



Design and Implement the Innovative Drugstore for Health Care Services Based on Health Mobile Applications and Advanced IoT

Yusur S. AL - Saffar, Sabah A. Gitaffa , Abbas H. Issa * 

Electrical Engineering Dept., University of Technology-Iraq, Alsina'a street, 10066 Baghdad, Iraq.

*Corresponding author Email: abbas.h.issa@uotechnology.edu.iq

HIGHLIGHTS

- The smart pharmacy works with the smart system through IoT technology.
- The health care problems are errors in taking medication and improper storage of the medication.
- This paper provides an integrated system for health care services for patients and provides a solution to them by an Innovative drugstore.

ABSTRACT

The health care problems are errors in taking medication, improper storage of the medication, irregularly taking the medication on time, and not knowing the side effects of taking medication with different foods. This work aims to find an integrated system that works on informing people of the medicine they take, the exact dose of the medicine at all times, keeping the medicine from spoiling, alerting the patient to the side effects of the medicine, and creating tables for taking the history of taking medicines. This assists doctors when going to the hospital in emergency cases. The innovative drugstore is built from Digital Temperature and Humidity Sensor, Magnetic Door Sensor, Keypad, Arduino Mega, Esp8266 modules Arduino, Liquid Crystal Display, built-in cloud-based on firebase database, build Smart application works on mobile phones, and computer operating systems based on the JavaScript language. The innovative drugstore uses Internet of Things technology to automate the control of all previous parts. The innovative drugstore efficacy has been tested on 12 drugs that differ from each other in use and properties and proven to be effectively enhanced by results through adherence to dose (96.45%), time to adherence (96.18%), and expiration (97.81%). The early pharmacy operates on-site as it is provided with a username, password, and on-site alerts from a Light Emitting Diode alert bell. The smart pharmacy also works with the smart system through IoT technology. The smart pharmacy can be used in different workplaces, homes, and hospitals.

ARTICLE INFO

Handling editor: Ivan A. Hashim

Keywords:

Arduino Mega
Real-time Database
DHT 22
Healthcare Application
Innovational drugstore using internet

1. Introduction

In recent years, the world has witnessed outstanding achievements in modern societies, as societies witnessed a revolution of development in various fields, especially medicine and nutrition. This development was accompanied by an increase in the number of years that the elderly live compared to the past years [1,2]. The main challenges in the health care field for seniors are making them commit to medical appointments [3], taking the proper medication, knowing the exact dosage of each, examining the drug-food interactions, and the ideal way to store the drugs [4,5]. Therefore, the researchers intensified their efforts to find promising solutions in the healthcare field. In contrast, hospitals require large numbers of specialists and doctors besides providing proper infrastructure and large financial burdens [6,7]. Adopting at-home healthcare solutions instead of traditional hospital healthcare is the ideal solution in modern times [8,9]. The emergence of modern technologies and the adoption of advanced technology and its applications in the healthcare field have a prominent role in developing the at-home healthcare sector. Internet of things (IoT) technology has brought a qualitative leap in this vital sector [10-12]. The establishment of the innovative drugstore is to connect the various components of electronic parts and sensors with smart applications that allow the creation of a database in the electronic cloud with a mobile application user interface for data entry and output [13-16]. This paper provides an integrated system for health care services for patients. It provides a solution to them by an Innovative drugstore that aims to preserve the types of medicines they need, alerting the patient when to take their medicine, providing the patients with the information they need, organizing schedules such as the days of taking medicine and determining the course duration.

2. Related Works

Health care is one of the most prominent areas in which researchers have focused their efforts because of its great role in people's lives. Many researchers went to solve healthcare problems using IOT technology, and we mention them as the closest to this study. Elie et al. the researcher's study relied on isolated areas with few pharmacies, forcing some to stand for a long time to get the medicine. The researcher suggested relying on IoT technology to search for medicine in the pharmacy and keep the medicine from spoiling by using sensors that maintain the pharmacy temperature [14]. Thierry et al. this study is based on finding solutions for healthcare systems in sub-Saharan Africa that face a shortage of medicines. This study uses smart medicine that adopts Internet of Things technology in the drug supply monitoring system and drug delivery at specified times to increase adherence to treatment times [17]. Julia et al. this study suggested using IoT technology to obtain a healthy and safe environment. The study relies on sensors that send data, and health data is sent and processed according to IoT technology, according to standard definitions [18]. Sivakumar et al. this study deals with the problem of patients waiting for long periods in the pharmacy to obtain the drug. The study aimed to solve the problem by creating an embedded system that distributes medicines automatically to reduce time and human errors [19]. Regina et al. this study aims to find suitable options for consumers. The study relied on developing a smartphone application for purchasing medicines from pharmacies. The study was conducted in Jakarta, Indonesia, by ordering medicines through the application and sending the medicine to the customer without going to the pharmacy [20].

3. Proposed System Methodology

The proposed system has two main parts; the physical part and the smart application based on the database part. The physical parts components include all the mechanical devices and electronics for the drugstore. At the same time, the smart applications are used to create a database to save the information and program a smart user interface for data entry and extraction. All components of the innovational drugstore are controlled by the IoT technology that availability users with the best services by monitoring and controlling all work requirements to produce the required results. The cost of one cube is \$80. Figure 1 shows the general block diagram of the proposed drugstore.

