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M-Healthcare Model: An Architecture for a Type 2 Diabetes Mellitus Mobile Application

Salaki Reynaldo Joshua, Wasim Abbas and Je-Hoon Lee *

Department of Electronics, Information and Communication Engineering, Kangwon National University, Samcheok-si 25913, Republic of Korea
* Correspondence: jehoon.lee@kangwon.ac.kr

Abstract: Type 2 diabetes mellitus (T2DM) is a metabolic disorder wherein the patients require DM management to keep their blood glucose under proper and regular control. Diabetes mellitus can be managed with the help of technologies, one of which is mobile health. Mobile health is an innovation in telemedicine that utilizes gadgets as a medium to access digitally based health information and services by utilizing electronic devices connected to the Internet. Mobile health services are distinguished based on interactions between users and medical personnel; namely, interactive and non-interactive services. The developed application can integrate Android mobile application software with supporting hardware, such as a glucometer, a wearable band, a heart rate sensor, a treadmill, and an exercise bike. The provided features in this mobile application include the monitoring of medication, food intake, exercise, and sleep. This study's goal was to create a mobile application architecture for type 2 diabetes mellitus mobile applications. This research focused on developing an architecture for mobile diabetes applications, a hardware block diagram design, and an architecture of sensors for a type 2 diabetes mellitus mobile application.

Keywords: mobile health; diabetes; architecture; mobile application; mobile operating system

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Citation: Joshua, S.R.; Abbas, W.; Lee, J.-H. M-Healthcare Model: An Architecture for a Type 2 Diabetes Mellitus Mobile Application. *Appl. Sci.* **2023**, *13*, 8. https://doi.org/10.3390/app13010008

Academic Editors: Chien-Hung Yeh, Wenbin Shi, Xiaojuan Ban, Men-Tzung Lo and Shenghong He

Received: 6 October 2022
Revised: 12 November 2022
Accepted: 18 November 2022
Published: 20 December 2022

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1. Introduction

1.1. Smart Healthcare Systems

Smart healthcare systems enable users/patients and related parties in the healthcare sector, such as doctors and nurses, to access, collect, and manage medical data and information quickly and accurately, and to assist in recommending or supporting decisions in the healthcare sector. Still in their early stages of development, smart healthcare systems provide several focused service functions in which software and hardware are integrated to optimize the complete service of the smart healthcare system. Several technological developments in the field of smart healthcare systems help to treat patient illnesses and support the optimization of doctors' health services, whereas, in general, a smart healthcare system's architecture consists of software and hardware [1]. Challenges and supporting technology in a smart healthcare system are indicators that cannot be abandoned. The need (for various types of disease and services) is increasing every day in terms of both hardware and software technology. This, of course, requires appropriate integration so that service needs can be met, assisted by the development of adequate hardware and software technology. Several related studies apply the principles of smart healthcare systems in responding to existing challenges and needs [2].

1.2. Smart Healthcare Systems

Diabetes mellitus (DM) is a metabolic disorder that leads to high blood sugar levels. In addition to type 2 diabetes, there is also type 1 diabetes. Diabetes causes hyperglycemia because the pancreas cannot produce enough insulin. Under other conditions, the pancreas

can produce insulin, but the insulin it produces cannot be used optimally. Both of these conditions can cause blood sugar spikes in diabetics [3].

Diabetes (DM) is generally divided into type 1 diabetes, or insulin-dependent diabetes mellitus; type 2 diabetes, or non-insulin-dependent diabetes mellitus; other types of diabetes mellitus; and gestational diabetes mellitus (Table 1). Type 2 diabetes is a metabolic disorder characterized by hyperglycemia due to insulin resistance and/or deficiency. Patients with type 2 diabetes mellitus (T2DM) need DM management to properly and regularly control their blood glucose levels. Blood sugar levels can increase and decrease in an unstable manner if type 2 DM sufferers do not control their blood sugar levels properly, which can trigger complications [4]. Diabetes mellitus control is carried out using the basic principles of diabetes mellitus control management, including the modification of unhealthy lifestyles to become healthy in the form of diet, physical exercise, and adherence to antidiabetic drug consumption [5].

Table 1. Classification of diabetes mellitus.

No	Diabetes Mellitus	
	Type	**Description**
1	Type 1 [6]	Beta cell damage, generally leading to absolute insulin deficiency [3].
2	Type 2 [7]	It varies from dominant insulin resistance with relative insulin deficiency to dominant insulin secretion defect as a result of insulin resistance [7].
3	Other Types [8]	• Diabetes mellitus is caused by a disease of the exocrine pancreas. • Diabetes mellitus due to drugs (e.g., HIV and AIDS therapy or after kidney transplantation, etc.), chemicals, or infections. • Diabetes mellitus is caused by immunological disorders.
4	Gestational [9]	In gestational diabetes mellitus, the diagnosis of DM is made at the time that a patient's pregnancy is in progress.

