi-platform technologies, this kind of apps are fast and relatively easy to develop.
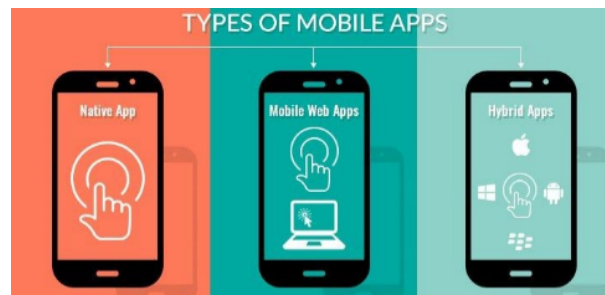
Figure 1.1: Types of mobile apps. [24]

1.3   Mobile operating system

1.3.1   Definition

Mobile operating system (OS) is software that allows smartphones, tablet PCs (personal computers) and other devices to run applications and programs.[4]

1.3.2   Types of mobile operating systems

There are numerous mobile device operating systems available today, and four of the most widely adopted are :

- Google Android.

- Apple iOs.

- Microsoft windows phone.

- BlackBerry OS .[5]

Figure 1.2: Mobiles operating Systems. [26]

1.4   Android operating system

1.4.1   What's android ?

Android is an open source and Linux-based Operating System for mobile devices such as smartphones and tablet computers. Android was developed by the Open Handset Alliance, led by Google, and other companies.

"Android offers a unified approach to application development for mobile devices which means developers need only develop for Android, and their applications should be able to run on different devices powered by Android."[9]

1.4.2   Why Android ?
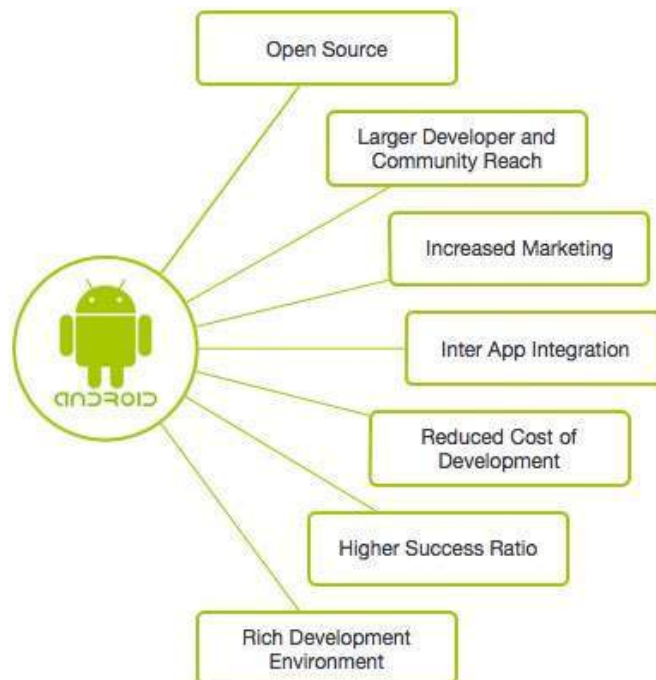
Figure 1.3: Android features [9]

1.4.3   Architecture of Android platform

"Android is an open source, Linux-based software stack created for a wide array of devices and form factors"[8]. The following diagram shows the major components of the Android platform:

- The Linux Kernel.

- Hardware Abstraction Layer (HAL).

- Android Runtime.

- Native C/C++ Libraries.

- Java API Framework.

- System Apps.[8]
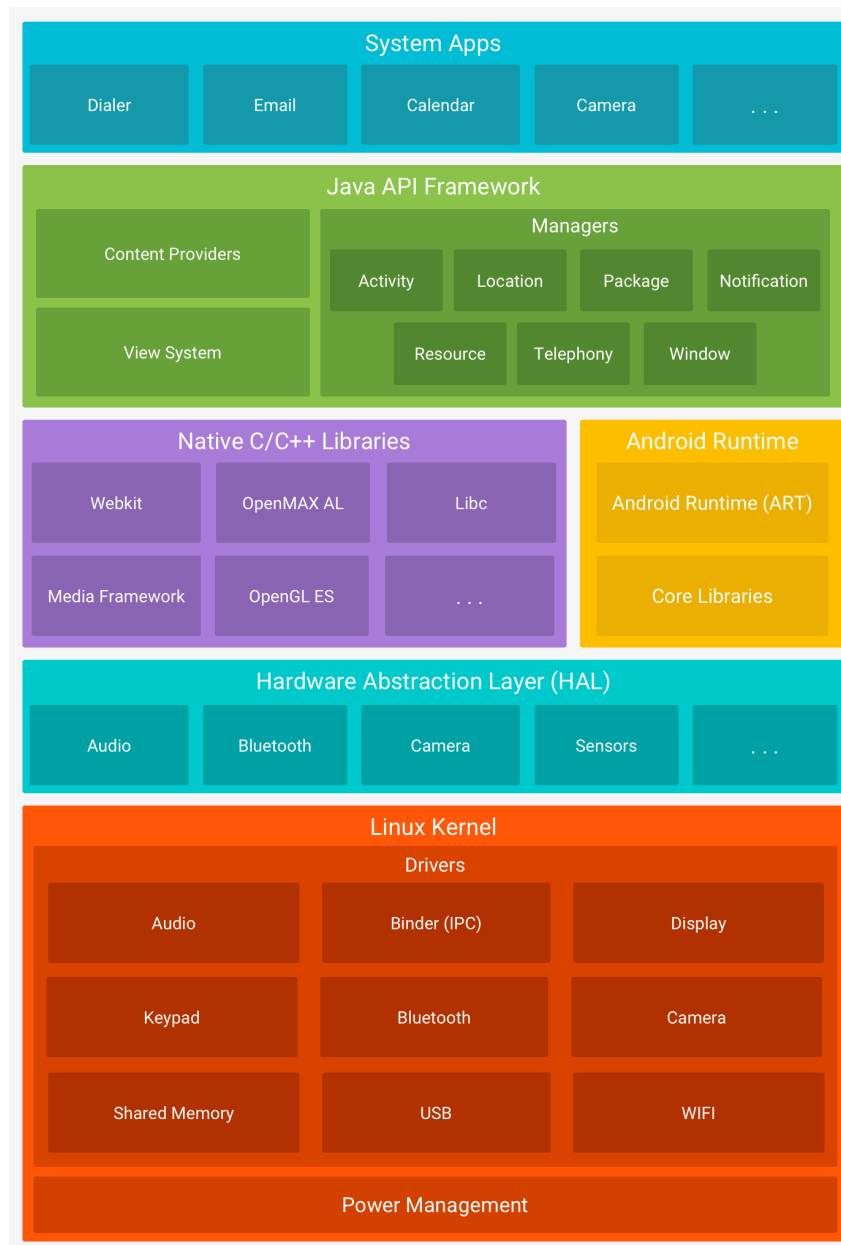
Figure 1.4: Architecture of Android platform [23]

1.4.4 What Is the Android SDK ?

The Android SDK is a collection of software development tools and libraries required to develop Android applications.