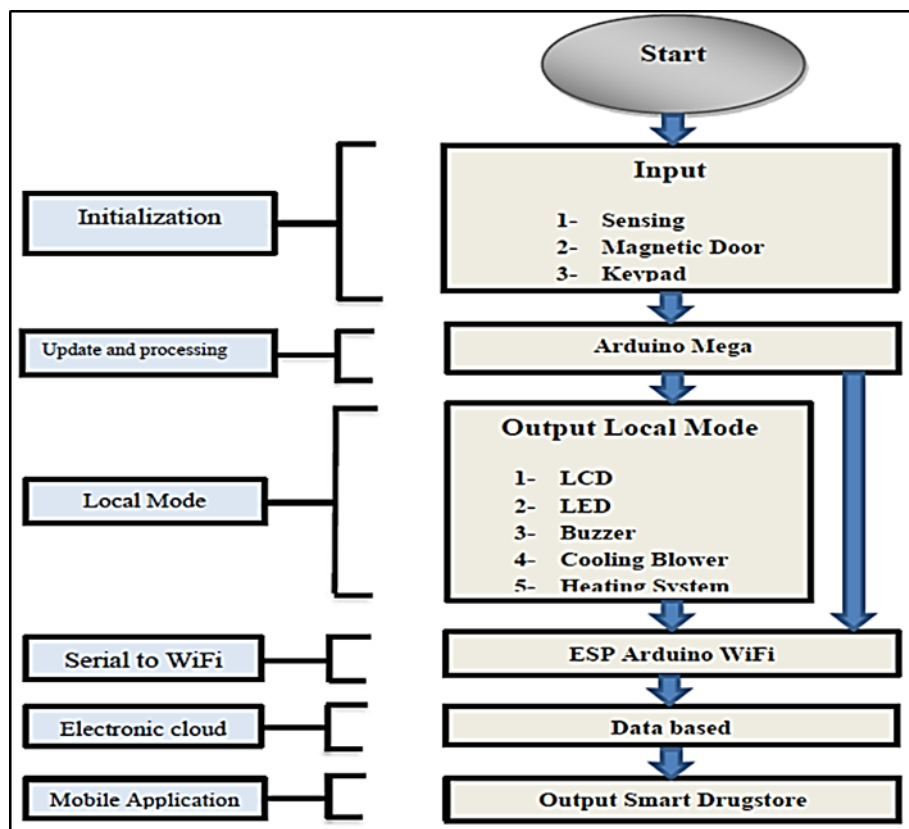


Figure 1: General Block diagram for the innovative drugstore system

3.1 Dht22

Monitoring temperature and humidity are very important in various applications. However, many types of temperature and humidity sensors differ in their ability to measure the different temperatures and humidity, measurement accuracy, and sensitivity. Whereas the temperature and humidity of medication are monitored using IoT technology. To safely store medication, we need specific degrees of storage and storage of medication in the wrong degrees of humidity or temperature, which leads to their spoilage, causing great harm to the patient. Various drugs need temperatures ranging from (-20-30) degrees Celsius. This range can be obtained using the DHT22 sensor. It is characterized by measuring the temperature (-40-

80), an accuracy of (+/- 2% for humidity, +/- 0.5°C), humidity (0-100%), suitable for long-term use, and the price are relatively affordable. The prominent features of the DHT22 sensor make it the best product that can measure temperature and humidity and is controlled by IoT technology.

3.2 Magnetic Door Sensor

The innovative drugstore consists of four cubicles separated by insulating materials and a separate door. Each cube can be operated at a certain temperature and humidity. Keeping medicines from spoiling requires controlling and monitoring the temperature of the cubicle and keeping the door closed when not in use. However, patients may forget to close the door, especially elderly users. To overcome this problem, the magnetic door sensor is used, which consists of two wires separated by a specific distance. The sensor senses the complete closure of the door if the two wires are not connected. On the contrary, if the door is open, the sensor connects with the buzzer that alerts when the door is not closed well for over 10 seconds.

3.3 Keypad

The keyboard, in general, is used to enter data as used in computers. There are keyboards of different sizes and shapes, all of which are similar in functions. Here, a keyboard with four rows and four columns intersects with each other to form 16 buttons. The keypad contains the numbers (0-9) and four letters (A, B, C, and D) as well as two signs (#, and *). The keypad is connected to the Arduino Mega for data entry setting control and security.

3.4 Arduino Board

Arduino Mega is an open-source platform designed for programmers and specialists developing various scientific fields. It receives input and output signals from different sensors. This type of controller is programmed using the C programming language. Our Arduino Mega microcontroller consists of 16 digital ports, 16 analog ports, a memory capacity of 256 KB, and the potential difference is 5 volts. Data received from the input devices (DHT 22, magnetic door sensor, and keypad) is processed in the innovative drugstore. Temperature and humidity stored in the database and the data entered by the mobile application user interface are adjusted. The magnetic door sensor also communicates data to the controller to process and send specific alerts. The output devices are connected to the micro-controller (cooling system, buzzer, LCD, LED). All data is processed by the controller to keep medicines from being damaged and ensure the safe use of the innovative drugstore.

3.5 Cooling system

An innovative drugstore is designed to meet the seniors' needs and keep medicines from spoiling. At the same time, medication safety is achieved by maintaining temperatures and humidity. As each medication has a specific temperature to store, four cubes are designed in the smart drugstore. The cubicle's temperature varies according to the type of drug stored in it and can be adjusted by the Arduino Omega controller through the cooling system. The cooling system consists of a refrigerant compressor, cooling tubes, and an air blower to pull the cooling air into the cubical to get the desired temperature.