Self-management is an integral part of diabetes control. Self-care management of diabetes can effectively reduce the risk of DM (Table 2) sufferers having coronary heart complications; in addition, self-care can control normal blood sugar levels, reduce the impact of DM problems, and reduce DM mortality [10,11]. Self-care performed by DM patients includes diet, eating habits, exercise, monitoring blood sugar levels, medication, and diabetic foot care. Efforts to overcome the weakness of self-care management of type 2 DM in controlling blood glucose levels that develop in the community to minimize DM complications can be assisted by utilizing technological developments [12].

Table 2. Risk factors.

No	Risk Factor [13,14]	
	Factor	**Description**
1	Obesity (overweight)	There is a significant link between obesity and blood sugar levels, and the degree of obesity with a body mass index (BMI) > 23, which can lead to an increase in blood glucose levels of up to 200 mg%.
2	Hypertension	An increase in blood pressure beyond the normal range of hypertensive patients is closely associated with the improper storage of salt and water, or increased pressure in the body of the peripheral vascular system.
3	Dyslipidemia	Dyslipidemia is a condition characterized by elevated blood fat levels (triglycerides > 250 mg/dl). There is a relationship between an increase in plasma insulin and low high-density lipoprotein (HDL) (<35 mg/dL).
4	Age	Individuals aged > 40 years are susceptible to DM, although it is possible for individuals aged < 40 years to avoid DM. The increase in blood glucose occurs at the age of about 45 years and the frequency increases with age.

Table 2. *Cont.*

No	Risk Factor [13,14]	
	Factor	Description
5	Genetic	Type 2 DM is thought to be associated with familial aggregation. The empirical risk in the event of Type 2 DM will increase two to six times if there are parents or family members suffering from type 2 DM.
6	Alcohol and Cigarettes	An individual's lifestyle is associated with an increase in the frequency of Type 2 DM. Most of this increase is associated with increased obesity and decreased physical activity; other factors associated with the shift from a traditional to a westernized environment, including changes in cigarette and alcohol consumption, also play a role in the increase. Alcohol will interfere with blood sugar metabolism, especially in people with Type 2 DM, so it will complicate regulation and increase blood sugar.

1.3. Development Mobile Application

ICT (Information and Communication Technology) is a tool that provides added value by generating high-speed, complete, accurate, transparent, and up-to-date information. The era of information and communication technology is being used to increase the provision of health information. Researchers are trying to innovate to develop diabetes care applications that take advantage of technological developments in providing information for self-care management in controlling blood glucose levels. The diabetes care application is expected to be able to answer the problem as a smart solution to minimize complications that arise in Type 2 diabetes mellitus (T2DM) patients [15].

Android is an operating system for Linux-based mobile devices that appears among other operating systems currently under development with a good set of supported features (Table 3). However, current development operating systems run in a way that prioritizes internally built core applications without taking into account the significant functionality of third-party applications [16]. Therefore, there are restrictions on third-party applications that can capture native mobile data and communicate between processes, and there are restrictions on distributing third-party applications to the platform. An application is a special set of instructions on a computer designed for us to complete certain tasks.

Table 3. Android features.

No	Android Features [17]	
	Features	Description
1	Storage	A data store, using SQLite, a lightweight database.
2	Connectivity	Android not only provides a standard network connection, but also an API that allows apps to connect and interact with other devices using protocols such as Bluetooth, NFC, Wi-Fi P2P, USB and SIP.
3	Messaging	Supports MMS and SMS
4	Media support	Media support for audio, video, images (MPEG4, H.264, MP3, AAC, AMR, JPG, PNG, GIF), and GSM telephony.
5	Hardware support	Camera, GPS, compass and accelerometer.
6	Play store	Online catalog application on smartphones, without using a PC (personal computer) that can download and install applications.

1.4. Previous Research

The Android mobile application's first development efforts were devoted to managing Type 2 diabetes. At this stage, the research team involved 20 people, consisting of 10 people with diabetes and 10 people without diabetes, in the use of diabetes mobile applications with supporting hardware, namely a wearable band, glucose meter, and treadmill [18]. The results of the initial research were used as reference material for the development of the second stage. At this stage, the researchers evaluated some of the functionality and accessibility of the application by conducting tests involving 40 people, consisting of

20 people with diabetes and 20 people without diabetes. The results of the second stage of research concluded that there was a need for changes and adaptation of applications for users, especially related to user registration for applications and glucometer and wearable band (smartwatch) connectivity with various versions [19]. Previous researchers have conducted preliminary research through two previous studies (Table 4).

Table 4. Comparison of our previous work.