"The Android SDK comprises all the tools necessary to code programs from scratch and even test them".[9]

1.4.5 What Is the SDK Manager ?

The Android SDK is composed of modular packages that you can download, install, and update separately using the Android SDK Manager. The SDK Manager helps to update new SDK releases and updates whenever a new Android platform is released.[9]

1.4.6 What is Android Activity Life Cycle ?

As a user navigates through the app, Activity instances in your app transition through different stages in their life-cycle. The Activity class provides a number of callbacks that allow the activity to know that a state has changed: that the system is creating, stopping, or resuming an activity, or destroying the process in which the activity resides.[10]
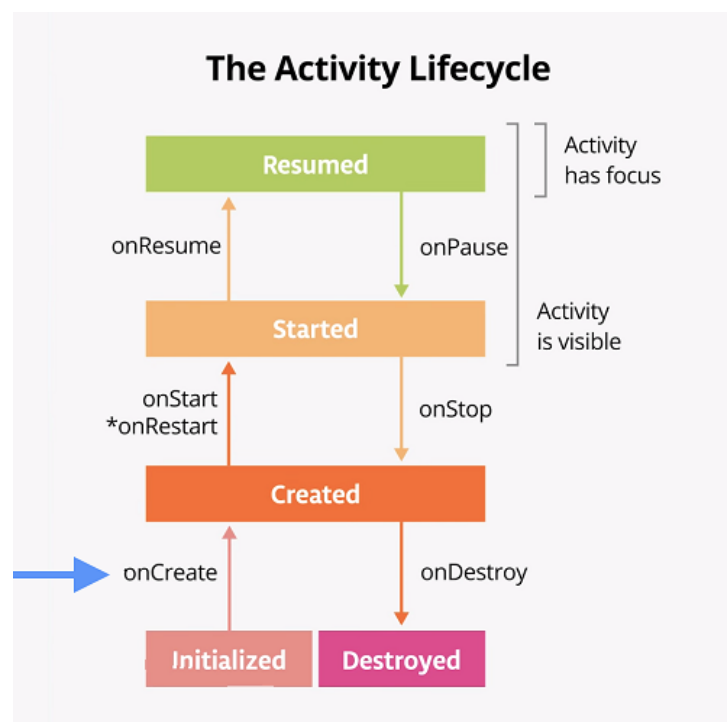
Figure 1.5: The lifecycle of Android activity. [25]

1.4.7   Life Cycle Methods and Callbacks

In general, activity lifecycle has seven callback methods:

- 1- onCreate(): In this state, the activity is created.

- 2-onStart(): This callback method is called when the activity becomes visible to the user.

- 3-onResume(): The activity is in the foreground and the user can interact with it.

- 4-onPause(): Activity is partially obscured by another activity. Another activity that's in the foreground is semi-transparent.

- 5-onStop(): The activity is completely hidden and not visible to the user.

- 6- onRestart(): From the Stopped state, the activity either comes back to interact with the user or the activity is finished running and goes away. If the activity comes back, the system invokes onRestart().

- 7- onDestroy(): Activity is destroyed and removed from the memory.[10]
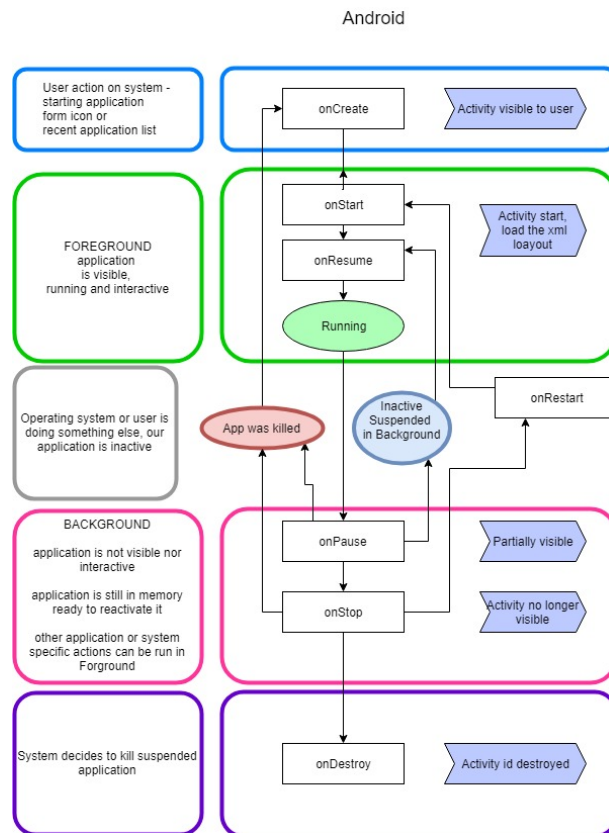
Figure 1.6: The lifecycle of android application. [29]

1.5 The telemedicine

1.5.1 Definition

" Telemedicine, a term coined in the 1970s, which literally means "healing at a distance", signifies the use of ICT to improve patient outcomes by increasing access to care and medical information "[11].

Telemedicine uses new technologies as a means of communication between healthcare professionals and one or more patients with distance and the help of a medical professional.
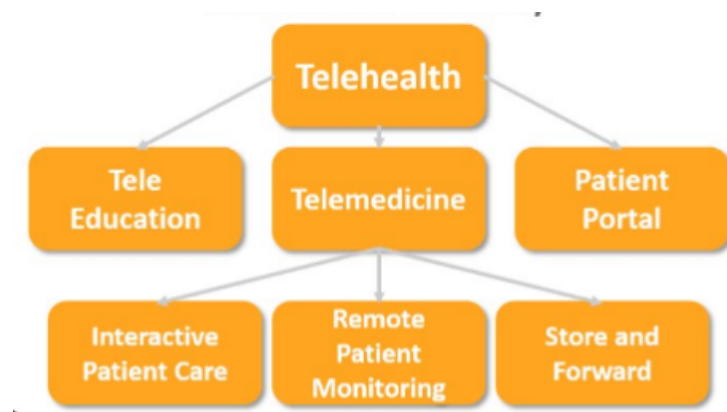
Figure 1.7: Telehealth general schema. [27]

1.5.2 The advantages of telemedicine

Being healthy today can be challenging and expensive sometimes, and stressful at times for the healthcare provider therefore telemedicine makes it easier and more convenient, and this some of its advantages:

- Increases access to health care .

- Improves quality of care delivery .

- Reduces healthcare costs.

- Enhances traditional face-to-face medicine.

- Improves patient engagement and satisfaction.[12].

1.6   The diabetes

1.6.1   Definition

"Diabetes is a chronic disease characterized by elevated levels of blood glucose(or blood sugar), which leads over time to serious damage to the heart, blood vessels, eyes, kidneys and nerves".[13].

Diabetes has become a worldwide health problem, the global estimated prevalence approaches 10 percent and the burden of this disease in terms of morbidity and mortality is unprecedented.

"In 2014, 8.5 percent of adults aged 18 years and older had diabetes. In 2016, diabetes was the direct cause of 1.6 million deaths and in 2012 high blood glucose was the cause of another 2.2 million deaths".[14].

The advances acquired through the knowledge of the mechanisms of the disease and the variety of therapeutic approaches contrast with the inability of private and public health systems in underdeveloped and even developed countries to achieve the goals of treatment.

1.6.2   The symptoms

The diabetes symptoms can be change from person to another, and those are some of the sign:

- Increased thirst .

- Frequent urination.

- Extreme hunger.

- Unexplained weight loss.

- Presence of ketones in the urine.

- Fatigue.

- Irritability[14].

Figure 1.8: The symptoms of diabetes. [28]

1.6.3 Diabetes diagnosis

Diabetes can be diagnosis with different tests, as fasting sugar blood tests or with A1c blood tests, also known as glycated haemoglobin tests. A fasting blood sugar test is performed after the patient fast for at least 8 hours, and the normal result for fasting blood sugar is less than 100 mg/dl (5.6mmol/l).[15]. " A1C test should be performed in a laboratory using a method that is certified by the NGSP and the DCCT."[15].

Table 1.1: Table of blood sugar levels for normal, pre-diabets and diabetes test

Type of test	Normal	Pre-diabetes	Diabetes
Fasting glucose test	Less than 100	100-125	126 or higher
Random glucose test	Less than 140	140-199	200 or higher
A1c test percent	Less than 5.7	5.7-6.4	6.5 or higher

1.6.4 The diabetes Types

Type 1 diabetes

Type 1 diabetes can develop at any age, but occurs most frequently in children and adolescents. When you have type 1 diabetes, your body produces very little or no insulin, which means that you need daily insulin injections to maintain blood glucose levels under control.[15].

Type 2 diabetes

Type 2 diabetes (formerly called non-insulin-dependent, or adult-onset) results from the body's ineffective use of insulin. The majority of people with diabetes have type 2 diabetes. This type of diabetes is largely the result of excess body weight and physical inactivity.

Until recently, this type of diabetes was seen only in adults but it is now also occurring increasingly frequently in children.[15].