3.6 Buzzer

We pay attention to details to get the best performance in the proposed drugstore. For example, maintaining the temperature of the cube requires that the cube remain closed when not in use. Sometimes, the Alzheimer's patient forgets to close the door, and thus the medicine will be damaged. This problem was fixed using an alarm buzzer.

3.7 Lcd Arduino

It is necessary to display the output of the innovative drugstore. It is used to display the output of innovative drugstore components on the LCD screen. The display is connected to the Arduino Mega microcontroller for information exchange. The display screen is used for each cube because the cubes' data vary according to use. When using the innovative drugstore for local mode, the outputs of temperature and humidity are displayed, display screen connects to the microcontroller, Wi-Fi connection, cooling system, and device security type.

3.8 LED

The innovative drugstore meets all the needs of the senior. It is common for seniors to lose their hearing, so reliance on the buzzer will not be enough. The visual alert method was also adopted as an additional means of alerting. LED lights were used to alert each cube's operation and provide the drugstore with the electrical energy necessary to operate it.

3.9 ESP Arduino

Arduino's open-source microcontroller supports Wi-Fi, which enables the application of IoT technology to connect the components of the drugstore to the internet. This type of micro-controller consists of 10 pins used for digital input and output, a voltage of 3.3 volts, 4 ground pins, two buttons to install the operating system, an analog input, and a voltage regulator to operate the controller with a voltage-ranging (3-10) volts. In this work, the ESP NODE MCU -12E Wi-Fi microcontroller has been used as it was programmed in the Arduino language IDE. First, the ESP microcontroller is connected to the Arduino Mega microcontroller by serial communication (TX, RX). Then, it is connected on the other side to the database created in the cloud. Finally, the ESP microcontroller is connected to the database using a WLAN connection.

4. Database

Given the many types of medications, their versatility, and the many instructions accompanying the medication use, creating is necessary Servers are the most used solution for storing data. However, using servers is accompanied by some disadvantages and high prices, t. Therefore, it relied on high technology save effort, low operating costs, top security, and ease to use. The electronic cloud is one of the magic solutions for creating a database. Google provided a service (Google Firebase) for programming a database with many features such as data security, easy-to-use, data change in real-time, and the ability to modify data, sending various notifications. The database is managed by a specialist with a wide knowledge of the subject. Also, the database includes all data for each cubical such as medical information for medication use and drug usage history from starting registration at the drugstore until the present.

5. Mobile Application

The tremendous development in smartphone technologies, versatility, and popularity made it the best tool for researchers in various fields. The healthcare sector needs to take advantage of smartphone applications for their ability to carry out various tasks. Smartphone applications allow the use of IoT technology, one of the best modern technologies, because of its tremendous features. Our drugstore application was created using the programming language (JavaScript), one of the best programming languages characterized by exceptional ability. The application can be used with various operating systems, such as Android and iPhone, as well as computer operating systems. Our application will be available to download once it is done being programmed. The application operates with IoT technology that connects the user to the database through the smart application with the internet presence. The mobile is registered to the application using a username, password, and user information to achieve the necessary protection for each user. If the password is forgotten, it will be sent via e-mail. Figure 2 shows the sign-up and sign-in methods in the proposed mobile app for the drugstore. The user welcome interface appears to the user after sign-in the application, and the other main menus appear after pressing "skip". The main menus include the cube information menu containing all the cube details, the schedule's list containing drug timing schedules, the list of drugs representing complete drugs information, and their user list.

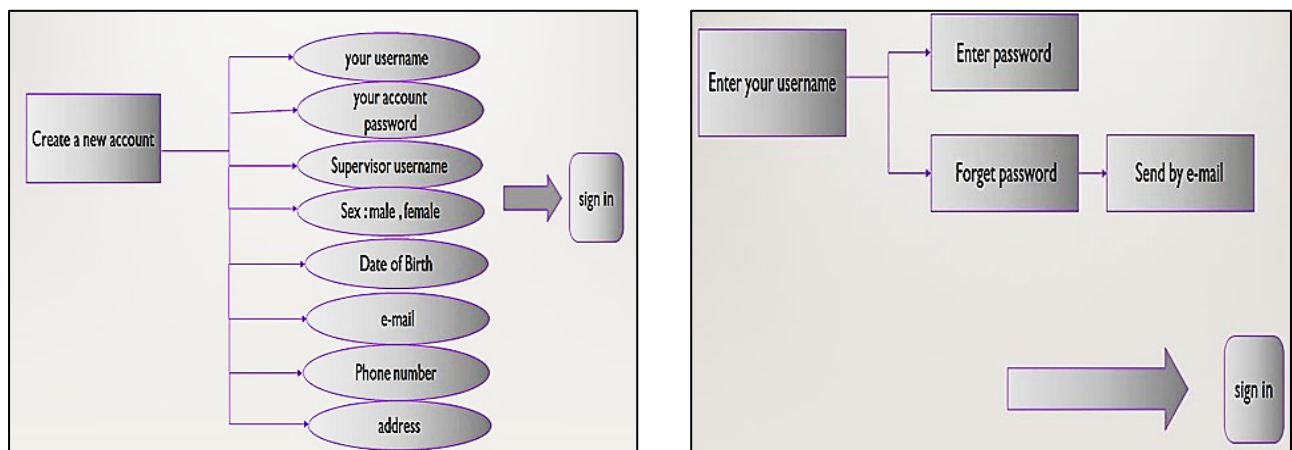


Figure 2: The registration method in the smart drugstore. (a) The user sign-up into the application for the first time, (b) the user signs in to the user interface of the application

6. Results and Discussion

All results obtained from the creation of the innovative drugstore will be explained. However, this study relied on a specialized person (admin) who manages everything related to the database because of the large amount of information, so it may be hard for the senior user to keep up with, so a supervisor must be assigned. The innovative drugstore is designed to meet all requirements of the elderly and can be used in both local and smart modes.

