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Designing an Android application using the software platform (FLUTTER) to alert the times of medical treatments (MT)

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Abstract. This research dealt with the use of the descriptive analytical method for how to analyze, design and develop an application (therapeutic dates (By studying the engineering steps and stages for developing a remedial appointment application, where the SDLC model was used to clarify the stages of application design, starting from the planning stage of how to build the application and what its specifications are and ending with publishing the application on the platforms of google play and the app store to benefit from it in Reminder of medication appointments The star UML language was also used to design and analyze our application, to document how to access it, add the name and type of treatment to alert the times it was taken, as well as the user's interaction with the application through its use of the application, where the Unified Modeling Language (UML) can help to model systems in different ways, and this language is designed to be simple and easy to use, and the use case diagram, activity diagram, and flow chart diagram models were used .To clarify the stages of software engineering for the design of the application and how it interacts with the user, and after the completion of the application design, an analytical study was conducted for the application's work from the users' point of view, and an electronic questionnaire was made that consisted of the following samples (students pharmacists and students of medical and health specialties, pharmacists, doctors, Patients, other groups) where the application was tested by them, their opinions were collected, and the results of this questionnaire were analyzed using screening processes for the results of the questions, and positive and encouraging results were obtained.

Keywords. Android application, Dart ,Flutter, Software Development Kit(SDK),Android operating system, medical treatment(MT), Software Development Life Cycle (SDLC), my treatment appointments(MT) software development life cycle(SDLC), Star Unified Modeling Language(Star UML)

1. Introduction

Smart phones have become an integral part of modern human life, and many institutions and companies have rushed to use these portable devices to keep up with users' needs. Where this research deals with a study on Android operating systems that run on most smart phones, as well as in this research learning how to program and design smart phone applications that work on the Android system. The medicine is on time, which was called My treatment appointments, and the Dart Flutter language was used to program the application, which is part of the Flutter software platform, and this platform enables the programmer to program applications for all types of applications Phones Whether the phone works on the

Android system in most smart phones or the IOS system in i-Phone devices, and the Flutter platform works using the Android studio program, which serves as a general platform that contains all Flutter tools**.**

1.1 Android Applications:

An Android application is software designed to run on an Android device or emulator, and it is a software application that runs on the Android platform. Since the Android platform is designed for mobile devices, the typical Android application is designed for a smartphone or tablet running on Android OS and is the primary software in which Android applications are programmed whether in java, kotlin, or Dart Flutter, and the official development environment for programming Android applications is Android Studio

For the development of Android applications, and at the end of programming any Android application, the application is stored in the Android package (.apk) via the Android Asset Packaging Tool (AAPT), as any Android application that is installed on the mobile phone has its extension on .apk format [2][3][4][5][6,[

Where the application (My Treatment Appointments) was designed on the Android operating system using the dart flutter language in the Android studio program.

1.2 Flutter software platform:

Flutter is a suite of application programming and development tools that provides a comprehensive framework in the Dart Flutter language dedicated to drawing destinations with high quality and at the same time gives the developer the tools that make him build complete applications in the least time. Tools is the mobile SDK.

Flutter is a framework that was created from scratch and used to write and build it in the Dart language and the C++ language, as Google launched it in early 2017 and during this period it achieved a very great success.

Flutter is based on the Dart language, a programming language that Google programmed in 2011. On it [11][12][14][16.[

And the Android studio program is within the framework of the flutter filters that were used to program our application, and it supports more than java, kotlen and dart languages. The Dart Flutter language was used in application programming.

1.2.1 Flutter Tools:

The Flutter software platform consists of several tools(Git sdk, flutter sdk, Dart sdk, Android studio Android studio for designing applications that run on Android devices and visual studio code (VSC) is used to program applications that run on Apple devices, android SDK library for creating an Android application and iOS SDK library for creating applications that run on Apple devices)

2. Research objectives:

The objectives of this research lie in designing an Android application that works on smart phones that alerts the times of taking medical treatments at the appropriate times for the purpose of helping patients of all age groups, to reach a state of recovery by taking the treatment (medication) at the time specified by the treating physician? .

The design of this application is characterized by simplicity of use and without complexity, its aim is to help patients of all age groups to use it, to reach the state of recovery by taking the treatment (medicine) at the time specified by the attending physician as it works to remind the patient to take treatment doses at the time specified by a notification, specified by

device, as the reminder method supported by this application improves the patient's health and helps him to adhere to the specified dates for taking the medication, as many patients neglect to remember the dates of taking the medicines at the specified times, and certainly the failure to adhere to the specified dates To take medicine, especially in some diseases that cause many health problems, so the application of (My Treatment Appointments) solves all these problems that the patient suffers from.

Through this application, the user can specify and adjust the specific times of medications by the user, and he can add any number of medications and set notifications to remind the patient of the time of each type of medication that has been added. Our application has been programmed using the Drat Flutter language in the Android program studio, where a series of software engineering steps and stages were worked to develop the MT application, where the SDLC model was used, and the language that was used to model the steps on which the application was built is Star UML language.

3. My Treatment Appointments(MT):

The application is installed on the mobile phone, and the application is entered by pressing the application icon. After entering the application, a temporary screen called (Splash screen) will appear in which the name of the application designer and the name of the design supervisor appear? .

And after the disappearance of the temporary screen, an interface will appear in which there is no medicine added

And this interface will have several buttons, which is the button to change the language from Arabic to English and vice versa, and there will be a rose around the application that contains a welcome sentence about the application and general information about the application.

After that, press the plus sign in the lower corner of the main interface of the application

A text box will appear in which we write the name of the medicine and another text box in which we write the details of the dose of the medicine and the morning or evening and other details.