No	Comparison of our Previous Work			
	Researcher	Features	IoT Devices	Participant
1	Lee, J.-H.	1. Blood glucose levels 2. Physical activities 3. Dosage or injection 4. Wake up and sleeping time	1. Glucometer 2. Wearable band and aerobic exercise equipment 3. Smart medication monitor 4. Wearable band	20
2	Park, J. C.	1. Blood glucose levels 2. Physical activities 3. Food intake 4. Dosage or injection 5. Wake up and sleeping time	1. Glucometer 2. Wearable band and aerobic exercise equipment 3. Smart food tray 4. Smart medication monitor 5. Wearable band	40

2. Analysis

2.1. Application in Healthcare

An application in healthcare is a program created by a user that aims to complete a specific task (Table 5). An application is the storage of data, problems, and work in a container or medium that can be used to implement or implement existing things or problems in a new form without losing the fundamental values of the data, problems, and work itself [20].

Table 5. Application classifications in healthcare.

No	Application Classification		
	Researcher	Classification	Description
1	I. Contreras	Disease Prediction	Disease prediction applications are applications that are used to help patients/application users to find out the prediction of diseases, along with the overall results of the diagnosis obtained based on the symptoms felt. This application was developed using certain methods according to the scope of the case study (disease) to be analyzed by calculating all parameters related to the symptoms of the disease. The development of this disease prediction application is useful to help doctors and also provide recommendations to patients/users who have difficulty knowing the disease they are suffering from but only know the symptoms they feel.
2	E. G. Spanakis	Clinical Communication	A clinical communication application is a development of technology in the health sector that helps achieve a state or health status as a whole, both physically, mentally, and socially. The focus of developing this application is the focus of communications related to health. The database in this application will store and process the existing data so that it can be useful for later use. Several clinical communication applications provide real-time communication services between patients/users and doctors to conduct health consultations. Doctors can collect information about the patient's health status, or they can access a database to view the patient's medical history.
3	Adu, U. H	Medication	The lack of information about treatment and about drugs is the basis for developing health applications in this field. If it is not handled properly, the patient/customer will self-regulate the drug therapy they receive, which will impact an increase in cases of drug administration errors that are not in accordance with the patient's needs. A medication health application focuses on education about drug information, assisting in health consultations on drug administration based on symptoms, and viewing the history of purchasing/using drugs stored in the database.
4	Lee, J.-H.	Exercise	Exercise health applications, also called health and fitness applications, are applications that can provide information to users related to health and fitness without limitations of place and time, and cam help users to achieve their health and fitness targets. Some exercise applications provide features to be able to connect applications with other supporting devices to collect health information more comprehensively; for example, connecting applications with treadmills, cycles, smartwatches, or other supporting devices used.

Table 5. *Cont.*

No	Application Classification		
	Researcher	**Classification**	**Description**
5	R. K Więckowska	Nutrition	A nutrition application is an application that helps patients/users to find out the number of nutritional needs and nutritional status by referring to nutrition and health sciences efficiently, cheaply, and accurately, where each country has different nutritional guidelines. This is very useful because food consumption affects a person's nutritional status. Good nutritional status or optimal nutritional status occurs when the body gets enough nutrients that are used efficiently, so as to support physical growth, brain development, workability, and general health as much as possible. A nutrition application already has a nutritional value based on a calculated formula (nutritional standards) by accessing the database; the application can find specific numbers (food/beverage) that will be or have been consumed.

The application can be categorized into three groups in its development, namely [21]:

(a) Desktop applications, namely applications that can only be run on a PC or laptop.
(b) Web applications, namely applications that are run using a computer or laptop and an internet connection.
(c) Mobile applications, namely applications that run on mobile devices.

2.2. Mobile Technology and Operating System

A mobile phone is a portable electronic device that functions like a regular phone and can be moved over a wide area. While mobile phones currently use a combination of wireless transmission and traditional telephone circuit switching, packet switching is used in parts of the mobile phone network, especially for Internet access and WAP services [22]. Mobile phones, or "cell phones", are electronic communication devices that have the same basic functionality as traditional landlines, but they can be carried anywhere (mobile) and do not need to be connected to a phone network using a cable (wireless) [23].

The mobile operating system is the primary software that directly manages and controls the hardware, and also manages and controls other software so that it can function (Table 6). Therefore, the mobile operating system is responsible for manipulating the various features and functions available on mobile devices. tasks, keyboards, WAPs, emails, text message scheduling, synchronization with other applications and devices, music playback, cameras, and control features [24]. In addition to the ability to control mobile phone hardware and software resources such as keyboards, screens, phonebooks, batteries, and network connections, the operating system controls all applications to run consistently and consistently. The operating system needs to be flexible so that software developers can easily create sophisticated new applications [25].

Table 6. Mobile operating systems.

No	Mobile Operating Systems	
	Operating System	**Description**
1	iOS	iOS is a software operating system developed by Apple specifically to support the operation of mobile or handheld devices. iOS is used not only on iPhone phones but also on other Apple handheld devices such as iPad tablets and iPod music players. As a handheld operating system, iOS works the same as Android, developed by Google. Basically, the function of iOS is to design the iPhone so that it can be operated by the user. iOS can create a bridge that connects the interaction between the user and the iPhone hardware. iOS is responsible for interpreting user commands for applications on the iPhone so that you can interact with, move, or activate hardware features. Conveniently, iPhone users can take pictures and videos, listen to music, and make phone calls. This is because the iOS feature successfully receives these commands and interprets them for the iPhone hardware. As *Lifewire* reports, without iOS, you cannot use the iPhone hardware or its functions. iOS features are generally the same as those on Android, but there are some differences.