In the local situation mode, the innovative drugstore's physical parts have been linked to include four cubicles, each of which can be used with characteristics that distinguish it from the rest. Each Cube contains a DHT22 Sensor, Magnetic Sensor, Keypad, Arduino Mega Controller, Cooling System, Buzzer, LCD, LED, and Arduino ESP. With the Keypad, the data of the physical parts are entered and adjusted. The output is shown on the LCD screen. The innovative drugstore is operated in the local mode, using product protection through (armed status), setting the temperature, maintaining the temperature by keeping the door of the cube closed when not in use, monitoring the target temperature, and changing the password as follows:

- 1) The innovative drugstore operates safely as the armed feature can be activated using the passcode. However, when using the armed feature, a username and password are required for using the drugstore, which can be used in a disarmed mode, and safety will be disabled. Figure 3 shows the use of armed and disarmed for the product.
- 2) The door can be opened by entering the letter B. If the security feature "armed" is turned on, it will ask for the passcode before opening the door, while if the security feature isn't enabled "disarmed", the door will immediately open with no code. Figure 4 shows the process of opening the door of the cubical.

- 3) The letter C is used to change, set, and save the target temperature of the cubical to ensure that the medication is not damaged inside the cube. Figure 5 shows the settings function and automation preservation of the target temperature. The temperature can be changed when the medicine is stored inside according to its required storage conditions by entering the passcode and adjusting the temperature.
- 4) If the user wants to change the passcode for security reasons, it can be done by entering the symbol "# and confirming the new passcode". Figure 6 shows how to change the passcode.

The results of "Smart Mode" are linked to each other using IoT technology when connected to the Internet, where the output of the database in the electronic cloud is connected with the outputs of the smart mobile application in real time. In contrast, the database is connected to the physical parts of the drugstore via ESP Arduino, which supports Wi-Fi. The product was used on 11 people and proved successful, as shown in Table 1.

There is a wide variety of drugs and abundant information for each drug, which makes the provision of a database an urgent necessity. A database was created in the electronic cloud where a specialized admin handles entering and updating all the information, initially were ten medications as an example. The user information is entered into the mobile application and automatically saved on the database in real-time also recorded two medications. While the database consists of five main menus: First is the cube list, which includes the basic information about the cubicles, such as; the cube name, target temperature, current temperature, security mode, operating status, and cooling system. Second, a "cube dosage reminder" list includes the dose, the number of doses, and the name of the drug. Third, the "drug list" has all the drugs stored in the database by the specialized admin with its classification, name, use instructions, and the required storing temperature. Fourth, the list of "used medicine" that the user is currently taking includes the cube name, duration, expiry date, medicine name, instructions, start date, temperature, number of times of use per day, and time of taking the dose. Finally, a "list of users" includes usernames, user addresses, email, and phone numbers. Figure 7 shows all the results of the database.

Creating the mobile application was one of the most important stages of making the innovative drugstore. The data is entered and controlled by the user interface. However, the data exchange between mobile applications and other drugstore parts is carried out using IoT technology. Table 2 shows the mobile application results. The mobile application includes the following main menus: First, the "drug list search" that includes sub-menus is used to search for medicine previously stored in the database. Second, the "schedule" includes lists of sub-menus containing drug dose information, dose alerts, dose confirmations, and instructions. Finally, the "user list" includes all users. All the menus (main and sub) mentioned contain all information related to security, temperature, drug name, required dose, time of the first dose, remaining dose dates, dose date, dose alerts, and type of medicine.



Figure 3: The use of armed and disarmed. (a) the use of armed, (b) the use of disarmed



Figure 4: Opening of the cube door. (a) use of letter B, (b) the door is opening



Figure 5: The settings function and automation preservation of the target temperature. (a) using the letter C, (b) show target temperature

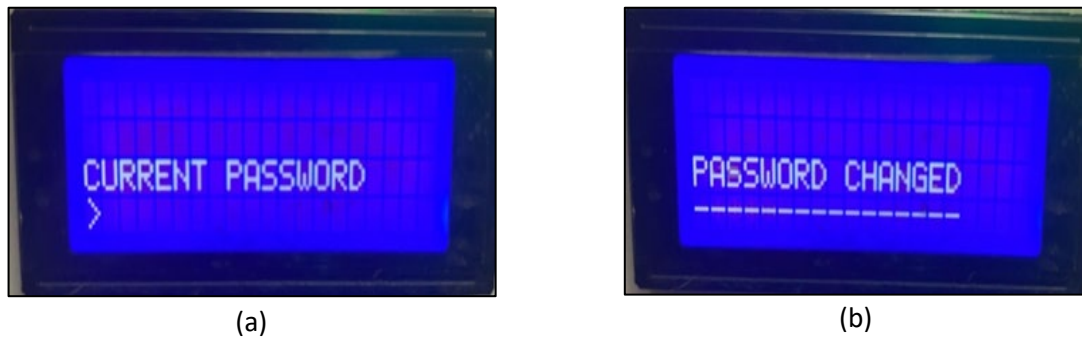


Figure 6: Change of the passcode. (a) current passcode, (b) new passcode

The results of "Smart Mode" are linked to each other using IoT technology when connected to the internet, where the output of the database in the electronic cloud is connected with the outputs of the smart mobile application in real time. At the same time, the database is connected to the physical parts of the drugstore via ESP Arduino, which supports Wi-Fi. The product was used on 11 people and proved successful, as shown in Table 1.