1.6.5   The diabetes health impact

According to the statistics,diabetes can cause a lot of complication and damage such as:

- Adults with diabetes have a two- to three-fold increased risk of heart attacks and strokes [16].

- Combined with reduced blood flow, neuropathy (nerve damage) in the feet increases the chance of foot ulcers, infection and eventual need for limb amputation.

- Diabetic retinopathy is an important cause of blindness, and occurs as a result of long-term accumulated damage to the small blood vessels in the retina. Diabetes is the cause of 2.6 percent of global blindness [17].

- Diabetes is among the leading causes of kidney failure [18].

1.6.6   The diabetes Treatment

Controlling blood sugar (glucose) levels and keeping it in the normal levels is the major goal of diabetes treatment, in order to prevent the damage of the disease.

Treatment for type 1 diabetes is managed with insulin medications as well as nutrition system changes and exercise.

Treatment for type 2 diabetes can be managed with non-insulin medications, weight reduction, or dietary changes.

1.6.7   The diabetes dietitian

What is an RDN

A RDN (Registered dietitian nutritionists) or diabetes dietitian offers specialist evidence-based dietary advice to patients with diabetes while considering factors including nutritional status, medication, diabetes control and lifestyle.

How an RDN Can Help with Diabetes

Diabetes affects the body's ability to make or properly use insulin. This leads to high blood glucose (sugar) in the blood. Maintaining a healthy blood sugar level is key to managing diabetes. Choosing nutritious foods and watching portion sizes can help patients control blood sugar levels. And, a registered dietitian nutritionist, or RDN, can help patients learn how to get the nutrients you need.

1.6.8 Diabetes and COVID-19

The World Health Organization has declared that older people and people with pre-existing medical conditions (such as diabetes, heart disease and asthma) appear to be more vulnerable to becoming severely ill with the COVID-19 virus. When people with diabetes develop a viral infection, it can be harder to treat due to fluctuations in blood glucose levels and, possibly, the presence of diabetes complications.[19].

1.7 Conclusion

In this chapter,and in the first part we briefly presented mobile computing and the Android world while describing the Android system, its architecture and the evolution of its versions over time from its appearance to the current version. Then in the second part we highlighted the telemedicine and its advantages, and showed a future vision where the technology (Android application, IA ...) will dominate the medical field. Then we gave short definition about diabetes and its symptoms, health impact, its types and how doctors diagnose it, then treat it. We dragged some statistics about diabetes according to the WHO. We updated these information with the last information about how COVID-19 effect diabetics. In the next chapter, we will present the analysis phase and the conception of our project.

CHAPTER 2

ANALYSIS AND CONCEPTION

2.1 Introduction

In this chapter, we give an overview of the work done in the field of smartphone health-care, with comparison between the different functions used, followed by presentation of our objectives while focusing in diabetes, and illustrate the design phase of our application with UML..

2.2 Related works

There are several applications developed in smartphones to monitor diabetics, we present among them :

2.2.1 mySugar

Mysugar app can help patients to track their blood sugar, medication and nutrition, they can also get medical advice from the app, it can be installed on android and iOS and offers information for diabetes users.

2.2.2 Diary apps

In Diary apps application we find that there's a section to save patients medicals information, such as the blood glucose level and body-weight.Some of them also track activities and the users' mood. Most of them present the data, they also make the user's data available on other hardware.[20]

2.2.3 Comparison and solution suggestion

Lot of other application in the field can be listed here, that's show the possibilities and the bright future of smartphones to be used as a medical equipment.People could get medical ad-

vice's without visiting the doctor. This can also be improved the humans life around the world specially the in country with the lack of doctors.

However, the most of the applications are "glossaries of clinical information", containing profound or basic knowledge, and these applications could be useful in societies with little medical regulation.

The new in our application is:

- trying to solve "lack of clinical information" by adding doctors and specialist as users to the application, and that will help us to know more about clinical information,and we can develop and update the application.

- solving the "societies with little medical regulation" problem with the ability of sharing the patient his data with doctors and expertise oversea and getting medical advice's without traditional face-to-face medicine.

2.3 Presentation and objectives of our application

2.3.1 Presentation

The project (Design and development of a mobile application for monitoring diabetes) is a medical mobile application which helps diabetes patient to track there blood sugar level and save data with the possibility to share it with the personal doctor and RDN.

2.3.2 Objectives

Our objective is developing android application for monitoring diabetes patient which is an interface between patient and his doctor and RDN, while collecting data from the test results for future studies.

2.4 Conception of our application

This section approach an important part of our work which is the conception of the application. we present there the UML diagrams we used.

2.4.1 What is the UML

UML, short for The Unified Modeling Language is a general-purpose, developmental, modeling language in the field of software engineering that is intended to provide a standard way to visualize the design of a system.

2.4.2   Why the UML

Modeling is a proven and well accepted engineering techniques. In building architecture, we develop architectural models of houses and high rises to help visualize the final products. In Unified Modeling Language (UML), a model may be structural, emphasizing the organization of the system or it may be behavioral, emphasizing the dynamics of the system. A model is a simplification of reality, providing blueprints of a system. UML, in specific:

- Permits you to specify the structure or behavior of a system.

- Helps you visualize a system.

- Provides template that guides you in constructing a system.

- Helps to understand complex system part by part.

- Document the decisions that you have made.

2.4.3   UML Diagram Types

The conception methodology we use is "the UML language which is an object-oriented modeling language.Developed in order to define the standard notation for modeling application built using objects"[21].So what are the different UML diagram types?
There are two main categories: structure diagrams and behavioral diagrams.

Structure Diagrams :

- Class Diagram.

- Component Diagram.

- Deployment Diagram.

- Object Diagram.

- Package Diagram.

- Profile Diagram.

- Composite Structure Diagram.

Behavioral Diagrams:

- Use Case Diagram.

- Activity Diagram.

- State Machine Diagram.

- Sequence Diagram.

- Communication Diagram.
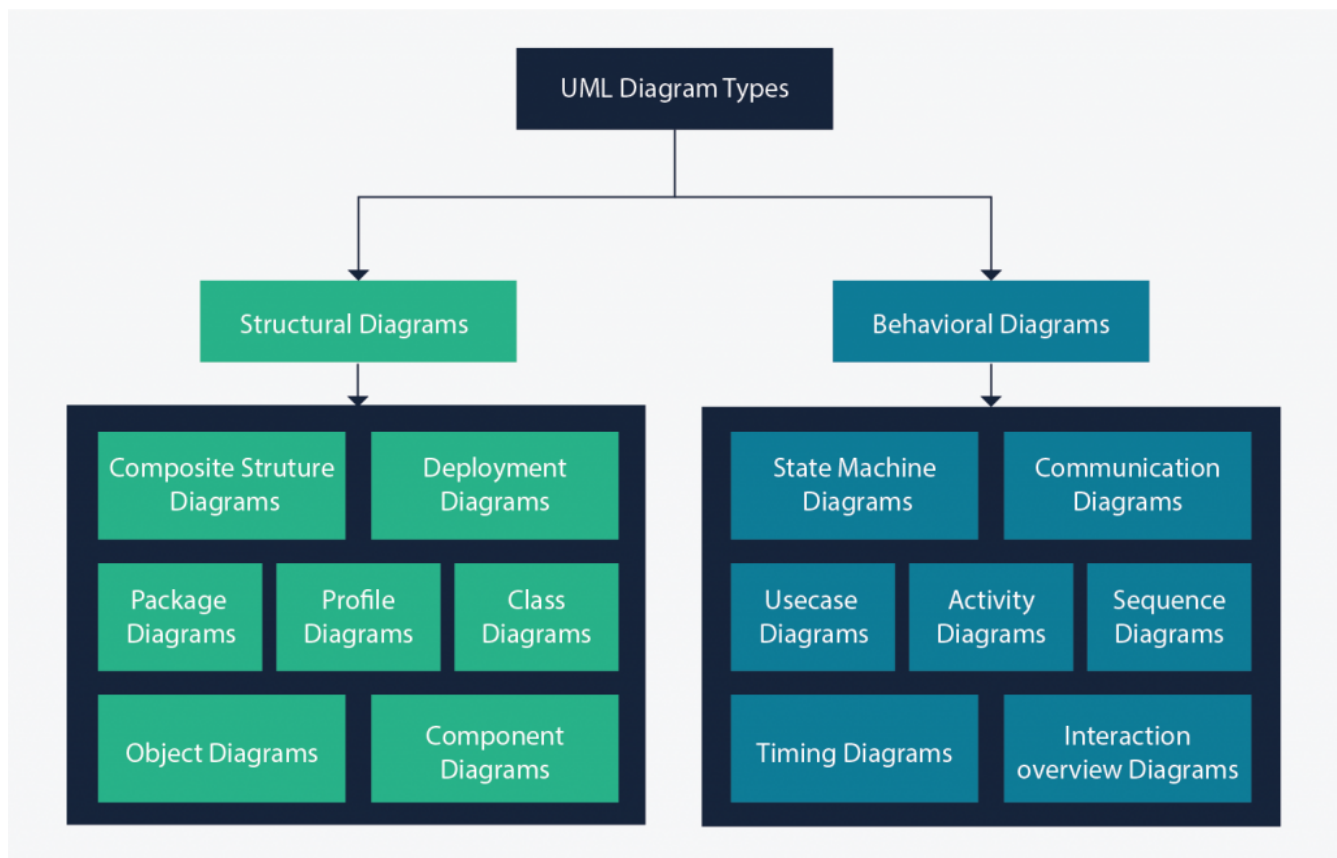
- Interaction Overview Diagram.