We choose the form of treatment (a pill, capsule or other) and then we set the clock at a specific time by pressing the alarm setting button. The alarm time for taking the drug is determined at this time. Set the alarm either through the analog clock or the digital clock according to the user’s desire, and then we press the OK button

After setting the clock, the application will alert the specified time and the alert will be in the form of a notification in which the name of the drug and dose details, as well as how much time has passed since the dose was taken.

Here are the interfaces for our app:

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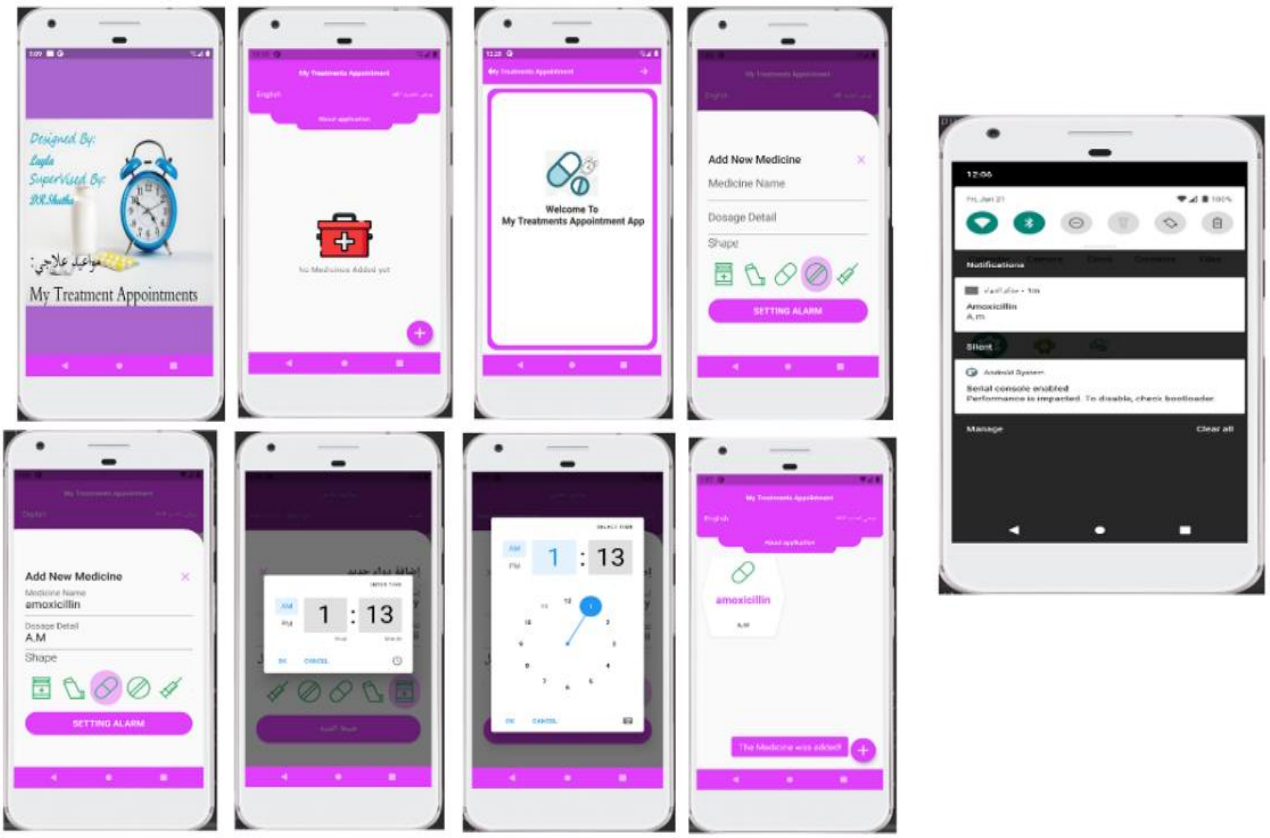

3.1 Characteristics and features of the application of therapeutic appointments:

1- The installation of this application is very easy, as soon as it is downloaded to the mobile phone, it is installed easily and quickly

2- The application reminds you on the specified dates to alert you of the time to take the medicine at the right time, and this is in the notification panel of the mobile phone

3- The application reminds you through a notification alerting you to take the medicine at the dates that were set for taking the required doses.

4- When the alert screen appears, the drug name, dosage details and how long it has been since the necessary dose was taken

5-The application of my treatment appointments is off line, that is, it works without the Internet

6- It does not affect the battery operation of the device or the processor

7-Any kind of medication, nutritional supplement, and treatment details can be added

8- It does not need a login or Gmail, so using the application is very easy once it is installed on the phone, it works easily

9- This application works in both Arabic and English

10- It is possible to add more than one drug and its details, and it can be deleted from the interface easily.

3.2 Analysis, design and development of MT:

This title aims at the engineering steps and stages for developing the application of my treatment appointments, where the SDLC model was used, which is an abbreviation for software development life cycle [1] [13], meaning the software development life cycle, as this model was used To clarify the stages of application design, as it starts from the planning stage of how to build the application and what are its specifications and ends with publishing the application on Google Play platforms to benefit from it in reminding of medication appointments.

The star UML language was also used to document how to enter the application and add the name and type of treatment to alert the times it was taken, as well as the application's interaction with the user, where the Unified Modeling Language (UML) can help to model systems in different ways. As the UML program is designed to be simple and easy to use, use case diagrams, class diagram, activity diagram, have been used.

3.3 SDLC Model (Software Development Life Cycle):

The SDLC model was used to detail the procedures and methods used, and the application of all stages makes the project of very high quality, and conforms to the standard standards.

Where the SDLC model was used to show how to design a treatment appointments application that alerts the patient to take the medication at the right time, starting with the planning stage of how to design the application and ending with the stage of publishing in the Google Play Store.