Table 6. *Cont.*

No	Mobile Operating Systems	
	Operating System	**Description**
2	Android	Android is a mobile operating system based on a modified version of the Linux kernel and other open-source software designed primarily for touchscreen mobile devices, such as smartphones and tablets. Android was developed by a consortium of developers known as the Open Handset Alliance, with the participation of Google, a key contributor and commercial marketer. The core of the Android source code is called the Android Open Source Project (AOSP) and is primarily licensed under the Apache license. This allows Android variations to be developed for a variety of other electronic devices, including game consoles, digital cameras, PCs, and other user interface designs. Notable derivatives include Android TV for TV and Wear OS for wearables, both developed by Google. Android source code has been used as the basis for many different ecosystems in the context of its own software suite, Google Mobile Services (GMS), which includes applications such as Gmail, Google Play, and Google Chrome web browsers.
3	Windows Mobile	Windows Mobile is a mobile phone operating system developed by Microsoft but released only for specific markets. The kernel used by Windows Mobile is Windows CE. In the Indonesian market, Windows Mobile is still little known, and it seems that there is not much demand from the general public. At that time, the success of smartphones with Symbian operating systems, from brands such as Nokia, Samsung, and Sony Ericsson, was evident.Originally, Windows Mobile existed in 2000 after Pocket PC 2000, but Pocket PC at that time was not a mobile phone, as it is today, but was generally called a PDA (Personal Digital Assistant). Other than the development of smartphones at the time, the version of Windows Mobile at the time was far from the innovations that have appeared.
4	Blackberry OS	Blackberry OS is a proprietary cellular working device evolved via RIM (Research in Motion) for the company's Blackberry line of hand-held cellphone gadgets. This working device allows for multitasking and enables RIM-exclusive gadgets, such as the track wheel, trackball, and, more commonly these days, the trackpad and touchscreen, to be used in handhelds. The Blackberry platform is possibly well-known for its local support for business communications environments, which enable full Wi-Fi activation and synchronization of email, calendar, tasks, notes, and contacts. These operating system updates can be obtained automatically from Wi-Fi vendors that assist Blackberry in which software is loaded over the air (OTASL). Third-party builders can write software to program the use of the available Blackberry APIs (Application Programming Interface), but applications that use positive capability must be digitally signed.
5	Symbian OS	Symbian OS was created by Symbian Ltd. It is a descendant of Psion's EPOC and runs only on ARM processors, but it has x86 ports that are not officially exposed. Symbian OS can perform multithreading, multitasking, and memory-safe operations. Additionally, all programming in Symbian is event-based; that is, if there is no input in the form of a particular activity, the CPU hardware will be idle. Today, Symbian OS is widely used by suppliers of various mobile communication equipment products for different types of products. This operating system has an application programming interface (API) that allows this deviation from the hardware side on which Symbian OS is implemented. The API supports common hardware communication and behavior that can be used with other application objects. This is possible because the API is an application-level-defined interface object that contains procedures and functions (and variables and data structures) that manage or call the kernel and act as links between software and hardware. This API standard helps developers customize their applications so that they can be installed on a variety of mobile phone products.

2.3. Telehealth

Telecare is a part of telehealth. Telecare focuses on the therapeutic side, while telemedicine covers the prophylactic, preventive, and therapeutic aspects [26]. One of the functions of telehealth, and a major requirement in providing health services, is patient monitoring and scheduling. The coverage of telehealth, telemedicine, and electronic health (e-health), telecare, and m-health is described by Totten AM et al. [27].

3. Research Methodology

3.1. Research Method

The research was conducted at the Circuit and System Design Laboratory at Kangwon National University. The research was performed by carrying out several systematic stages (Figure 1) in order to produce research reports and products (Mobile Application) that were in accordance with the objectives of the research implementation. The research method included six stages, starting with identification of the problem, setting the research scope, data and information gathering, software development, analysis, and the final report.

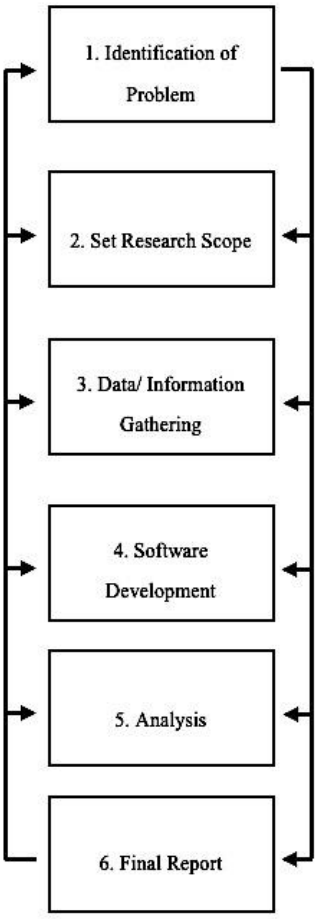


Figure 1. Research method.

