Blood Glucose Monitoring

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ABSTRACT

More and more services are becoming available on mobile applications under people's finger tips making their lives easier and go smoother in this busy world. How about if that service could help to save someone's life. The proposed application for diabetes patient type 1 to follow up the blood glucose. The application works on android operating systems. it is used to make easier monitoring and controlling the blood sugar through recording the blood sugar reading daily for four times, list the reading into a table as well as there is a graph to show the rate of blood sugar comparing with normal level. This idea was chosen because the diabetes is one of the most common diseases in the world and it is difficult to control it only in follow up the sugar level in the blood, then using specific food system. The application uses some medical functions and protocols to provide the user with a simple design and several other features. The important feature is using specific function to give the patient the insulin dose that he should take it.

KEYWORDS : Diabetes, Insulin, Application, Android operating System.

1. INTRODUCTION

Research for design of bio-medical systems which can generate health alerts for critical ailments like Diabetes is one of the major thrust areas for research in this direction [1]. Diabetes is deadly and forms the fifth leading cause of death in the world. It is a group of diseases marked by high levels of blood glucose resulting from problems in how insulin is produced, how it works, or both. Diabetes affects many parts of the body and is associated with serious complications, such as heart disease, stroke, blindness, kidney failure, and lower-limb amputation. The good news is that with increased education, people are recognizing symptoms, like going to the bathroom often, having blurry vision, losing weight, experiencing tingling or numbness in lower limbs, and feeling very thirsty, hungry, or tired. Thanks to earlier diagnoses, improved treatment tools, and better self-care, people are living better with diabetes. Part of that care includes eating healthy foods, exercising, taking medicines like insulin, so they can all help the user take control of his health [9].

Diabetes is due to either the pancreas not producing enough insulin or the cells of the body not responding properly to the insulin produced.[3] There are three main types of diabetes mellitus :

• Type 1 Diabetes Mellitus (DM) results from the pancreas's failure to produce enough insulin. This form was previously referred to as "insulin-dependent diabetes mellitus" (IDDM) or "juvenile diabetes". The cause is unknown.

• Type 2 Diabetes Mellitus (DM) begins with insulin resistance, a condition in which cells fail to respond to insulin properly. As the disease progresses a lack of insulin may also develop. This form was previously referred to as "non-insulin-dependent diabetes mellitus" (NIDDM) or "adult-onset diabetes". The most common cause is excessive body weight and not enough exercise.

• Gestational diabetes is the third main form and occurs when pregnant women without a previous history of diabetes develop high blood sugar levels[5].

Both type1 and type 2 diabetes has to be treated through a combination of antidiabetic drugs, regular exercise, watching your weight and eating right. All these aspects affect the condition differently. [2]

AIM AND OBJECTIVE

The research focuses on self-Monitoring of the level of blood glucose through an application used by the diabetes patient in order to provide methods for integrating the medical equipment required for controlling, collecting the data and sending information to Android Smart Phone in case of emergency. The application gives a rational

description of blood sugar testing, list testing times and frequency [11]. The other goals are introducing and integrating technology into a practical life.

ANDROID OPERATING SYSTEM

The android operating system is basically an operating system for mobiles

and is rapidly gaining market share, with dozens of smart phones and tablets either released or set to be released. Seem likely to see in the near future another mobile phone with considerable promise for the development of educational applications, the Android phone [4]. The android operating system was chosen here because it is providing many libraries that it is possible to get it and makes it easier to apply the idea, like the graph library and OCR library...etc. and for user it is an easy operating system provide access to his file and he can install the application easily [7]. The Android platform promises to be competitive in features with the iPhone and in some areas, eclipse it. It will feature, for example, background access to networks, shared copy and paste, and support for Flash, all missing on the iPhone. [8]

RELATED WORK

Regular glucose monitoring is one of the ways that enable people with diabetes can learn more about their condition. When it is time to make important decisions about medication dosage, exercise, and diet, knowing your blood glucose levels will be a major help for you, your doctor, and the rest of your healthcare team. By checking your blood glucose levels routinely, you'll also know when your blood sugar is too high or too low, both of which can cause symptoms and serious health problems [9]. There are few applications used to monitor the blood sugar. They depend on many factors to determine the insulin dose that the patient must take it, like the weight of the diabetes patient or other factors. One of these applications named Glucosio, it is a free and open source project, created in 2015 by a group of open source developers to develop Android, iOS and Firefox OS applications for diabetes management and research. There are many differences between Glucosio and this application like database, design, graphs [6].