3.4 The important stages of the SDLC model:

1- Planning stage: It is the first stage of this model, and the first step of the planning stage is to choose the appropriate program for programming our application, where the Android studio program was used, including the Dart flutter language, as well as planning how to work The application in terms of how to plan the interfaces from the users' point of view so that they are suitable for the work of the application and how the information related to the treatment is entered and what is the database that was linked in the application to store information within the application where the SQLite database was used, all of this took a lot of time to plan.

2- Analysis stage: At this stage, the application requirements and software libraries required to build the application to be called by Main dart and how many are understood, as well as understanding the flutter platform tools, which are: Git SDK, flutter SDK, Dart SDK, which were used to create the application in order to serve the largest number of users.

3- Design stage: In this stage, the interfaces of the application were designed, as well as the application control buttons and colors that give the application more aesthetics in order to allow the largest number of users to benefit from it, as a temporary interface was designed with a name The designer and the title of the application and this interface appears when entering the application, as well as the main interface designed to make the application in which the name of the drug and other details about it are entered, the button to switch to Arabic or English, the button about the application and other buttons and other interfaces, where the The use of Flutter Widget interfaces within the framework of the flutter, which represents the layer responsible for showing everything to the user, whether texts, colors, buttons, or images related to the application. Also, at this stage, the code was written in the main program that represents the main dart in Android Studio within the flutter framework and link this code with the interfaces.

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4- The implementation phase: After the phase of designing interfaces and writing the code in Main dart, the implementation phase of the program (application) comes by pressing the implementation button in the flutter program, where the implementation is carried out by operating the mobile The default (Emulator) after installing it in (Flutter) and watching the execution through it.

5- Testing phase: In this phase, the performance of the application was tested by the programmer when programming the application and the results of calling the programming libraries in Main dart were tested by running the emulator as well as the test By the users of the application and its efficiency, and whether the warning was given about the time of taking the medication on time and without errors. A questionnaire was made about the use of the application by a group of users. ?

6- Deployment stage: At this stage, the application is downloaded on the Google play platform to serve the largest number of patients as a reminder of the times of taking the medication at specific times. Where the models (Flow Chart Diagram, USA Case Diagram, Activity Diagram) of the Star UML language were used to analyze, design and develop our application (my treatment dates) as follows:

The following figure shows the stages of the SDLC model:

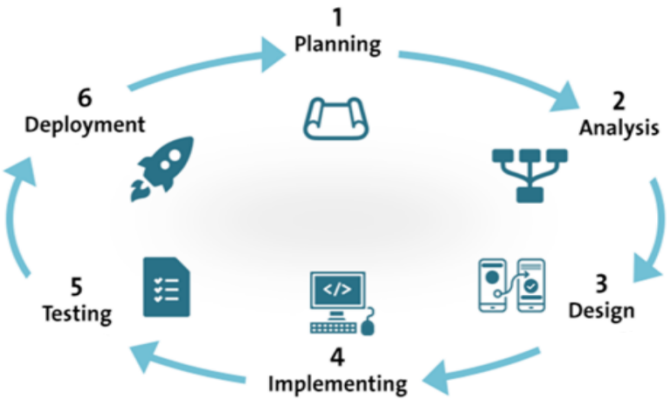

Figure (1) Stages of the SDLC Model

3.5 **Application Flow Chart Diagram**

Also called a flowchart, it is a type or form of graph, which is a group of geometric shapes that are connected to each other through a group of arrows with a specific direction, so that each geometric shape represents a step of the algorithm and represents the direction of the arrows The order of the steps.

These geometric shapes have specific connotations, that is, they follow pre-defined standard standards, or in a simplified form, each of the shapes has a fixed function, as building the model for the application began using the oval shape that indicates the beginning of entering the application and in order for us to enter the data For the drug, the geometry designated for the data entry process was used, which is a parallelogram, and the rectangular shape was used to represent the processes for the application (Process) as well as the rhombic shape to represent the decision-making process.

Where the figure (2) shows the flow chart of how the application works in detail from the beginning, i.e. from the stage of entering the application until the alert through the notification of the mobile phone.

Where the user enters the application by pressing the application icon in the mobile phone and a temporary screen (splash screen) will appear in which the name of the application designer and supervisor and the name of the application will appear. After that, the main interface of the