Table 1: The results before and after the use of the proposed system

No.	Name	Patients	chronic diseases	Several medicines at the same time		Adherence doses		Adherence to times		Exp.		medication history
				person	No.med	Before	After	Before	After	Before	After	After
1	Ahmed	2	1	1	3	60%	98%	30%	98%	30%	99%	yes
2	Ramiz	1	1	1	2	80%	95%	40%	98%	50%	99%	yes
3	Assad	4	2	3	2,2,2	30%	97%	35%	90%	50%	99%	yes
4	Nour	5	3	2	3,3,2	70%	91%	55%	95%	80%	99%	yes
5	Yusur	3	2	3	2,2,2	40%	98%	45%	94%	95%	95%	yes
6	sad	2	2	1	2	50%	94%	80%	99%	30%	99%	yes
7	Mary	4	3	2	3,2	45%	95%	50%	95%	50%	99%	yes
8	Ali	3	1	2	4,2	80%	99%	55%	95%	60%	90%	yes
9	Gaffer	2	1	1	2	90%	99%	80%	98%	40%	99%	yes
10	Fatima	2	1	1	2	65%	97%	90%	99%	40%	99%	yes
11	Mohammed	4	3	3	3,4,2	70%	98%	60%	97%	80%	99%	yes

There is a wide variety of drugs and abundant information for each drug, which makes the provision of a database an urgent necessity. A database was created in the electronic cloud where a specialized admin handles entering and updating all the information. Initially were ten medications as an example. The user information is entered into the mobile application and automatically saved on the database in real-time, also recorded two medications. While the database consists of five main menus: First, the cube list, which includes the basic information about the cubicles, such as; the cube name, target temperature, current temperature, security mode, operating status, and cooling system. Second, a list of the "cube dosage reminder" that includes the dose, the number of doses, and the name of the drug. Third, the "drug list" has all the drugs stored in the database by the specialized admin with their classification, name, use instructions, and the required storing temperature. Fourth, the list of "used medicine" that the user is currently taking includes the cube name, duration, expiry date, medicine name, instructions, start date, temperature, number of times of use per day, and time of taking the dose. Finally, a "list of users" includes usernames, user addresses, email, and phone numbers. Figure 7 shows all the results of the database.

