Bachelor of Science in Computer Science & Engineering

An Automated and Online Based Medicine Reminder and Dispenser

by

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Submitted in partial fulfilment of the requirements for
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in Computer Science & Engineering

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Abstract

It's important to take the right medications at the right times and in the right amounts. Patients, on the other hand, often fail to take their medications at the times specified in their prescriptions, causing disease or illness to develop more slowly, especially in the elderly or those who are too preoccupied with their job. An Automated and Online Based Medicine Reminder and Dispenser application is introduced in this paper. A three-part package, an LCD on top of the box, a buzzer, and a multicolored LED light were all included in this unit. This interface also reminds the consumer when it's time to take their medicine. An Android application on this device displays some of the results. The input interface and the output interface are the two components of this mobile app interface. Prescriptions are accepted or modified via the input interface. Empty lists, previous data, and whether or not to take medication are all shown on the data interface. The LED lights and buzzer will switch on when it's time to take medicine, and the LCD will show the prescription at the same time. So that the patient is conscious that drug time has arrived. The proposed method is assessed both quantitatively and subjectively. The results show that the success rate in terms of perfect functioning is 95%, and the participants scored the overall system on average 4.6 out of 5 in subjective assessment.

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Chapter 1

Introduction

1.1 Introduction

Today's world is filled with responsibilities and anxiety. People are vulnerable to various diseases and we need to ensure that we stay healthy and fit. It is very tough for family members if they are not at home, are out of town, or state to remind them. A significant proportion of patients refuse to meet their schedules. This can lead to a needless worsening of diseases, complications, reduced quality of life, and even death. [1]

The noteworthy thing is that patients forget to take the appropriate medications adequately and in due course. The majority of out-patient prescription errors occurred when patients purchased prescribed and over-the-counter (OTC) medications from various drug stores and used them at home with little to no instruction.

Adherence to medication that refers to the extent or to the degree to which a patient takes the proper medicine according to a doctor's recommendation at the appropriate moment has lately become a significant problem, as several studies have shown that non-compliance can have a crucial impact on the patient and increase healthcare costs.

Medication non-adherence is a chronic, complicated, and expensive issue that leads to poor patient outcomes and drains healthcare services. There are a variety of reasons for the rising pattern of non-adherence to medication.

Noncompliance is often attributed to a lack of belief in the need for medication, avoidance of side effects, trouble managing more than one dosage a day, or various prescription regimens.

As a result, developing an automated and online based system is critical to living a stable and safe life. Furthermore, the app will have a real-time prescription system to remind patients to take their medications on time, as well as minimize medication non-adherence due to other causes.[2]

This project is about people who fail to take their medications on time. It includes fields for date, time, and medication, allowing users to set alerts for various medications at different time intervals. Medication alerts tend to reduce medication mistakes and incorrect dosages.A system with a user interface that can easily be used that saves life, saves money and saves time.[3]

Although some have worked on this subject before, this project fills in certain holes and offers a realistic in-home prescription solution leveraging modern technologies. These approaches make it easier to update the prescription schedule set up in the smart dispenser. System managers can also monitor the system configurations, embedded applications, and operational errors.[3]

1.2 Framework/Design Overview

We developed a mobile user interface. This app accepts prescriptions. The data would then be saved on the cloud server in the form of a text file in JSON format. Following that, Node MCU reads the file and sends it to Arduino. The files are read by Arduino. After that, the Arduino starts processing. When it is time to take medication, the name of the medicine and how much medicine should be taken are shown on the monitor by the node MCU. The buzzer and LED light are then turned on by Arduino. When the buzzer goes on, the patient comes in and eats the medicine, and this information is added to our app. When there are less than zero medications available. The alarm goes on once more. Then we'll have to replenish it. When it is time to take medication, this phase continues; otherwise, it is in sleep mode.

Overall framework of an automated and Online Based Medicine Reminder And Dispenser is shown in Figure 1.1