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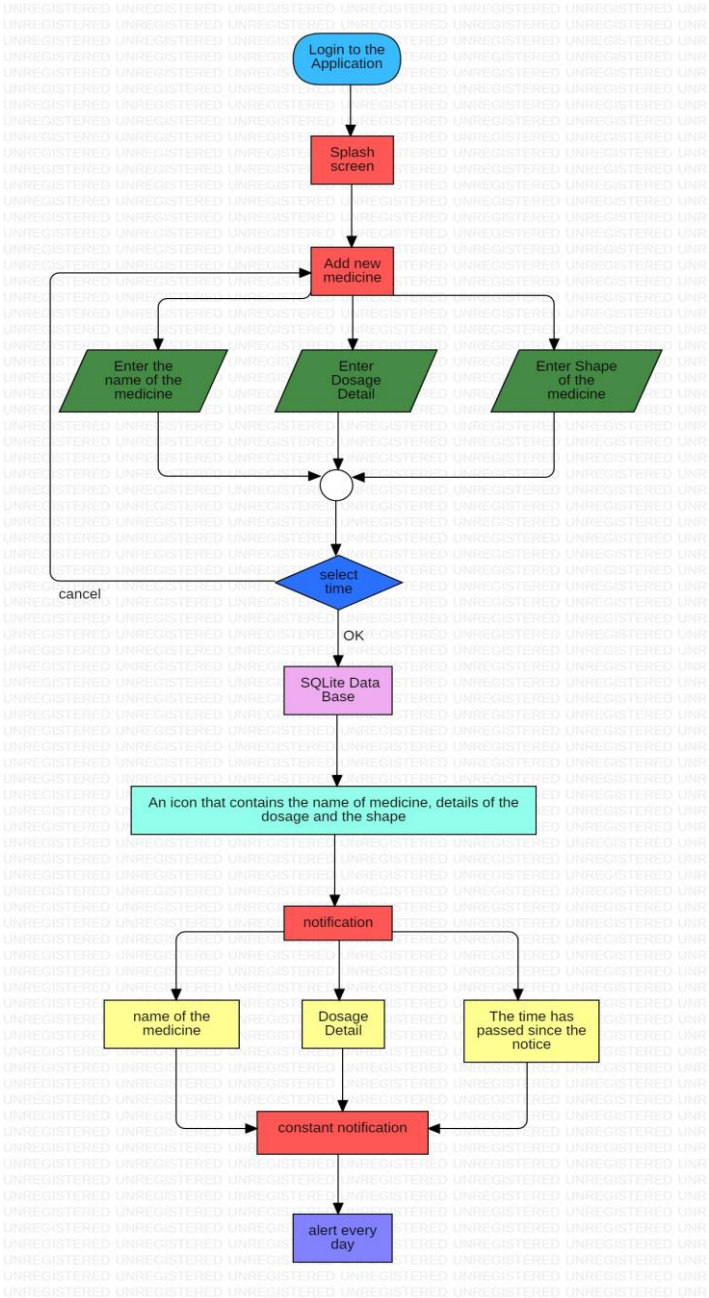
application will appear. The user will add new drug information that includes The name of the medicine, the dose details and the shape of the medicine, and after typing these details the user will choose the alert time (Select time). After setting the alarm, all this information will be stored in the SQLite database in which the information was stored. After that, the application will give a notification (notification) of the time of taking the drug, and the alert interface consists of the name of the drug, dose details and the time that has passed since the alert, and in the end, the application will alert the time of taking the drug every day at the same time that was specified? .



figure(2): Application Flow Chart Diagram

3.6 Application use case diagram:

The use case diagram was used to model the requirements of an application (therapeutic appointments) and represents the user's interaction with the application, which shows the

relationship between the user and the different use cases that were used. To model our application. ?

The use case diagram is used to describe the state and procedures of the system (application) that defines the processes of the application from the user's point of view.

The use case diagram is a type of Behavioral UML, a behavioral user modeling language that is described as behavioral because it describes what should happen in the system being designed.

Symbols used to design a use case diagram:

• System boundary: where it represents the boundaries of the system, and it is represented by a rectangle containing the components of the system and the name of the software, where the boundaries of our application are drawn and the name of the application is written within the boundaries of the system

• Actors: It means the representatives who deal with the operations of the system, they can be people as users and suppliers, since in this system the agent is represented by the user of the application who interacts with the application.

•: Use cases represent cases or operations within the system and are used to clarify the requirements of the system. The shape of the use case is an oval and the name of the operation to be performed is written inside it. In our application, these shapes were drawn and the operations that occur within the application were written. ?

Relationship: It represents the relationships between one process and another, that is, between one use case and another, or between the Actors and the system, where the relationships between the processes within the application and between the user of the application and the processes of the application.

Where the Application Use Case diagram is represented at two levels:

The first level: It shows how the application was designed in general without details, where the application is entered by the user and the temporary screen (Splash Screen) will appear and then the main interface of the application will appear, which consists of several buttons where the user chooses the language of the application (select language) A button is selected about the application, and when the user adds a new drug (Add New Medicine), an interface will appear with medication information (and then the user will set the alarm) Setting the alarm) and here the type of relationship is Dependency Relationship, as the alert interface depends entirely on the interface for entering drug information, meaning that the interface for setting the alarm does not appear until after entering the drug information and this information will be stored in SQLite Data Base, then the notification will appear at the time that was set, and the following figure shows the first level schema:

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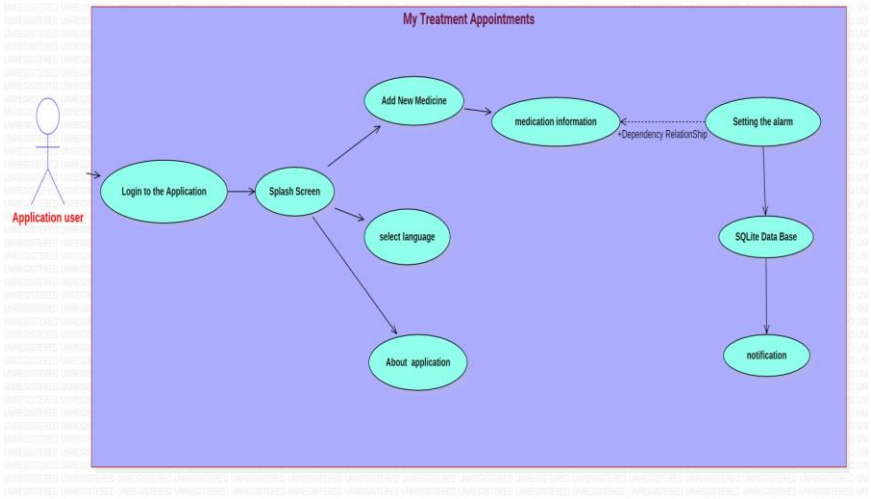

Application Use Case Diagram(First Level)

The second level: It shows more details about how to use the application, as the details of each use case and what its work is

Where the user enters the application and the temporary screen (Splash Screen) will appear that shows the name of the application programmer and the name of the supervisor, and then the main interface of the application will appear, which consists of several buttons, where the user chooses the language of the application (select language). Arabic or English, and a button is selected about the application, in which the information about our application (Application detail) appears, and when the user adds a new drug (Add New Medicine), an interface will appear in which drug information (medication information)) where it consists of the name of the drug (Medicine name) and the details of the dose (Dosage Detail) and the form of the drug (Shape) and then the user will set the alarm (Setting the alarm) and here the type of relationship is dependence) Dependency Relationship) between the drug information and setting the alarm, as the alert interface is completely dependent on the name of the drug, the details of the dose and the form of the drug, meaning that the interface for setting the alarm does not appear until after entering the drug information.