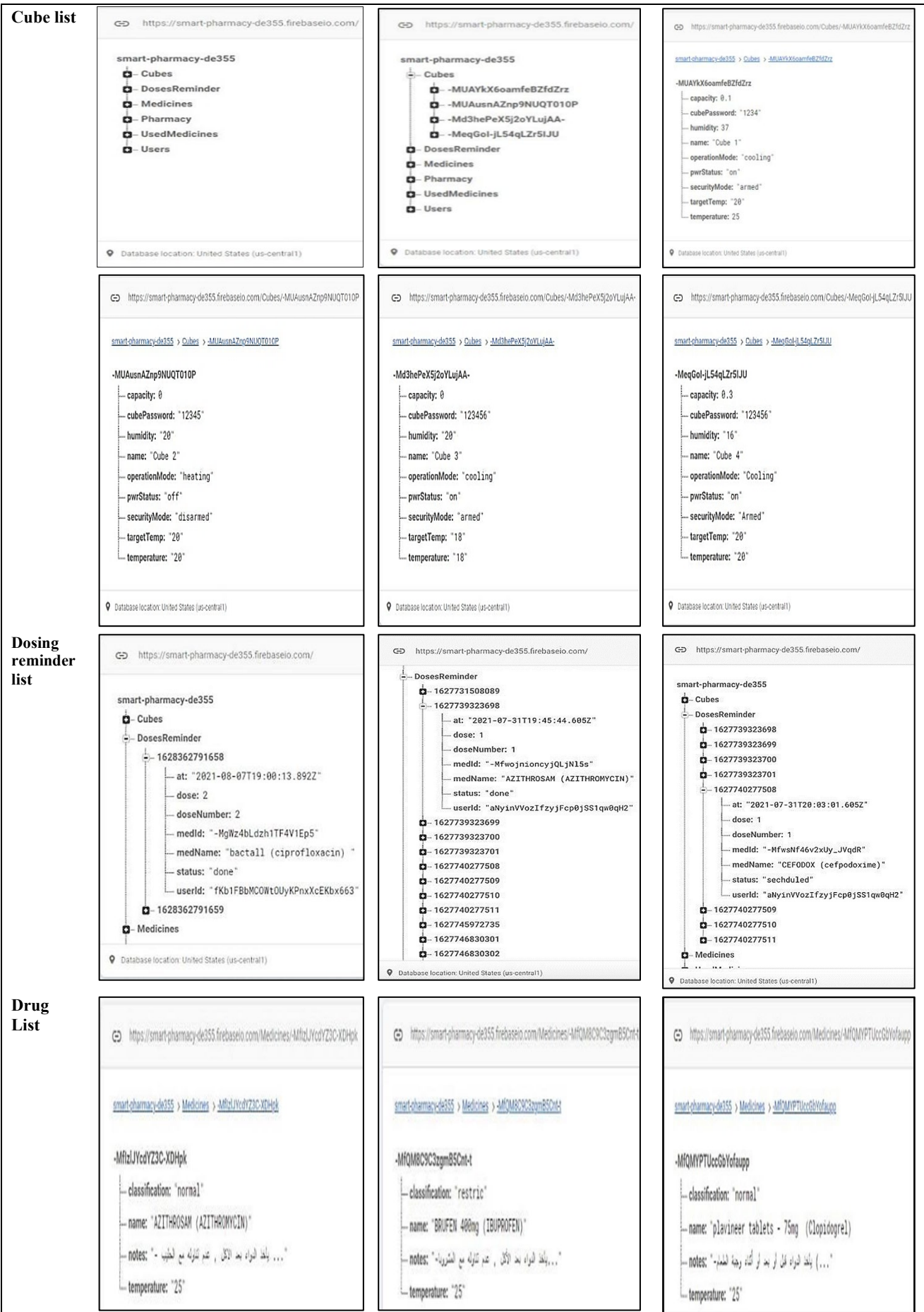


Figure 7: Results of the database

Creating the mobile application was one of the most important stages of making the innovative drugstore. The data is entered and controlled by the user interface. However, the data exchange between mobile applications and other drugstore parts is carried out using IoT technology. Table 2 shows the mobile application results. The mobile application includes the following main menus: First, the "drug list search" that includes sub-menus is used to search for medicine previously stored in the database. Second, the "schedule" includes lists of sub-menus containing drug dose information, dose alerts, dose confirmations, and instructions. Finally, the "user list" includes all users.

All the menus (main and sub) mentioned contain all information related to security, temperature, drug name, required dose, time of the first dose, remaining dose dates, dose date, dose alerts, and type of medicine.