- Timing Diagram.

Figure 2.1: The different UML diagram types [21]

2.5   Modeling " Healthy " System

To model our system, we choose four UML diagrams, which are:

- Class Diagram.

- Use Case Diagram.

- Activity Diagram.

- Sequence Diagram.

2.6   Class diagram of our application

After detailed study of the use cases the Figure 2.3, sequence diagrams Figure 2.5, we deduced the overall class diagram of the system the Figure 2.2. This diagram is considered the final phase of the theoretical design of our system and will be taken as the reference from which the software development will take place, and the writing of the source code of our application.
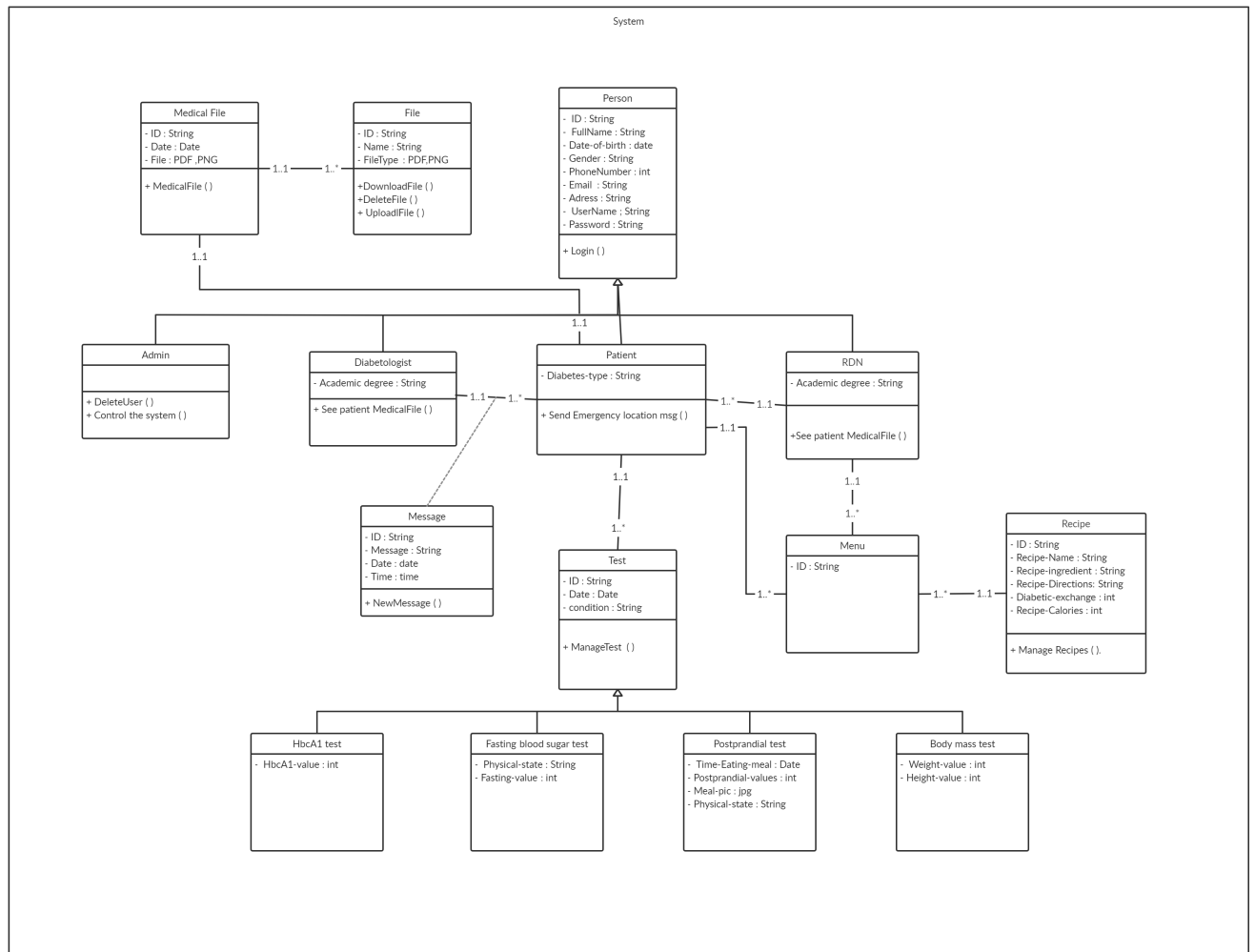
Figure 2.2: Class diagram

2.7   The Use case diagram of our application

"The use case diagram represents the structure of the major functionalities required by the users of the system."[22]