After selecting the alarm time (Select Time), the user either presses the OK button, which will store this information in the SQLite database, or presses the cancel button, which leads to the return to the “Add new drug” interface. new Medicine) and then the program will make a comparison between the time entered with the time installed in the mobile phone shows the second level diagram:

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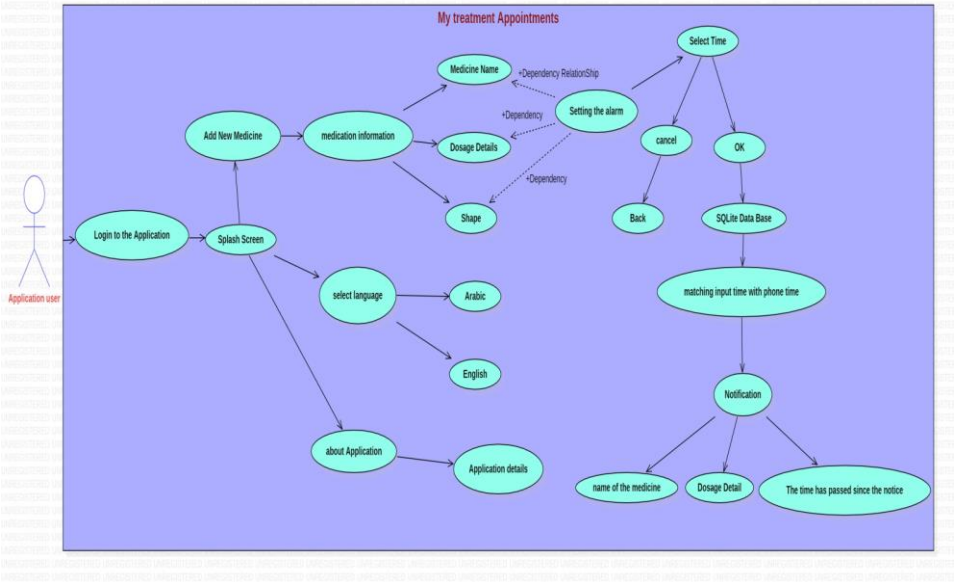

Figure(4):Application Use Case Diagram(Second Level)

3.7 Application Activity Diagram

Low level activity (efficiency) scheme allows, Where modeling is performed with ease compared to other behavioral diagrams, the behavior between objects is shown (Objects) that represent the processes used within the (My Treatment Appointments) application, And the activity diagram was used to model the behavior of the processes within the application, i.e. the workflow from the beginning (entering the application until the appearance of the notification at the time of taking the drug)

3.8 Activity Diagram Elements:

Before we start designing the effectiveness chart for our app, we must first understand its structure. Some of the more popular elements of an activity chart include:

•Action: It is a procedure that performs a specific task, and this procedure represents the type of process that the system performs. This procedure is encoded with circular-edged rectangles in which the name of the process used in the system is written. This shape was used in the design of our application to represent the processes that perform It contains the application user from the stage of entering the application until the notification of the time of taking the medication . ?

•Decision node: It is a conditional branch in the flow that is of a (rectified) shape. It includes one input and two or more outputs. This form has been used in building the application model in order to set the alarm and choose the alarm time. The decision is made either by choosing the (OK) button, and the information is stored in the database of the application, or by choosing the (cancel) button where it is returned. To the interface add new medicine

•Control flow: This element shows the flow between the steps in the diagram as it represents the connections between the regions (circular rectangles) that represent the activities where the processes within the application that the user performs are linked.

•Start node: symbolizes the start of the activity. The start node is represented by a black circle and represents the start of entry by the application user.

•End node: It represents the last step in the activity. The end node is represented by a specific black circle. It represents the end of the operations performed by the application user in order to notify the time of taking the drug.

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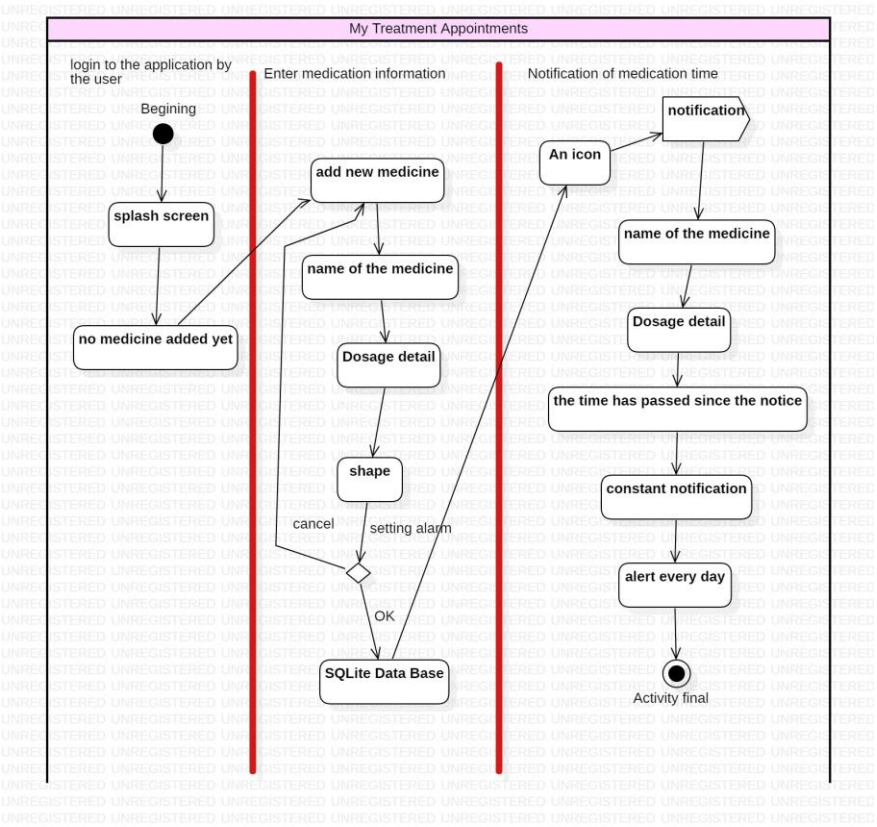
The Activity Diagram is designed to apply my treatment appointments as shown in the following figure:



Figure(5):Application Activity Diagram

4. Fundamentals of testing my treatment appointments app:

Any Android application that is designed by the programmer must be tested either by the programmer himself, that is, while writing each programming code that is tested before downloading it to the mobile phone, or by users after installing the application on their mobile phone.

Testing any Android app is an integral part of the app development process. By constantly running tests on the application, the validity, functionality and usability of the application can be verified before it is released publicly, i.e. before it is published on Google platforms.[15]

The MT app has been tested twice:

The first: testing by the programmer

Second: testing by users of the application

4.1 Test by the programmer:

The application of my treatment appointments was tested manually while writing the program in flutter Dart language by installing the virtual simulator (Emulator) inside Flutter through the AVD Manager tool, which is the tool for the simulators in the program .

Every line of code in the app was tested, and later the app was run with compatible devices. But running the application directly on the physical device is not practical because it will be very slow and expensive, i.e. the application is not checked on the physical device after writing each code because this will require time and effort in downloading the application to the mobile phone, instead it can be after completing the Writing the code The application is downloaded to the mobile phone and the program is tested.

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In this way, a good test strategy will find the appropriate balance between test accuracy and both its speed and reliability. The similarity of the test environment to a real device determines the accuracy of the test. Therefore, higher accuracy tests are performed on the simulated devices or on the physical device itself.

High-accuracy tests are often slower and require more resources, so not every test should be a high-accuracy test.The test by the programmer consists of different types of tests done on our application

Mobile applications in general are complex and should work well in many environments. As such, there are many types of tests and are as follows:

•Functional testing: Our app is tested for what it does and what the app is supposed to do.

•Performance testing: The application was tested in terms of the performance of the operations it performs, for example, the transition between one interface to another, and whether this was done quickly and efficiently.

•Accessibility testing: Does the app work well with accessibility services?

•Compatibility testing: Our app has been confirmed to work well on every smart device after it is installed in the device and the API level has been checked.

4.2 Dimensions of these tests:

Tests also vary by size or degree of isolation:

•unit testing or small tests check only a very small part of an application, for example testing a small program statement, a specific instruction, or a specific class within our program.

•End to End testing or Big tests check larger parts of the application at the same time, ie the whole program is tested.

Medium tests: This type of test is between the two types above and checks the integration between two or more units, that is, between two or more parts of the program.

These ranges of tests are illustrated in the following figure:

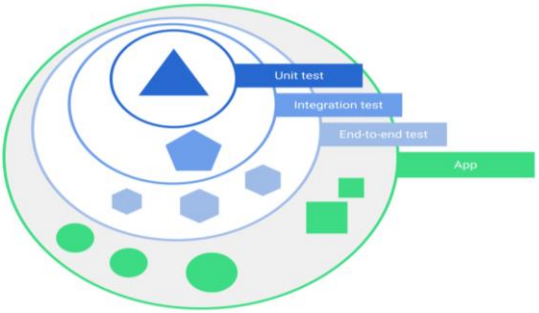

Figure (6) Test Scopes for . Application

4.3 Instrumented tests and local tests: local tests

These tests were conducted on Android devices:

•Instrumented tests: These types of tests are carried out on Android devices, whether they are physical, that is, on a real mobile phone or on a virtual device that is included in the program that has been installed within Android studio. . Automated tests are usually user interface tests i.e. testing application interfaces from the point of view of the user of the application, its operation and how these interfaces are interacted with by the user.

•local tests: These tests are performed on the programmer's development machine or server, so they are also called host side tests. They are usually small and quick tests, which isolate the subject under test from the rest of the application.

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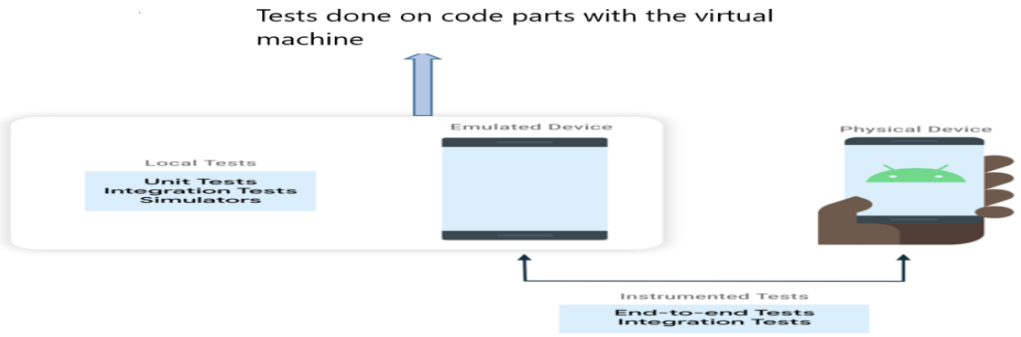
As shown in the following figure:



Fig(7):Instrumented tests&local tests

4.4 Test by users of the application:

The My Treatment Appointments application was given to users (the pharmacist, doctor, patient and other users) and the application was installed on their mobile phones that run on the Android system. Their opinions were taken about the performance of the application, its behavior, the interfaces used in it, the colors, formats and buttons, and their opinions were positive about the work of the application.