Table 2: Results of Mobile Application

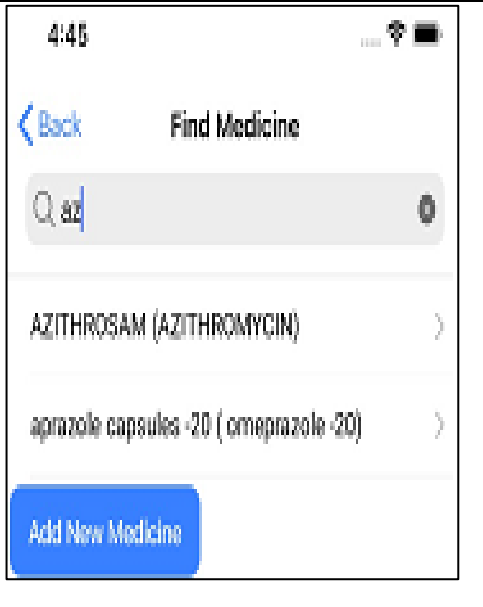
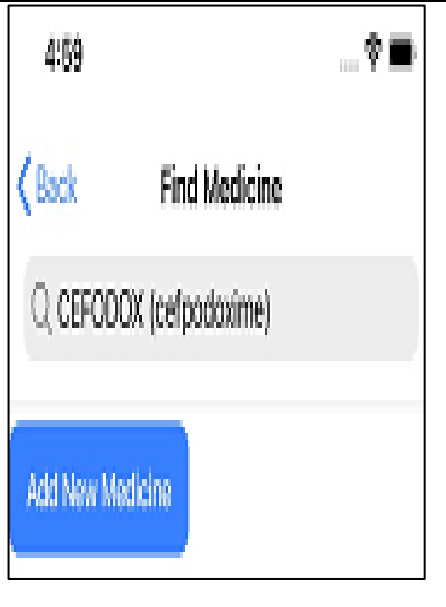
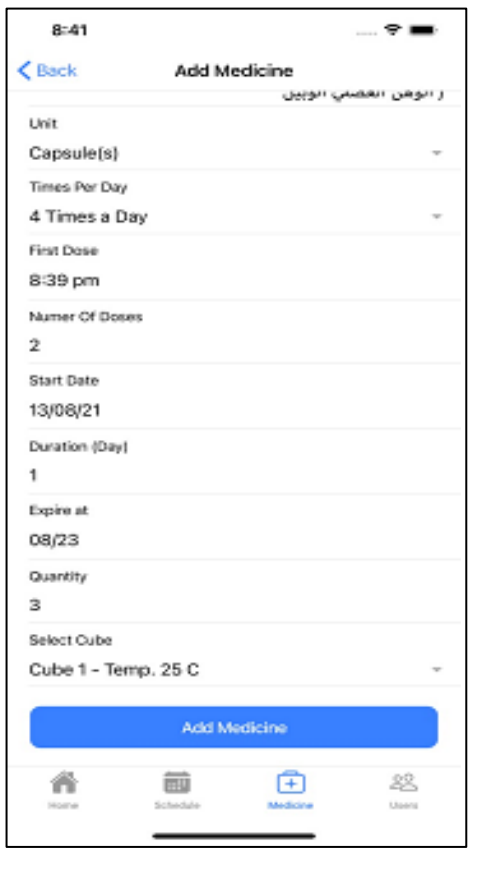
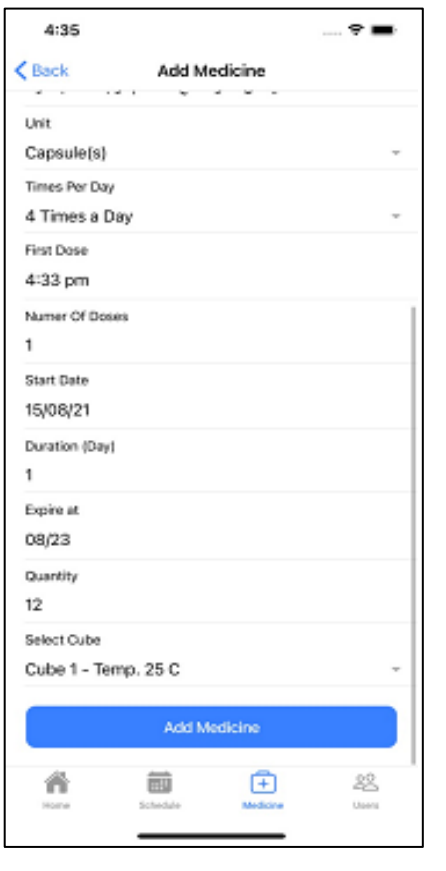
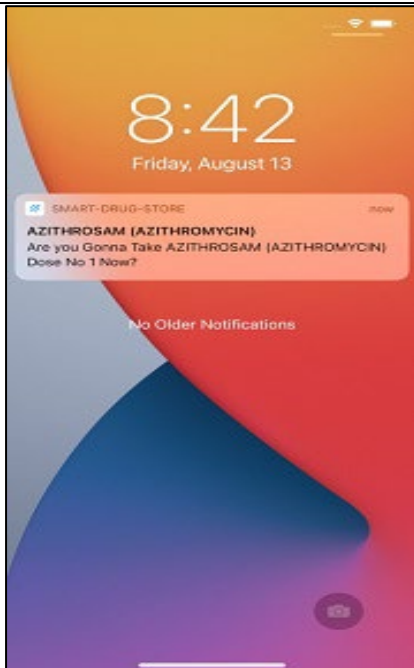
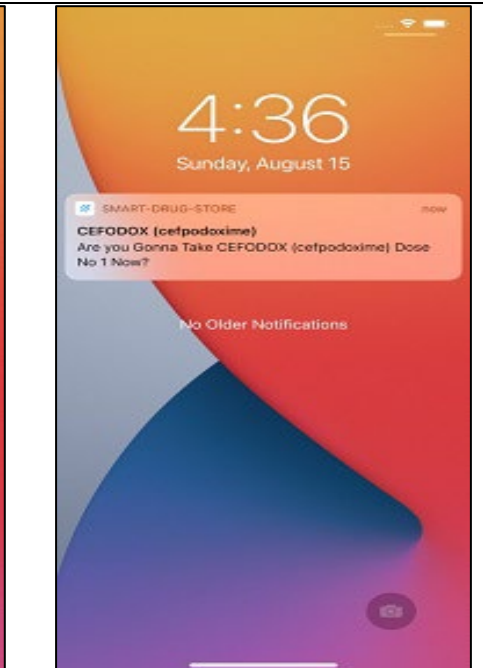
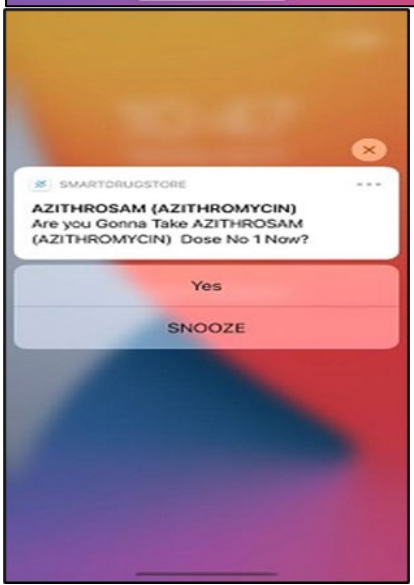
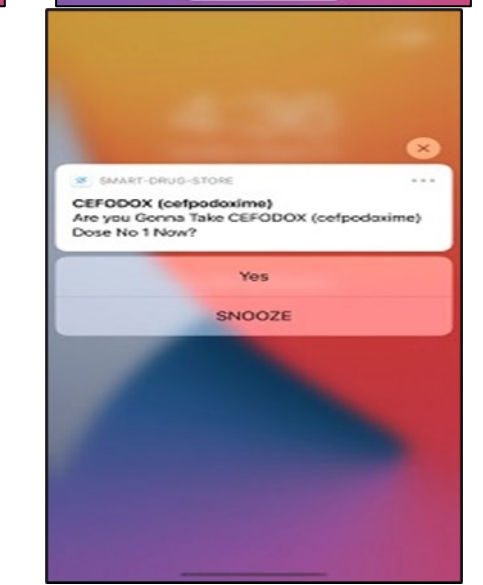

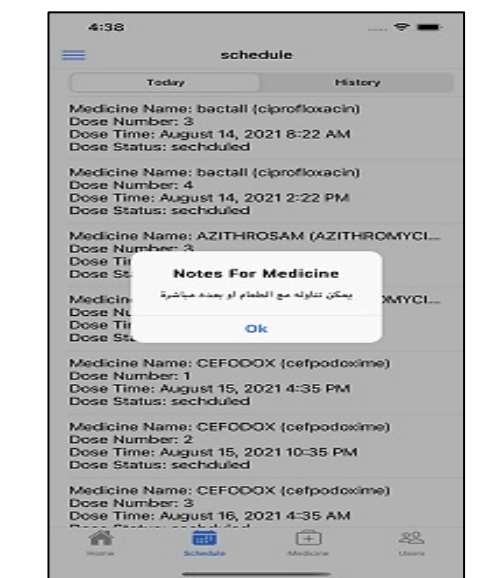
Notice	Zithromax	Cefodox
Find medicine		
My medicine list		

Table 2: Continued

<p>Dose number 1</p>		
<p>Confirmation dose number 1</p>		
<p>Instructions for use</p>		

7. Conclusion

The innovative drugstore was established based on IoT technology that gives the best results by helping patients obtain the best health care by protecting medications from damage, accessed only by authorized users with a username and password. In addition, it provides reliable medical information entered into the database. The mobile application provides an easy-to-use drugstore user interface to perform various tasks, including taking the drug at the specified time, required dosage, the starting date, alert confirming taking dose, and the time for each one. This drugstore combines advanced technologies with simple electronic components to give the finest services for healthcare.