3.2. Software Development Methodology

In developing this application, we used the prototype model [28] as an approach to mobile application development. We performed three stages: creating and revising the mockup, conducting customer test drives, and listening to customers. All steps in this prototype model were chosen because they were in accordance with the project being developed, which does not have many stages, and the parties or teams involved can also be maximized in the three existing stages [29,30].

4. Proposed Architecture

4.1. Mobile Application

The development of the architecture (Figure 2) for the Type 2 Diabetic Mellitus Mobile Application is broadly divided into three major parts:

- Medical Sensor and Exercise Equipment

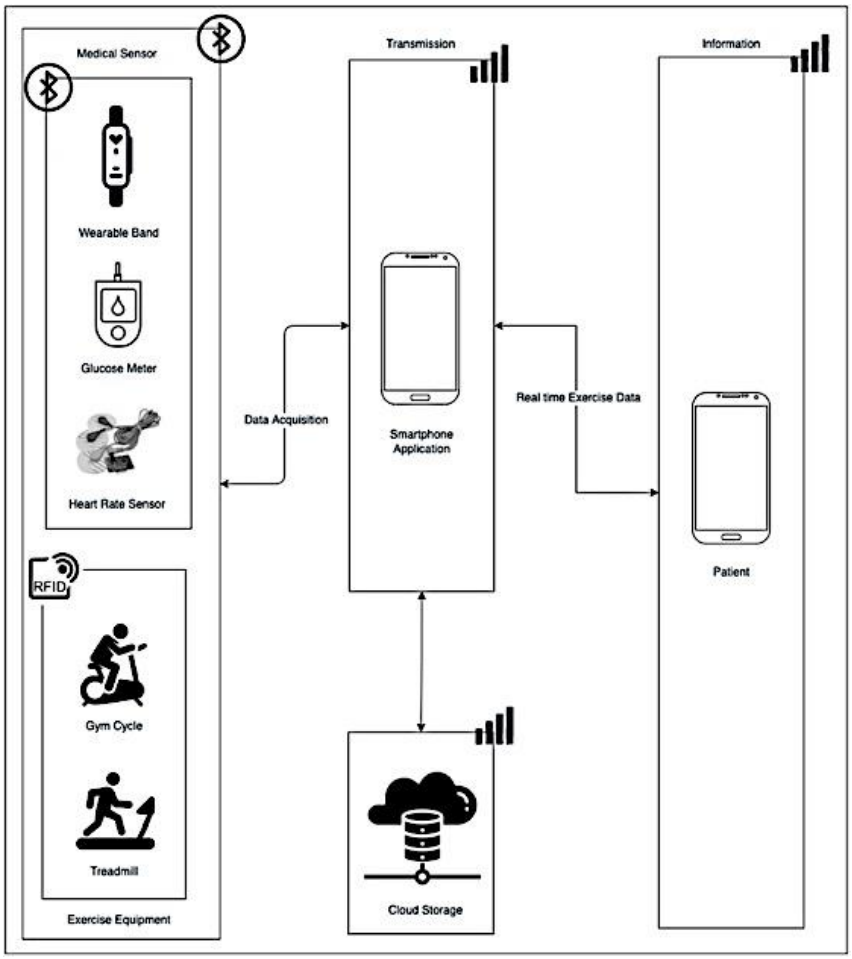


Figure 2. Proposed architecture for diabetic mobile application.

Medical sensors in the architecture section include supporting devices (inputs) in the form of wearable bands, glucose meters, and heart rate sensors. The exercise equipment consists of a gym cycle and a treadmill. In this section, the device is Bluetooth- and RFID-compatible. In this section, the device will work for the next stage of data acquisition before going to the transmission section.

- Transmission

Transmission in the architecture section consists of smartphone applications and cloud storage. In this section, the smartphone application receives input data from the Medical Sensor and Exercise Equipment section, which is referred to as the data acquisition process. The processed data are stored in cloud storage, and in this part of the process, the entire process is supported by the Internet network.

- Information

Information on the architecture is the final part (output), namely the process after the data are processed in the transmission section. The process at this stage is called "real-time exercise data", where the processed data can be received at the same time by the user (patient) with an Internet connection as network support.