It defines the relationship between the user and the elements that the system implements, and gives a view of the system in its external environment. The followed diagram in the Figure 2.3 shows the function used in system by the users.There are common functions that doctor, RDN and patient can use, we mention Create account, Send and receive messages and there are specific functions like "Test management" for patient which we have based on our project, and we will explain it in the following diagrams.
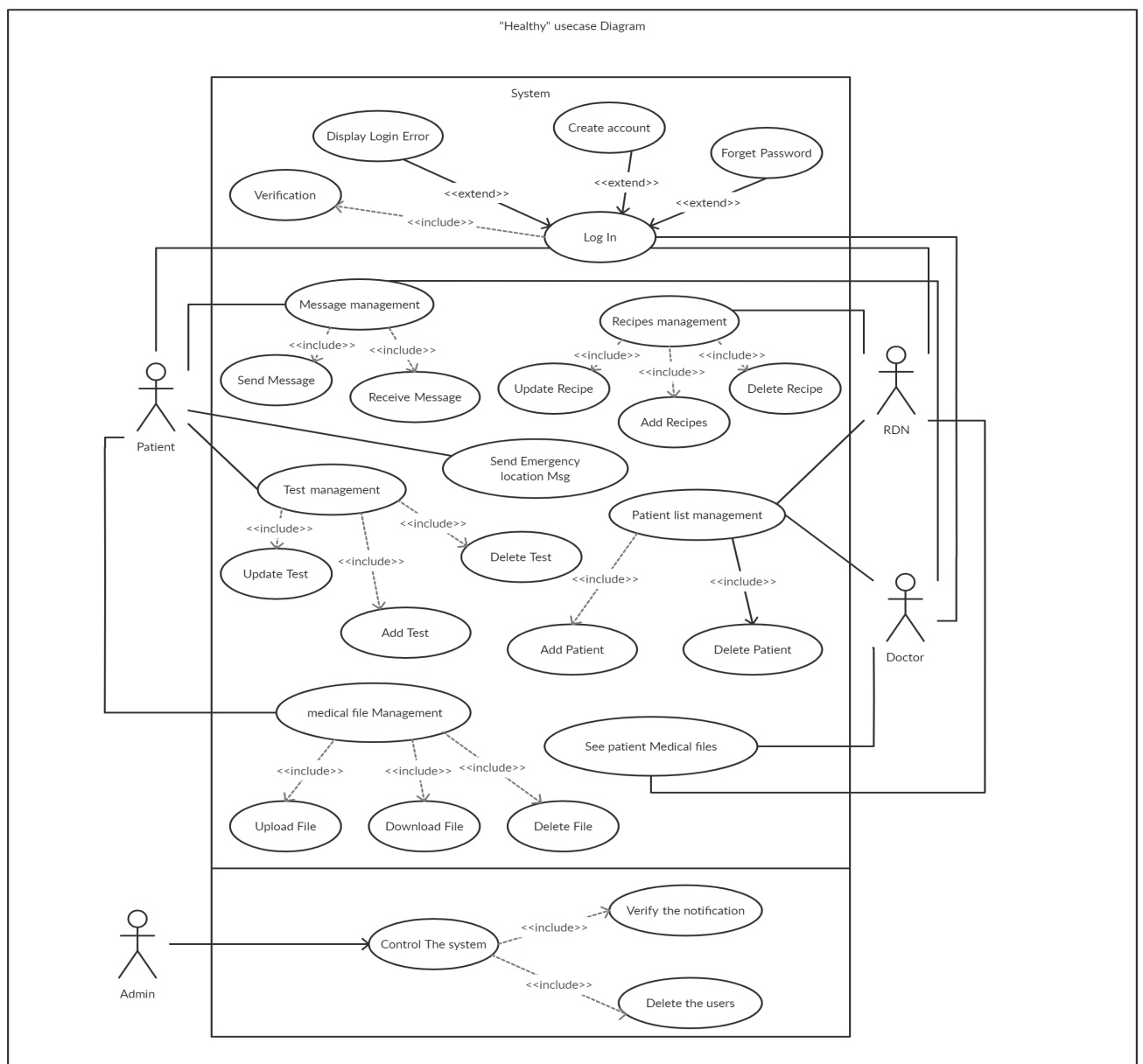
Figure 2.3: Use case diagram

2.8 Sequence Diagram of our application

On the first sequence diagram shown in the Figure 2.4, there's three colon Users ,the system "Healthy " and DB,this diagram explain how the demand for new Account, and that can transfer from users to the data base passing by application Healthy.

On the second sequence diagram shown in the Figure 2.5, there's three colon Users ,the system "Healthy " and DB,this diagram explain how the patient demand to fill new test,and that can transfer from users to the data base passing by application Healthy .
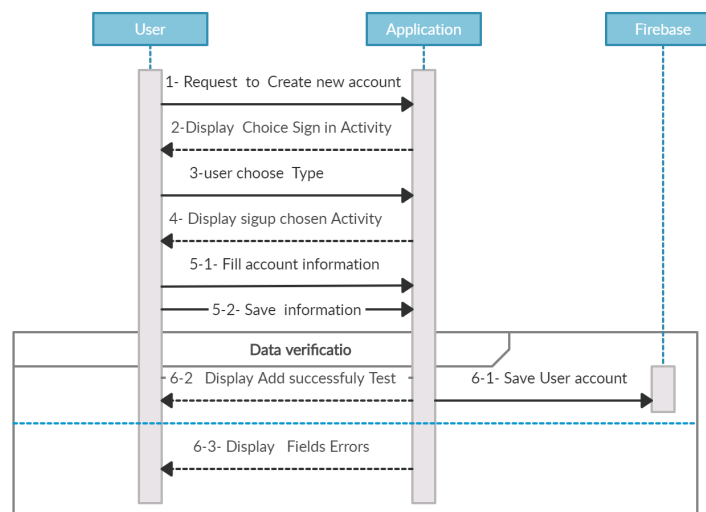
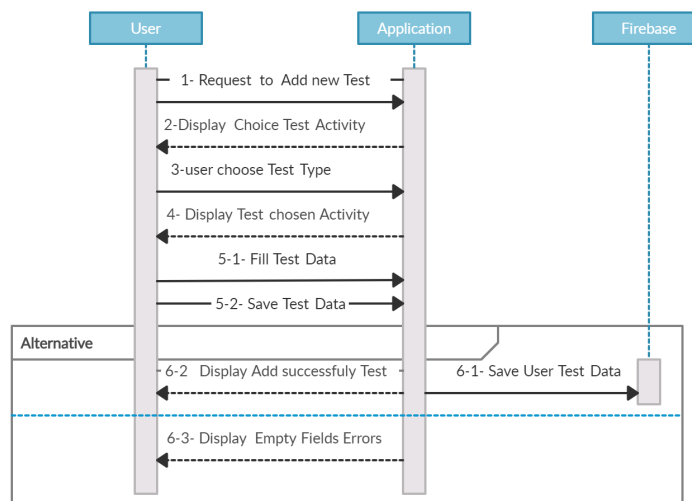Figure 2.4: Sequence Diagram (Create new Account)

Figure 2.5: Sequence Diagram (Add new Test)

2.9 Activity Diagram of our application

On the first activity diagram shown in the Figure 2.6, there's table with three colon represent the user ,application and database showing how the system behave in the case of creating new account.

On the second activity diagram shown in the Figure2.7, there's table with three colon represent the user, application and database showing how the system behave in the case of patient adding new test.
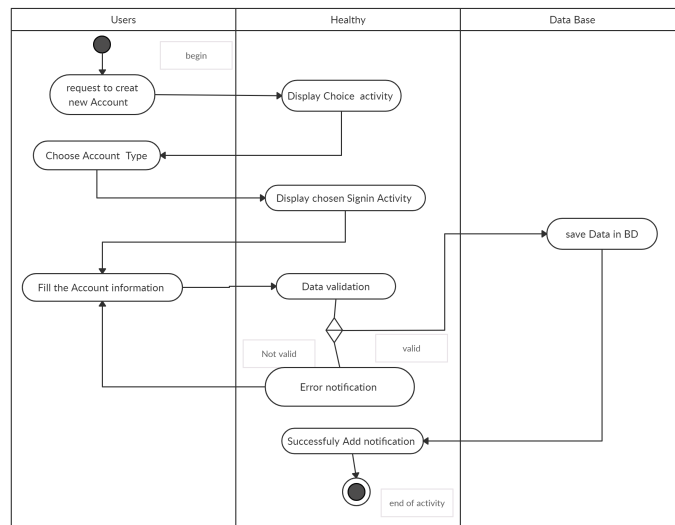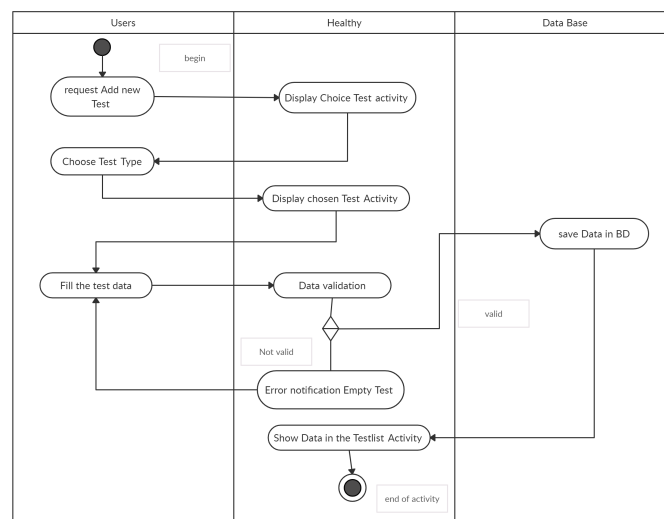
Figure 2.6: Activity Diagram (Create Account)

Figure 2.7: Activity Diagram (Add new Test)

2.10   Conclusion

In this chapter we presented our project, defined and specified the user needs using method UML.we used use case, followed by Sequence and Activity diagram explaining in details how the interface Healthy can be the canal enter the user and data base.Finally, we have the overall system class diagram which gives us the starting point for developing our software system.
In the next chapter, we will introduce our final software.