Author contribution

All authors contributed equally to this work.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author.

Conflicts of interest

The authors declare that there is no conflict of interest.

References

- [1] D. Pal, S. Funilkul, 'Internet-of-Things and Smart Homes for Elderly Healthcare: An End User Perspective, IEEE Access, 6 (2018). <https://doi.org/10.1109/ACCESS.2018.2808472>
- [2] H. M. Fisher, Managing Chronic Conditions for Elderly Adults: The VNS CHOICE Mode, Health Care Financing Review, 27 (2005) 33–45.
- [3] B. Jimmy, J. Jose, Patient Medication Adherence: Measures in Daily Practice, Oman Med J., 26 (2011) 155–159. <https://dx.doi.org/10.5001%2Fomj.2011.38>
- [4] S. S. Arumugam, P. Dhanapal, Automated Medicine Dispenser in Pharmacy, Int. J. Electr. Comput. Eng., 4 (2019) 6-11 .
- [5] R. E. Riantini, How Pharmaceutical Consumers in Jakarta Adopt New Marketing Technology: Digital Pharmacy Mobile Application, 2020 Int.l Conf.Inf. Manag.Technol., 2020, 510-515. <https://doi.org/10.1109/ICIMTech50083.2020.9211215>
- [6] A. Woodburn, Analysis of challenges of medical supply chains in sub-Saharan Africa regarding inventory management and transport and distribution, MSc. Thesis, Westminster Business School, Univ. of Westminster, London, 2013.
- [7] Park, S.J. et al. 2017. Development of the Elderly Healthcare Monitoring System with IoT, vol, 482. pp 309–315 Springer, Cham.. https://doi.org/10.1007/978-3-319-41652-6_29
- [8] A. Bharadwaj, D. Yarravarapu, Enhancing Healthcare using m-Care Box, 2017 International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC), Palladam, India, 2017, 352-356. <https://doi.org/10.1109/I-SMAC.2017.8058370>
- [9] M. N. Mani, Health care and Hospital management using Internet of Things, Int. J. Eng. Res. Sci.Technol., 2 (2016)cs30-cs 38.
- [10] C. May, Mobilizing modern fact: 'Health Care Technology Assessment and The Politics of Evidence, Sociol. Health Illn., 28 (2006) 513-532.
- [11] X. Liu, 'Building A Collection of Labs for Teaching IoT Courses, The Third International Conference on Cyber-Technologies and Cyber-Systems, Canada, 2018.
- [12] M. Rath, B. Pattanayak, Technology Improvement in Modern Health Care Applications Using IoT (IoT) and Proposal of Novel Health Care Approach, Int. J. Hum. Rights Healthc., 12 (2019) 148-162. <https://doi.org/10.1108/IJHRH-01-2018-0007>
- [13] G. N. Tran, L. H. Truong, A Design of Sensing Data Collection Circuits for Wireless Sensor Networks Utilizing Wi-Fi Technology, ICSES Trans. Comput. Hardware Electr. Eng., 5 (2019)1-5.
- [14] E. N. Mambou, S. M. Nlom, 'Monitoring of the Medication Distribution and the Refrigeration Temperature in a Pharmacy based on Internet of Things (IoT) Technology, 2016 18th IEEE Mediterr. Electrotech. Conf. 2016, 1-5. <https://doi.org/10.1109/MELCON.2016.7495412>

- [15] B. N. Karthik, L. D. Parameswari, Survey on IOT & Arduino Based Patient Health Monitoring System, *Int. J. Sci .Res. Comput. Sci., Eng.Inf. Technol.*,3 (2018) 1414- 1417 .
- [16] A. H. Issa, S. A. Gitaffa, Y. S. Al-Saffar, Developing the Health Care System for Smart Drugstore Based on the IoT and the Embedded System, *Iraqi J Med Sci .9* (2022) 12-30. <https://doi.org/10.53523/ijoirVol9I1ID113>
- [17] T. Edoh, Smart Medicine Transportation and Medication Monitoring System in EPharmacyNet, 2017 International Rural and Elderly Health Informatics Conference, Lome, Togo, 2017, 1-9. <https://doi.org/10.1109/IREEHI.2017.8350381>
- [18] J. Rauscher, Safety and Security Architecture Analyses Framework for the Internet of Things of Medical Devices , IEEE 20th International Conference on e-Health Networking, Appl.Servi., (Healthcom),2018,1-3. <https://doi.org/10.1109/HealthCom.2018.8531121>
- [19] S. S. Arumugam, P. Dhanapal, Automated Medicine Dispenser in Pharmac, *Int. J. Adv. Comput. Electr. Eng.*, 4 (2019) 6-11.
- [20] R. E. Riantini, How Pharmaceutical Consumers in Jakarta Adopt New Marketing Technology: Digital Pharmacy Mobile Application, 2020 *Int. Conf. Inf. Manag.*, 2020, 510-515. <https://doi.org/10.1109/ICIMTech50083.2020.9211215>