4.2. Hardware Design and Implementation

The hardware design and implementation for the Type 2 Diabetes Mellitus Mobile Applications are written in block diagram format (Figure 3). Eight blocks (Figure 3) consist of RFID, DAQ for Treadmill and Gym Cycle, Heart Rate Sensor, Wearable Band, Glucometer, Signal Integration, Calculation and Memory, Smartphone Application, and Patient. The

first five blocks consist of RFID, DAQ for Treadmill and Gym Cycle, Heart Rate Sensor, Wearable Band, and Glucometer, which interact with the Signal Integration, Calculation and Memory block, which in turn send User ID, Exercise Data, Heart Rate, Number of steps, Heart Rate and Blood Glucose Levels, where the data received in the Signal Integration, Calculation, and Memory block will interact with the smartphone application block to send Real-Time Exercise data. The last block is where the patient interacts with the smartphone application block, which is a process of real-time monitoring alerts.

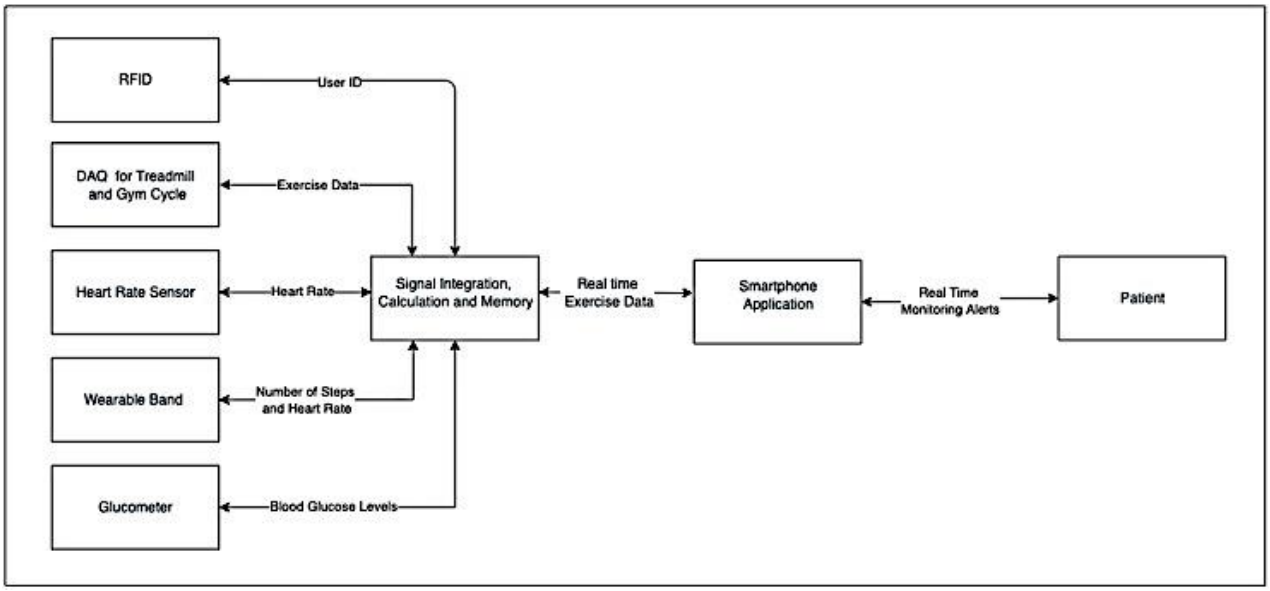


Figure 3. Hardware block diagram.

4.3. Sensor

The sensor is one part of the Type 2 Diabetes Mellitus Mobile Application. In Figure 4, the architecture of sensors is clearly described, starting from the deployment of sensors, active sensors taking measurements, reading RFID tags, and entering mobile applications. Then, in the stage of analyzing the measurement, there will be two choices: namely, updating details in storage with normal or above-normal conditions, or storing the updated data in the database and receiving real-time monitoring alerts.

4.4. Sensor User Interface

The user interface (UI) is what the user interacts with as part of an experience (Table 7). UI is not just about colors and shapes; it is about providing users with the right tools to achieve their goals. In addition, UI is more than just buttons, menus, and forms that the user must fill out. When the system and users can interact with each other through commands such as using content and entering data, this is referred to as a user interface. The user interface is one of the most important parts of application development because it relates to the user and can be seen, heard, and touched. At this stage, the researchers developed a user interface related to the appropriate needs and related to the development of the Type 2 Diabetes Mellitus Mobile Application.