CHAPTER 3

REALIZATION AND DEVELOPMENT

3.1 Introduction

In this chapter we will introduce the application,first with its environment and the different Hardware/software tools used in this project,then by showing screenshots and explaining how the user interface works.

3.2 Environment and development tools

3.2.1 The software tools:

The hardware tools used during the development of our application are as follows:

PC: we used a PC for the realization of the app

- Central memory: 4.00 GB.

- Processor: Intel (R) Core (TM) i3-4005U CPU @ 1.70GHz.

- Operating system: Windows 10 - 64 bits.

SmartPhone: we used a SmartPhone for the realization of the app

- Central memory: 4.00 GB.

- Internal memory: 4.00 GB.

- Lenovo S658t Android version: 4.4.2.

3.2.2   The Hardware tools:

Android Studio :Desktop app

Android Studio is the official integrated development environment for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development.

Pichon :Desktop app

Pichon - Designers, app allows you to class up your work with 120,000 pro icons free. For better, faster design jobs.

Creately : web site

Creately is an award winning diagramming tool renowned for its ease of use. Our uncluttered interface combined with unique features .

3.2.3   Languages used

java :

Java is a class-based, object-oriented programming language that is designed to have as few implementation dependencies as possible.

XML :

Extensible Markup Language is a markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable

Firebase :

Firebase is a platform developed by Google for creating mobile and web applications. It was originally an independent company founded in 2011.Firebase is platform that helps to develop high-quality apps.

3.3   Environment and redaction tools

3.3.1   Languages used

Latex :

is a document preparation system for high-quality typesetting. It is most often used for medium-to-large technical or scientific documents but it can be used for almost any form of publishing.

3.3.2 Tools used

TeX studio :

is an integrated writing environment for creating Latex documents ,which help creating scientific document using Latex language.

3.4 Presentation of "Healthy" application

Healthy application can be present as easy to use app, even children with diabetes can use it easily, clear to understand with focusing to use graphics and icons, rather than scripts .

3.4.1 Logo

our application logo is represented with two elements: different sizes of drop blood and the name of application.

Figure 3.1: Healthy app Logo

3.4.2 Front animation

In the opening of our application, two animation activities appear, the first animated figure is a caution warning and reminding the user of the need to wear masks during this COVID-19 pandemic. While the second animation represents a doctor, a patient and RDN who are the main users of our application.The app will ask for permission to use WiFi, access location and send SMS.

Figure 3.2: Healthy application animation

3.4.3   Login

In this activity users can only access the application with a valid user account. After opening the application for the first time, the screen in Figure 3.3 will be shown to the user.There, he can decide whether he wants to log in or create a new account.
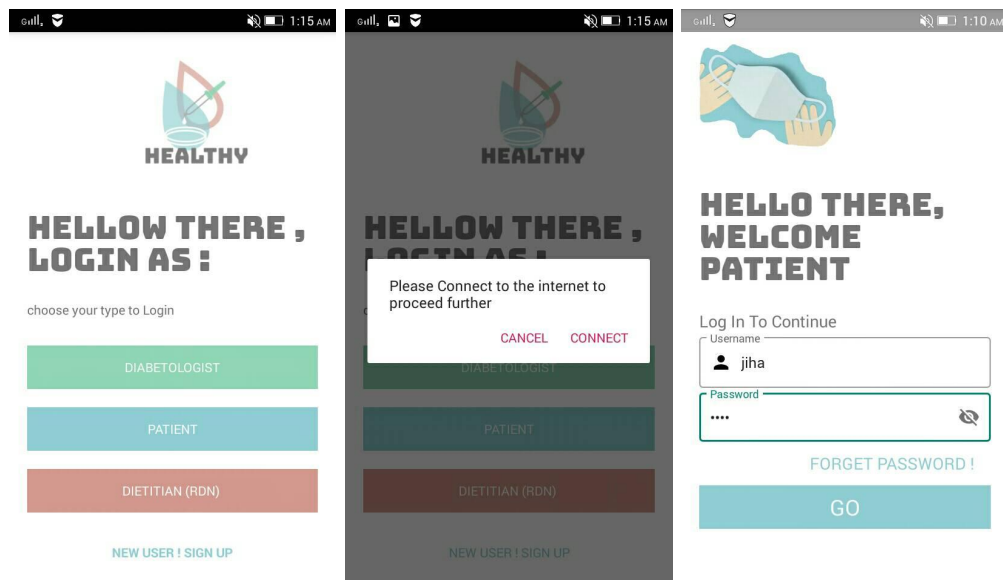

Figure 3.3: Log in activity for Healthy application

3.4.4   Forget Password

In the case that the user forgot his own password, then the user can click the read text
button "FORGET PASSWORD ! ", a new activity will be shown asking the user for his phone
number.There the program will search in his DB for the user with that phone number and select
the password from that user table and send it as a phone message for the user,in the case that
the program can't find that phone number entered in the DB an error notification will be shown
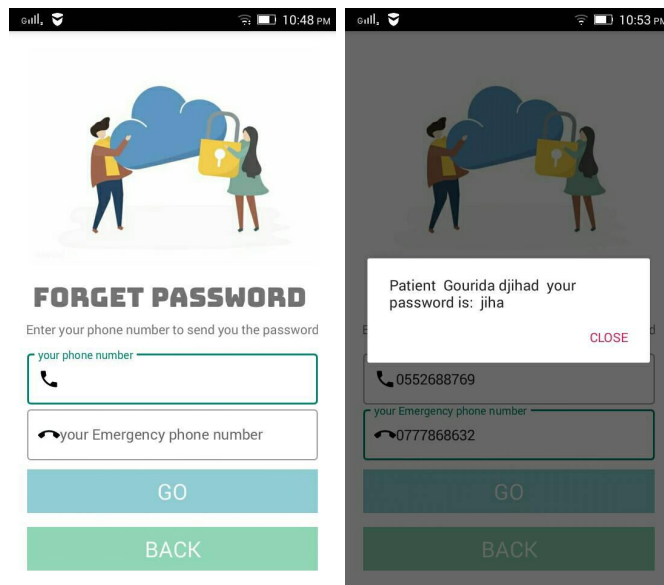"User not Found ".

Figure 3.4:   Sign up activity

3.4.5   Sign in activity

To register, patient clicks on " new user ! sign up". After he needs to fill sign up form, the
application will verify his information structure. Only when his information is validated, he can
use it to log in. Also, a username and password need to be specified for registration. Figure 3.5
shows a screenshot of the registration process.

Figure 3.5:   Sign up activity

3.4.6   Dashboard and navigation menu

This screen Figure 3.6 is displayed in the second step after having passed Login / Register. On the latter, all the functionality can be consulted and used, the icons menu has been created by CardView and each card has its own role. For the side menu, we used the navigation menu to summarize options such as: Home, profile, logout, share and rate us.
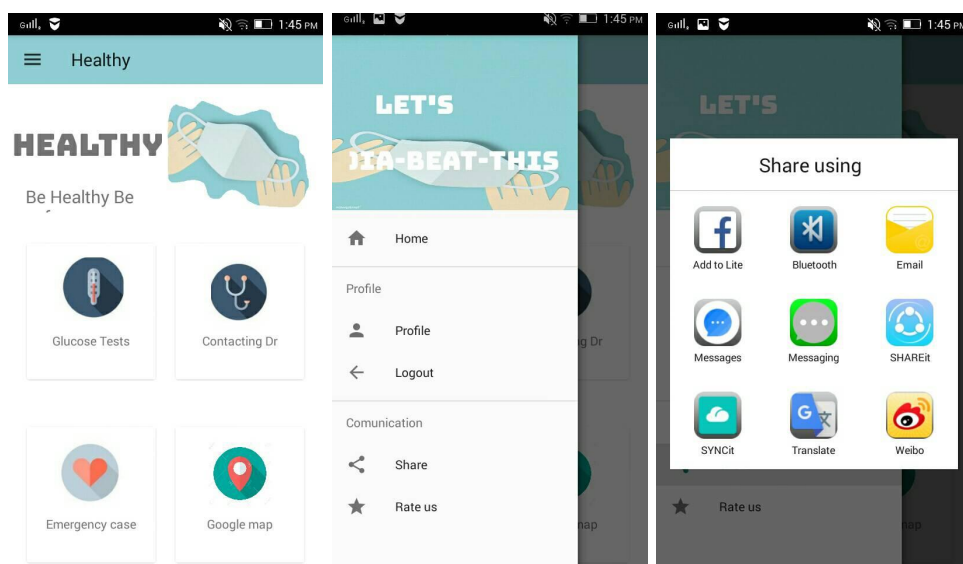