THE THEORETICAL PART

This application has been designed to specifically help managing type 1 diabetes. It provides a reference to monitor and control the level of sugar and clarify the complexities of blood glucose management [10]. The monitoring is done by recording four times reading the

measurement of sugar level through glucose meter, breakfast, lunch, evening and bedtime daily, this is so since a medical protocol dealing with diabetes disease, and using a graph, would enable the patient to see the level of his sugar (high, normal or low) and take the appropriate advice.

METHODOLOGY

The application consists of many layouts demonstrating the properties of the application and the way it works. A layout to be filled in by the patient contains the id, name, age, gender and weight. This information will be saved into database in a table i.e. the application can be used by more than one user, each one uses his own table of reading which connected with reading table by id as shown in figure (1) :

Figure (1) : Information layout

The user's weight is very important because it clarifies the food system for the patient when the level is high or low, as well as it can help to determine the insulin dose that he must be taken. The application also contains an alarm that alerts the patient by receiving notification to measure the blood sugar at a specified time and enter the reading. Another layout is for recording all blood sugar reading four times daily, and save them into the database, the mechanism of the application work is shown in following flowchart :
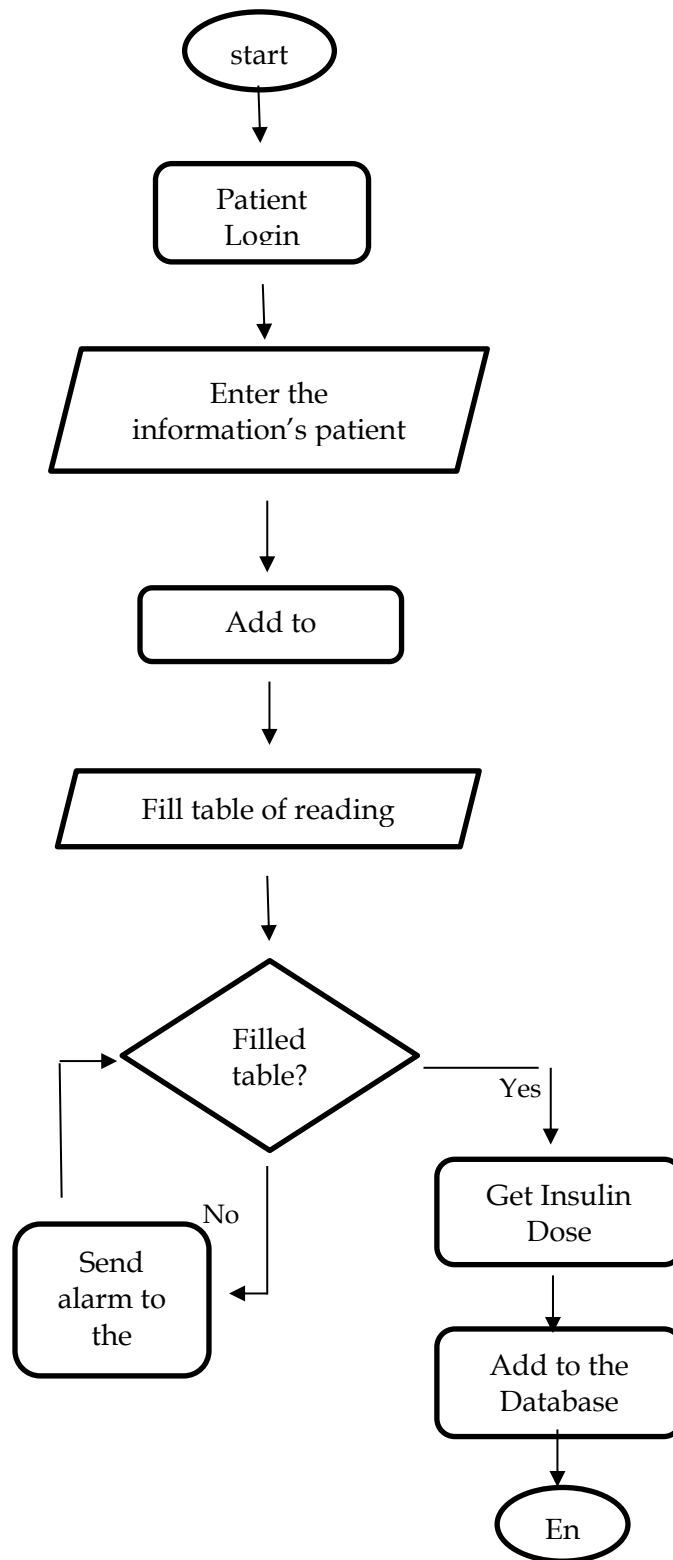
Figure (2) : Flowchart of application