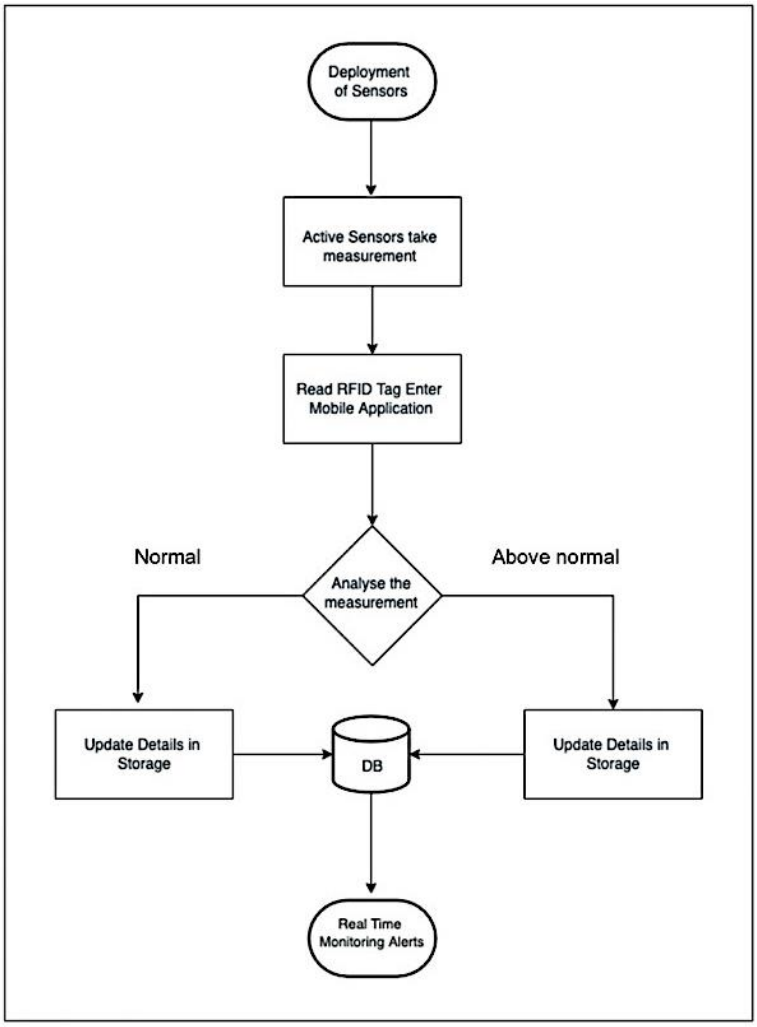


Figure 4. Architecture of sensor.

Table 7. Design user interface.

No	User Interface of Mobile Application		
	Page	**User Interface**	**Description**
1	Login		On the login page, the user will fill in data in the form of ID and password (if previously registered), while for new users, the application provides services to register by filling in detailed data or automatically using a Google account.

Table 7. *Cont.*

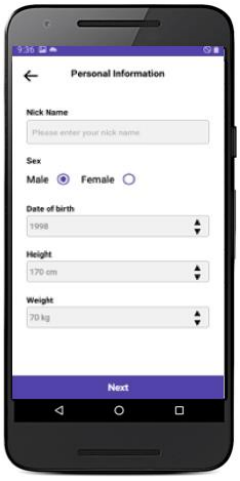
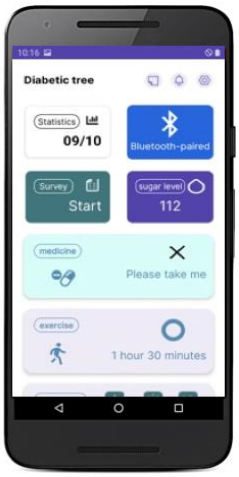
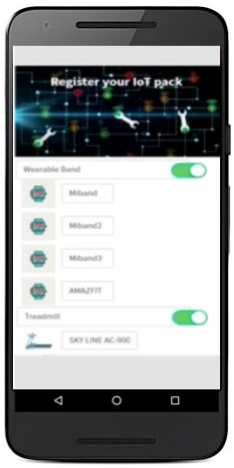
No	User Interface of Mobile Application		
	Page	**User Interface**	**Description**
2	Personal Information		Users are asked to enter information about their nickname, sex (male or female), date of birth, height, and weight on the personal information page.
3	Home		On the home page, the application briefly displays features that can be explored by users in the form of icon visualization, such as statistics to view the results of health data calculations, Bluetooth connections to devices, surveys, sugar levels, medicine, exercise, and a calendar.
4	Register Internet of Things Pack		Register for the Internet of Things Pack is a page used by users to connect applications used with devices owned by them, such as wearable bands, glucometers, treadmills, etc.

Table 7. *Cont.*

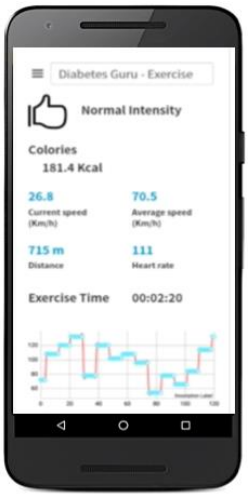
No	User Interface of Mobile Application		
	Page	**User Interface**	**Description**
5	Monitoring Medication		The medication monitoring page enables users to view or control the medication intake schedule as recommended, or it can be entered manually by the user.
6	Monitoring Food Intake		The food intake monitoring page allows users to directly control food intake by making direct adjustments at the specified time, which is divided into three parts, namely breakfast, lunch, and dinner.
7	Monitoring Exercise		The exercise monitoring page helps users see the exercise that has been done. The results of the exercise are in the form of current speed, average speed, distance, and heart rate.