Figure 3.6: Dashboard and navigation screenshots for Healthy application

3.4.7   Patient Profile

This screen can be displayed from the side menu of the dashboard activity figure 3.7, patient can update his profile (change diabetes type, username, address, email, phone number, emergency contact and even his password).
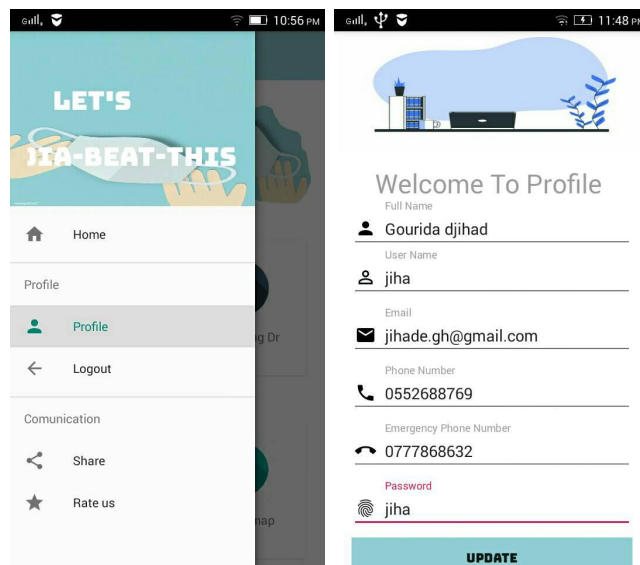

Figure 3.7: Dashboard and navigation screenshots for Healthy application

3.4.8   Medical Files

Medical files activity figure contain list of patient's medical tests and files, it appears on recyclerview list. Patient in this activity can add and delete files. It can contain the main medical lab results for any diabetes patient:

- Renal check up test.

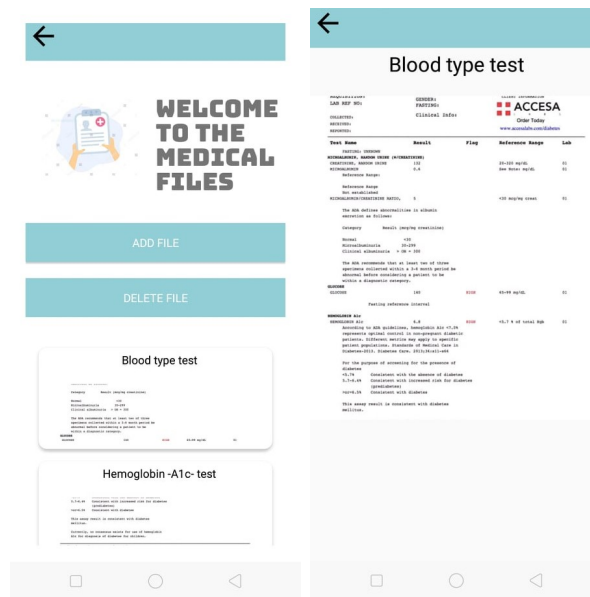- Creatinine clearance.

- Microalbuminuria.

- Blood type test.

Figure 3.8:   Medical file Healthy application

Adding a new medical file :

Patient can access this activity from Medical file activity and choose in his browser (gallery) the
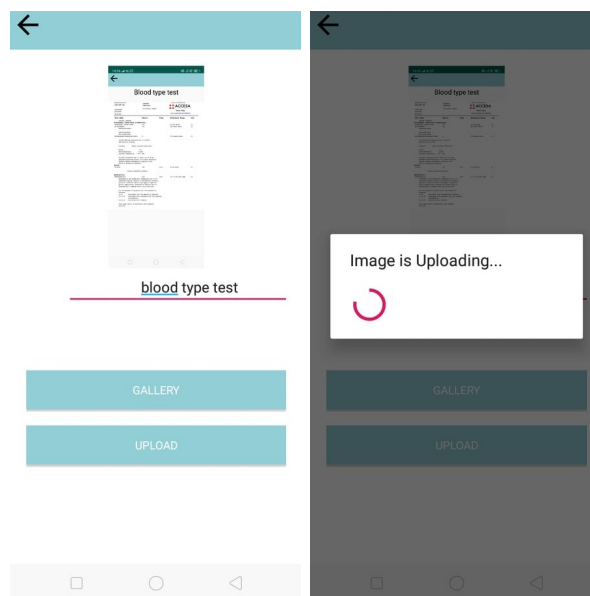file he wants to upload, then write a title for this file and thus upload it as shown in figure 3.9.

Figure 3.9: Adding a new medical file Healthy application

3.4.9   Tests

From the dashboard patient can access to tests activity and choose test type he wanna to add from this tests:

- Fasting blood sugar.

- Postprandial glucose test.

- Glycated hemoglobin (Hbac1).
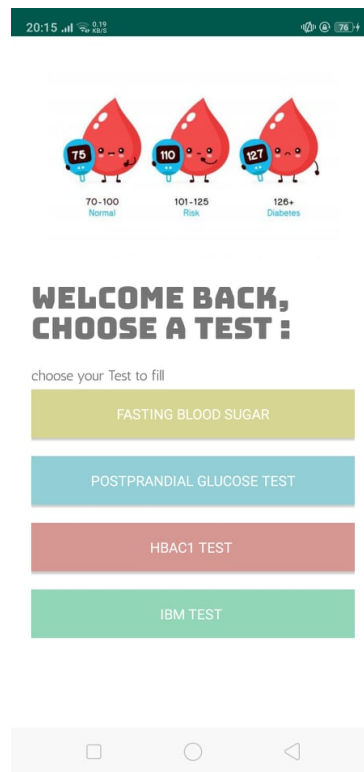
- Daily Weight test.

Figure 3.10: Adding a new medical file Healthy application

Fasting blood sugar test :

Fasting blood sugar levels are measured by taking a blood test after a period of fasting, usually of 8 hours without food. Typically, fasting blood glucose levels are taken in the morning before any breakfast is eaten.A fasting blood sugar level less than 100 mg/dL (5.6 mmol/L) is normal. The figure shows how patient can add a new fasting test which will be saved and shown in the list .
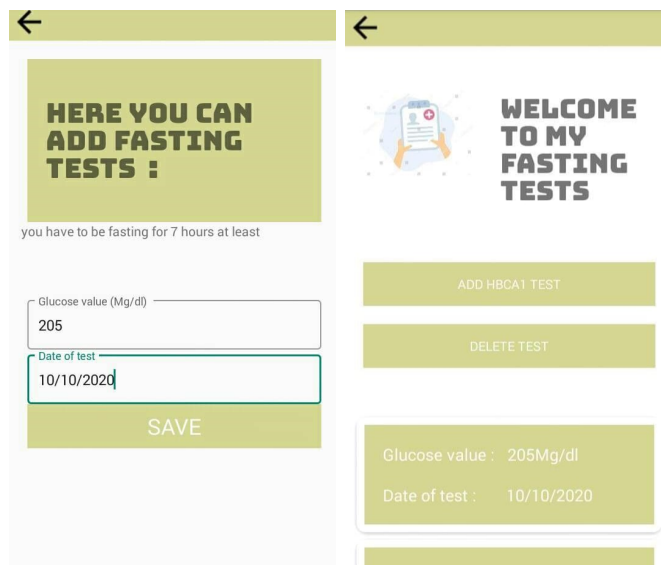
Figure 3.11: Adding a new medical file Healthy application

Postprandial glucose test :