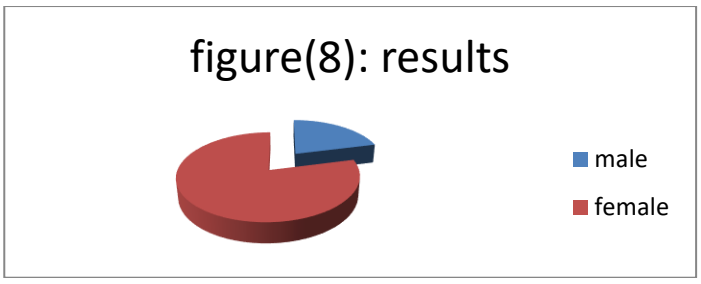
5. Discuss the results:

Varying percentages of answers were obtained for people who used the application, and the results were as follows:

First: general information

5.1 Gender of application users:

The results in the following table show the frequencies obtained and their proportions to the nature of the sex of the people who used the application:



From the above figure it is clear that the percentage of (males) reached approximately (21%), while the percentage of (females) approximately reached (80%), as the total number is a(940) person

5.2 User groups:

The results in following Figure, which show the obtained frequencies and their percentages for user groups:

It turns out that the percentage of students with medical and health specializations reached (56%), while the percentage of pharmacists was (15%), the percentage of doctors was (7%) and the percentage of patients (10) %) and other categories (9%)

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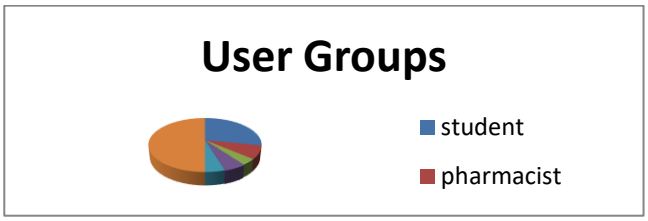


Second: Paragraphs of questions:

The questionnaire included the question paragraphs in several axes:

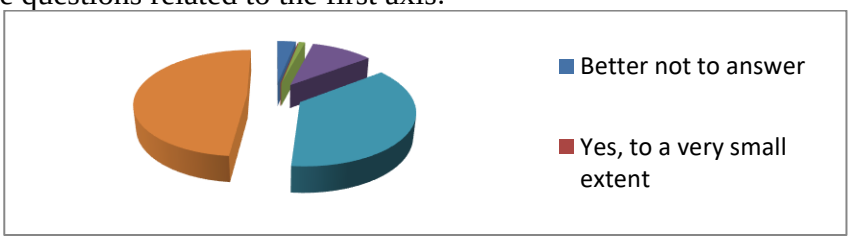
The first axis: the general appearance of the application in terms of its icon, title and aesthetic:

The results in the following table show the percentages obtained from the questions related to the first axis:

The first axis: the general appearance of the application in terms of its icon, title and aesthetic:

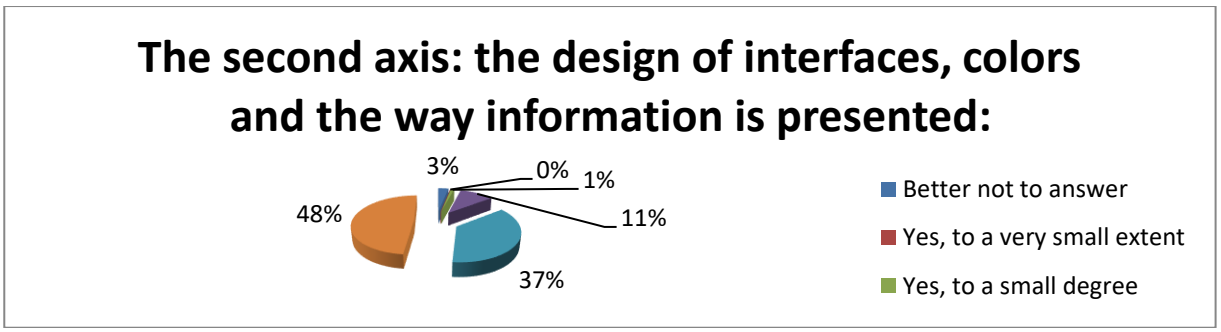
- Does the application icon fit the purpose for which the application was designed?
- Does the title give a clear and explicit impression of the work of the application??
- In general, is the application design appropriate and aesthetically pleasing??

The results of this axis are in the following figure, which show the percentages obtained from the questions related to the first axis:



The second axis: the design of interfaces, colors and the way information is presented:

The results in the following Figure show the percentages obtained from the questions related to the second axis:



The third axis: the efficiency of the application in terms of accuracy, ease of use, and the languages used in it:

The results show the percentages obtained from the questions related to the third axis