The database structure contains another table with the columns id, days, date, time, blood sugar reading, which must be an integer value because the blood sugar reading in reality is an integer number. The application will calculate the insulin dose by computing the difference between the normal range and the reading (1 unit from insulin per 50 points (mg/dl)). The user can fill the following daily table by hand, or he can enter the blood sugar reading through camera by clicking on "add reading by camera" button. The camera will start and the user can take the blood sugar reading from glucometer picture. He should enter the reading activity four time a day, so as to get the insulin dose in each time in the light of the reading (normal, high or low), then he must click on "add" button to save the information in the database.
Table (1) Daily Record Sheet

Daily Record Sheet			
ID :			
Day/ Date	Time	Reading	Result(Insulin)
Sunday 20-1-2017	Breakfast		
	Lunch		
	Dinner		
	Bedtime		
Monday 21-1-2017	Breakfast		
	Lunch		
	Dinner		
	Bedtime		
Tuesday 22-1-2017	Breakfast		
	Lunch		
	Dinner		
	Bedtime		
Wednesday 23-1-2017	Breakfast		
	Lunch		
	Dinner		
	Bedtime		
Thursday 24-1-2017	Breakfast		
	Lunch		
	Dinner		
	Bedtime		
Friday 25-1-2017	Breakfast		
	Lunch		
	Dinner		
	Bedtime		

APPLICATION LAYOUTS :
First of all, the Introduction layout shows the Services of the application as shown in figure (3) :

Figure (3) : Introduction layout

Introduction layout is a java activity that contains an array of layouts each layout shows in a simple way how the application works. Then the java files are divided according to the working mechanism, as
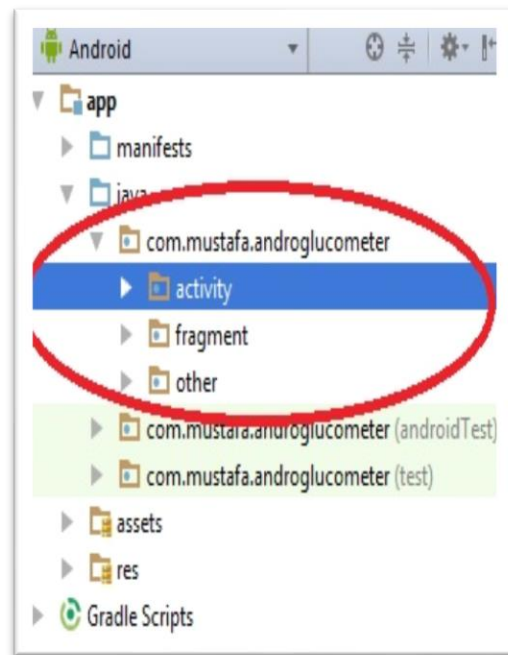Shown in the figure below :

Figure (4) : java files

When dividing the java files according to the same working mechanism at the package, it makes easier for the developer to access to java files, in the activity package, there are all java activity file; in the activity fragment package, there are all the fragments that added in navigation drawer. In another package, there are the database. Also, there is navigation drawer, which is a panel that displays the main navigation options in the application on the left edge of the screen. It is hidden most of the time, but it is revealed when the user swipes a finger

from the left edge of the screen. The navigation drawer contains many fragments, a fragment is usually used as a part of an activity's user interface and contributes its own layout to the activity. To provide a layout with a fragment, it must implement the onCreateView() callback method, which called by the Android system when it's time for the fragment to draw its layout. A fragment always embedded in an activity where the fragment's lifecycle is directly affected by the host activity's lifecycle. For example, when the activity is paused, so all fragments in it are paused, and when the activity is destroyed, so all fragments will have destroyed.
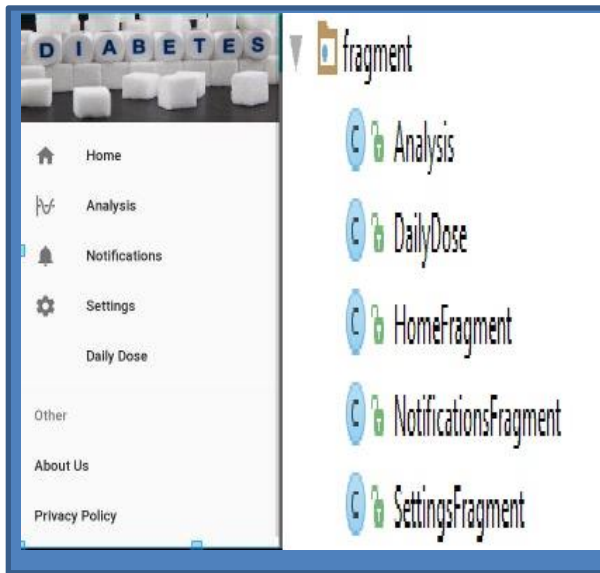

Figure (5) : Fragments

The internal database SQLite database is used; it is embedded into every Android device. Using a SQLite database in Android does not require a setup procedure or administration of the database. Only the SQL statements are defined to create and update the database. Afterwards the database is automatically managed by the Android platform. Access to a SQLite database involves accessing the file system, this can be slow. Therefore, it is recommended to perform database operations asynchronously. A public database is a constructer of class that contains a database name and the version of database. That version of database must be increased if any changes are applied. A method insertAll is added to call it when needed to save the data.