Table 7. *Cont.*

No	User Interface of Mobile Application		
	Page	**User Interface**	**Description**
8	Monitoring Sleep		The sleep monitoring page is visualized in the form of charts and calendars to make it easier for users to see the results of the evaluation and monitoring of sleep. The total presentation, as well as the average rest and sleep hours of the user concerned, can be seen.

5. Testing

Researchers conducted an evaluation stage on the development of a diabetes mobile application for 40 participants who were users of mobile-based diabetes applications (diabetic patients). Evaluation of user acceptance testing for mobile applications (Figure 5) adapted five main factors at the application testing stage (Table 8), which included functionality, ease of use, usefulness, security and privacy, and cost factors. Based on the results of the evaluation using a Likert scale (strongly agree, agree, neutral, disagree, strongly disagree) with an assessment weight of (5, 4, 3, 2, 1), the average value of factor functionality was 4.57, ease of use 4.67, usefulness 4.75, security and privacy 5.0, and cost 4.70. Based on the results of this evaluation, there are two indicators that have an evaluation value with an input value of 3 (neutral), namely the functionality and ease of use factors.

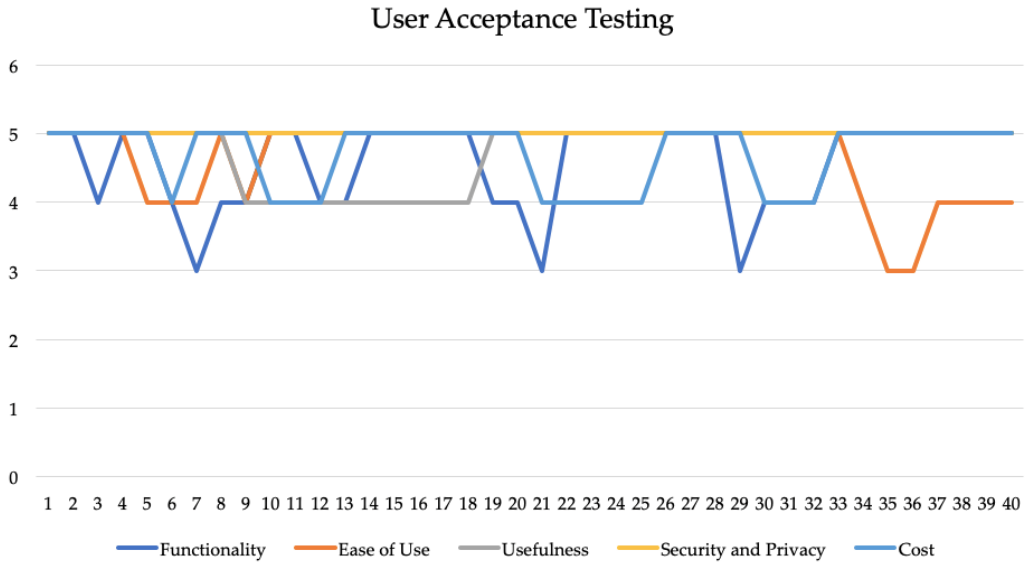


Figure 5. User acceptance testing for mobile application.

Table 8. Testing factors.

No	Testing Factors	
	Factors	**Variable**
1	Functionality	• Quality of Information • Core of Function • Personalization
2	Ease of Use	• User Interface Design • Efficiency
3	Usefulness	• Usefulness
4	Security and Privacy	• Security and Privacy • Authentication
5	Cost	• Cost

6. Summary and Conclusions

The development of the Type 2 Diabetes Mellitus Mobile Application involves an operational feature that allows an application to run according to specified requirements and can integrate an Android-based mobile application with supporting hardware such as a glucometer, wearable band, heart rate sensor, treadmill, and gym cycle. The provided features in this mobile application include monitoring medication, food intake, exercise, and sleep. Architectural Design for Diabetic Mobile Applications, Hardware Block Diagram Design, and Architecture of Sensors will be useful for the application development team as a benchmark or guideline for what kind of application or product will be produced. Based on the results of the analysis, this study resulted in three proposed architectures: namely, the architecture for mobile applications, the hardware block diagram, and the architecture of sensors, which clearly describe the operational functions that exist in the Type 2 Diabetes Mellitus Mobile Application. On the other hand, the architectural design will support the success rate of application development, so that applications can be useful and optimally utilized both by patients and doctors involved in the treatment of type 2 diabetes (T2DM). This study is also intended to serve as a reference for researchers who are currently conducting or will be conducting research in the field of developing type 2 diabetes mobile applications.

Author Contributions: S.R.J.: project evaluation, methodology, investigation, resources, supervision. W.A.: software developer, functionality evaluation. J.-H.L.: conceptualization, funding acquisition, resources, supervision, writing—original draft, writing—review and editing. All authors have read and agreed to the published version of the manuscript.

Funding: This research was supported by "Regional Innovation Strategy (RIS)" through the National Research Foundation of Korea (NRF), funded by the Ministry of Education (MOE) (2022RIS-005).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

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