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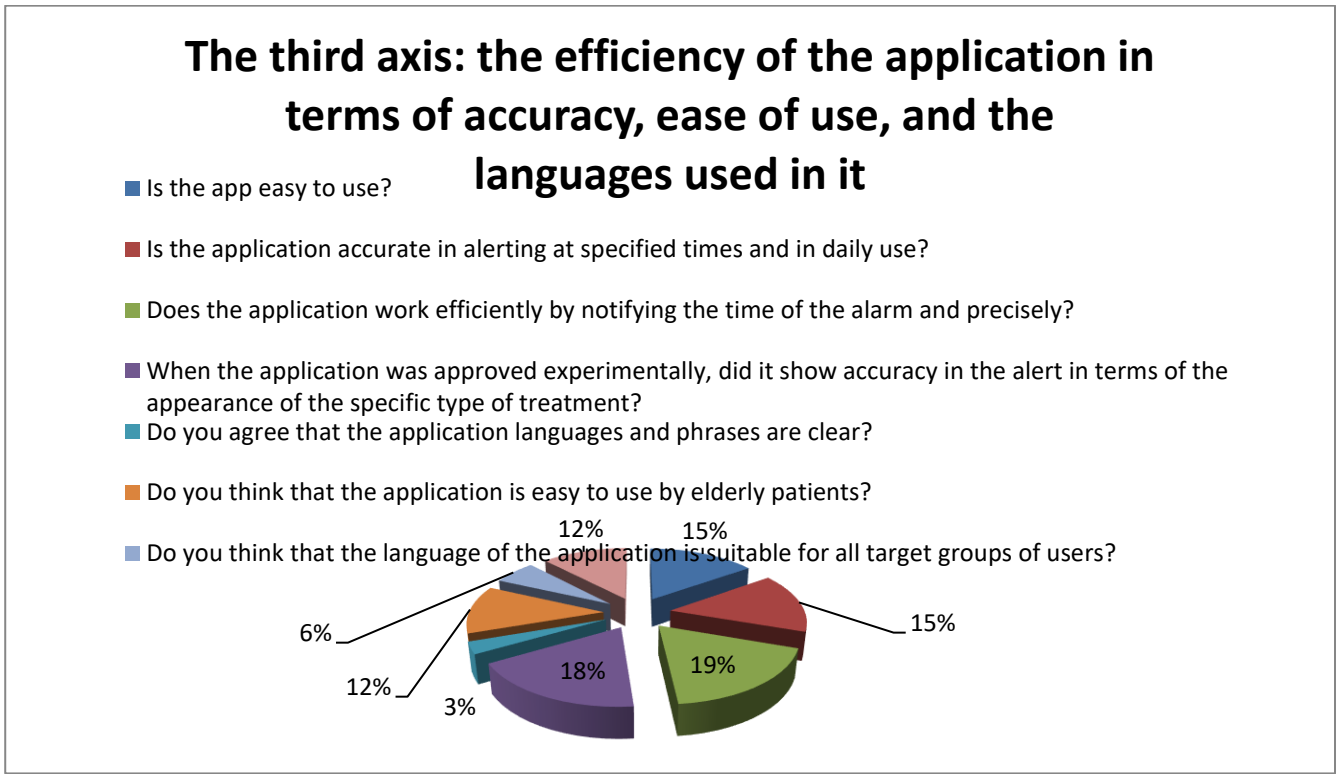
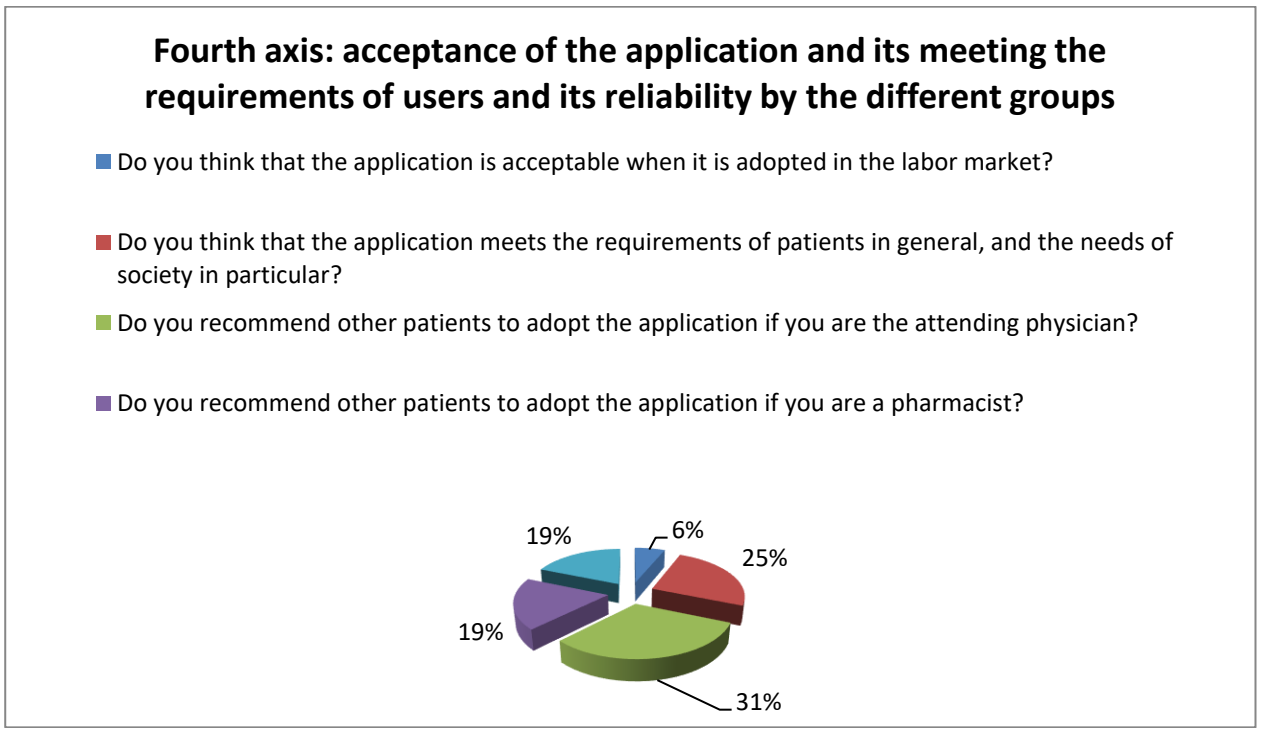


Fourth axis: acceptance of the application and its meeting the requirements of users and its reliability by the different groups

The results in the following Figure shows the percentages obtained from the questions related to the third axis



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