CALCULATING INSULIN DOSE

Generally, one unit of rapid-acting insulin will dispose of 12-15 grams of carbohydrate. This range can vary from 4-30 grams or more of carbohydrate depending on an individual's sensitivity to insulin. Insulin sensitivity can vary according to the time of day, from person to person, and is affected by physical activity and stress.

Bolus – High blood sugar correction

(also known as insulin sensitivity factor)

The bolus dose for high blood sugar correction is defined as how much one unit of rapid-acting insulin will drop the blood sugar.

Generally, to correct a high blood sugar, one unit of insulin is needed to drop the blood glucose by 50 mg/dl. This drop-in blood sugar can range from 15-100 mg/dl or more, depending on individual insulin sensitivities, and other circumstances.

HIGH BLOOD SUGAR CORRECTION DOSE

How to calculate the high blood sugar correction dose?

High blood sugar correction dose = Difference between actual blood sugar and target blood sugar ÷ correction factor.

For Example : assume :

1 unit will drop your blood sugar 50 points (mg/dl) and the high blood sugar correction factor is 50.

Pre-meal blood sugar target is 120 mg/dl.

Your actual blood sugar before lunch is 220 mg/dl.

Now, calculate the difference between your actual blood sugar and target blood sugar :

220 minus 120 mg/dl = 100 mg/dl

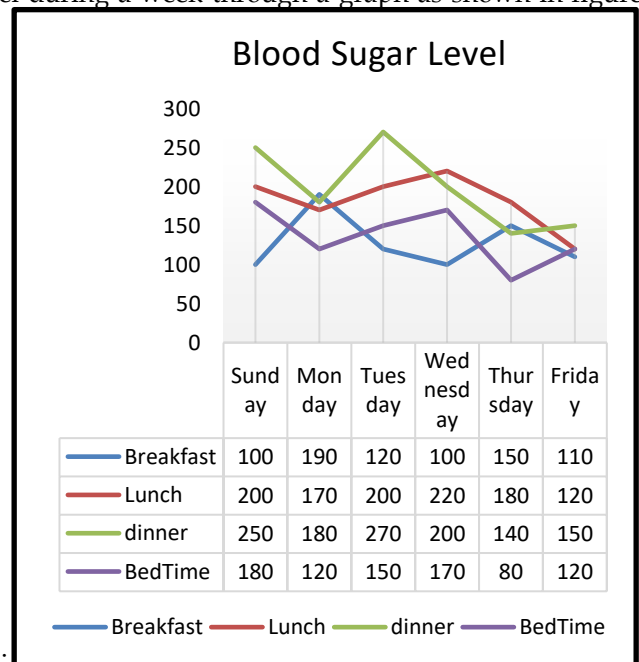To get the high blood sugar correction insulin dose, plug the numbers into this formula :

Correction Dose=

Difference between actual and target blood glucose (100mg/dl)

÷ correction factor (50) = 2 units of rapid acting insulin

So, you will need an additional 2 units of rapid acting insulin to "correct" the blood sugar down to a target of 120 mg/dl. [12]

The patient can observe the changing in his blood sugar level during a week through a graph as shown in figure (6) :

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
Breakfast	100	190	120	100	150	110
Lunch	200	170	200	220	180	120
dinner	250	180	270	200	140	150
BedTime	180	120	150	170	80	120

Figure (6) : Reading sugar level

CONCLUSION

The main objective of this application is to allow patients to monitor their own blood sugar more closely, and to aid them in taking their medication on time. Record the reading in one single application helps medical staff in finding the required information and in better aiding and treating the patients as well. When applying the application, regular testing and recording the blood glucose level on many patients in a week, it is obvious that it helps them to control their sugar level accurately, because the application works as an alarm of danger. Importantly, changes in the blood glucose pattern can alert the patient and his diabetes health care team to the need for a change in the method his diabetes is being managed. The application shows that self-monitoring of blood glucose is an important component of a treatment plan and it is an effective tool to help people with diabetes stay healthy.

FUTURE WORK

- The application can be developed to deal with the two types of diabetes (type1 & type 2). It can also be modified to monitor other diseases, record the reading of measurements and using many factors to make a true decision for treatment, like blood pressure.

- iOS can be used to implement the same application.

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