Postprandial means after a meal. This test is done to see how your body responds to sugar and starch after you eat a meal. As you digest the food in your stomach, blood glucose, or blood sugar, levels rise sharply.
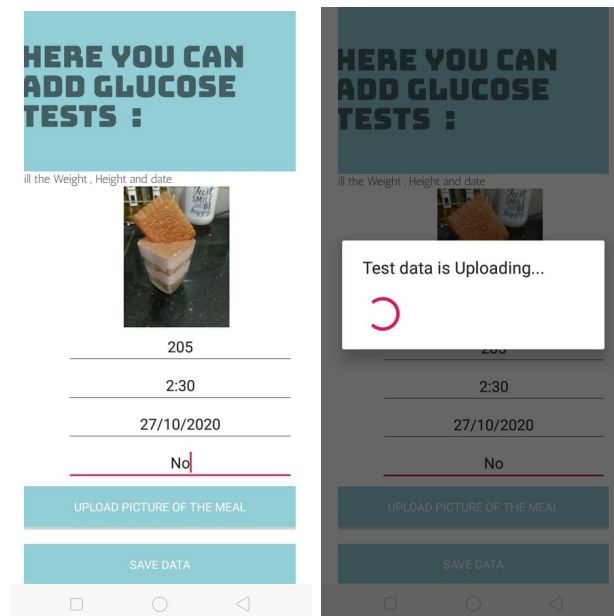

Figure 3.12: Adding a new medical file Healthy application

Glycated hemoglobin (HbacA1) :

The hemoglobin A1c test tells you your average level of blood sugar over the past 2 to 3 months.People who have diabetes need this test regularly to see if their levels are staying within range. It can tell if you need to adjust your diabetes medicines. The A1c test is also used to diagnose diabetes.

Patient need to do HbcA1 test each 3 months and it came with one result value , here we have two cases: the patient with an HbcA1 analyzer can do his own test and enter the value with the date in the app, for the patient who does HbcA1 tests in the laboratory, he can add the HbcA1 as paper laboratory in the activity medical Files Figure3.13.
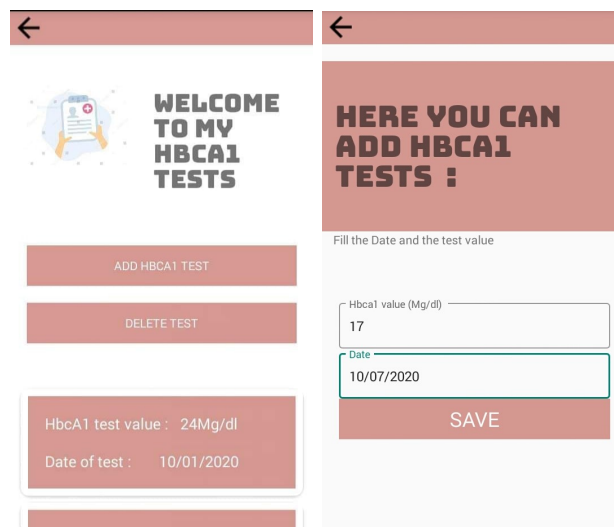

Figure 3.13: Adding a HcbA1 test Healthy application

Daily Body weight test :

High weight can be an indicator of high body fat. It can be used to screen for weight classes that may cause health problems, but it is not a diagnosis of an individual's body fat or health. One of the symptoms of diabetes can be weight loss. In this activity, body weight, the patient can measure his own weight, and the app will save this data with the current date and plot it as a graph Figure3.14.
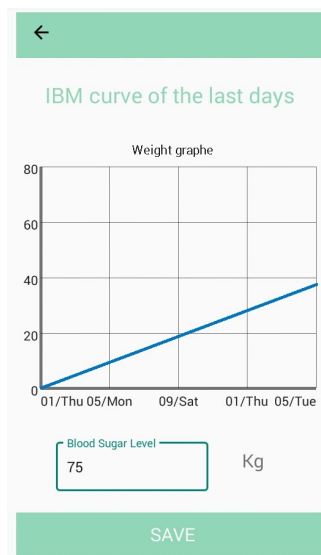
Figure 3.14: Adding a weight test Healthy application

3.4.10   Google Map

Emergency Location SMS :

In this Activity Figure3.15 patient with one click from the Dashboard can send an emergency SMS with his location coordinates(longitude and latitude) automatically to a emergency contact he already picked when he was signing up.

While we found that there's a possibility that the patient may pass out, and can be moved with ambulance or someone else, so we make it tracking the location for each 20m distance from the first location and put a marker and send another SMS with the new location coordinates.

Nearby Locations Google Map :

In The last part of our application is the Google Map nearby locations Figure 3.16, diabetes patient face two common problem in his daily life, having high or low blood sugar levels.We add Map activity to facility the research for restaurants or hospitals in circle of 700m.The app will ask for permission to use WiFi and access location.Then the app will shows user the circle in the map so he can decide which place is the closest.
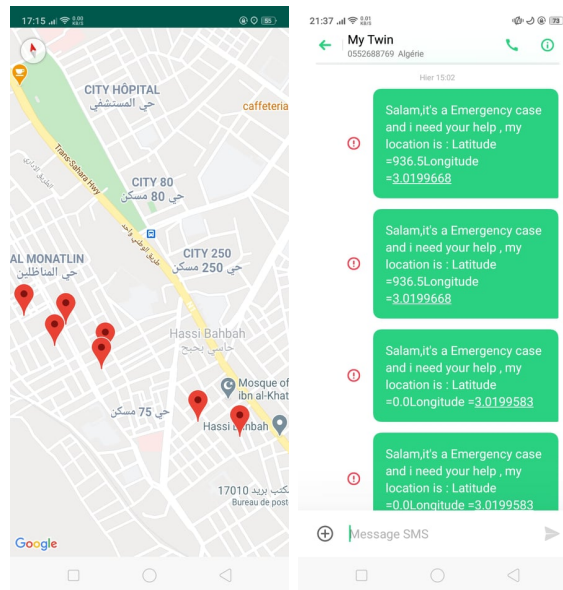
Figure 3.15: Emergency Locations and SMS Google map for Healthy application
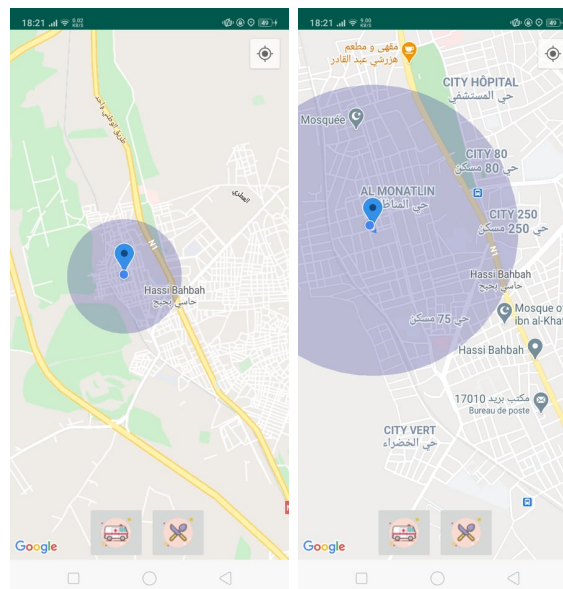

Figure 3.16: Nearby places Google map for Healthy application

GENERAL CONCLUSION

The main objective of our work was to develop a mobile application that helps diabetic patients to record and share their medical data with their personal doctor and RDN. As part of this project, we had the opportunity to :

- Enhance the quality of life for diabetes patients.

- Improve self-health-care and treatment methods.

- Help the doctors to get updated data for their patients.

- Collecting patient data and sharing it with future researchers.

For Future work and in order to improve and update "Healthy" application and gather more chronic diseases such as hypertension, we will work with medical specialists to use there expertise in order to improve our application services. The future development of "Healthy" may include various improvements as follows :

- Develop the function of nearby places followed with directions and traffic map, to help patients in emergency situations to find the nearest hospitals.

- Use the questionnaire to collect data for future researches.

- Update the application with addition another version concluding patients with hypertension .

- Develop a website containing patients medical data, offering easy access to researchers.

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