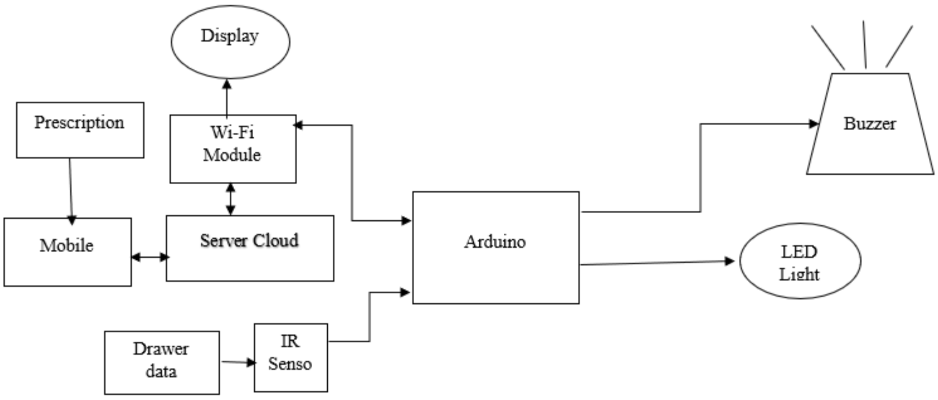


Figure 1.1: Overall framework

This is an overview of our Android applications with overall framework. Our software has two user interfaces. The update interface and the Data interface are two different types of interfaces. The update interface acts as an input, while the data interface acts as an output. The input interface receives a prescription and forwards it to the output interface, which forwards it to the Node MCU, which forwards the data to the LCD display and back to the Node MCU, which forwards it to the data interface and cloud server. As a result, it is saved by the data interface and the cloud server. The figure of Android applications with an overall framework is given in figure 1.2

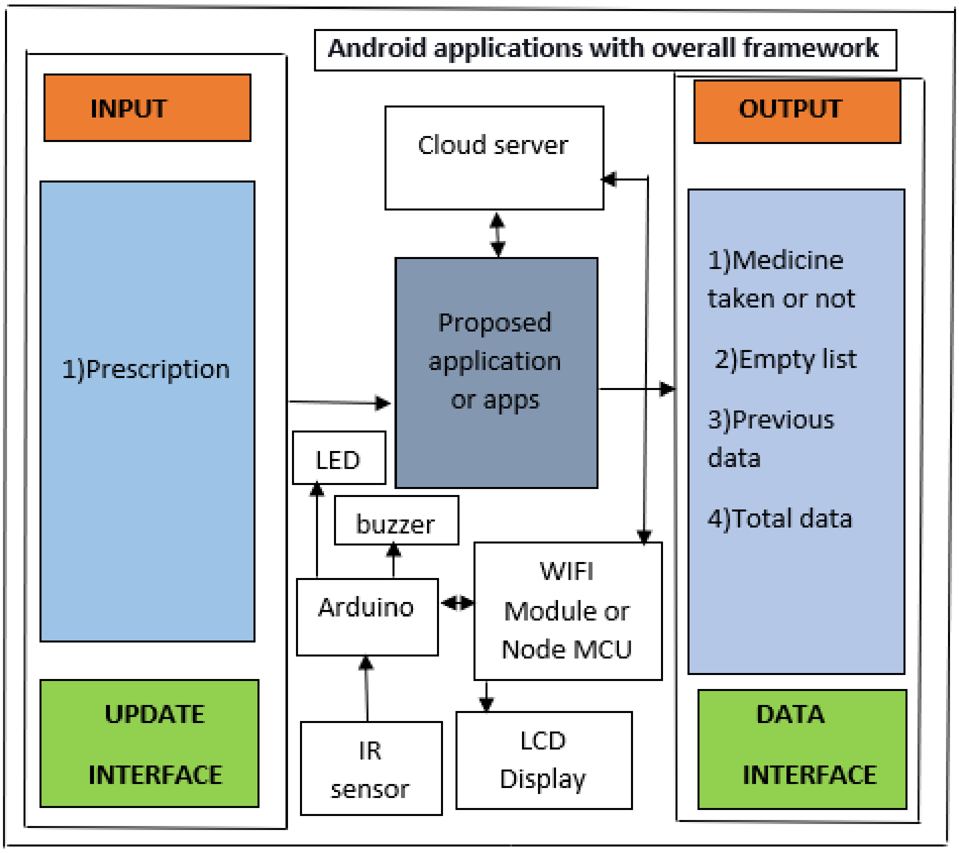


Figure 1.2: Android applications with an overall framework

1.3 Difficulties

Measurement is critical for improving healthcare quality. One must be able to recognise problem areas, understand the scope of their efforts, assess progress, and plan for future changes. However, determining the consistency of the drug system is not an easy task; many obstacles must be overcome. When assessing the quality of health care, for example, the opposing viewpoints of different people must be balanced. Patients typically assess the quality of their particular needs, while purchasers determine the norm based on how much money is charged in premiums on the life protected. Finding viable solutions to each person's needs while retaining the ultimate goal is challenging.

The following also include several challenges:

1. Provide the right medicine at the right time through a mobile application.
2. Choose a perfect medical dispenser.
3. Maintain a simple system for patients by including all features.

4. Keep the app user friendly.

5. In this pandemic situation, collect all the hardware components. 6. It must be cost effective so that poor people can use it at a low cost.

1.4 Applications

The main applications of this project are as following:

1. This system can be used for all ages of people and also busy people.

2. This system can be used in hospitals as well.

3. This system is appropriate for families with a limited number of members.

4. Our system can be very useful in this Covid-19 scenario because when a patient is quarantined or isolated, there is no one by his/her side to ensure that he/she takes the right medicine at the right time. Through our simple mobile application, we can monitor this system from outside the isolated space. As a result, he/she will simply obey the instructions on our device and take his/her medication.

1.5 Motivation

The initiative is being conducted to address certain general health system issues. The failure to perfectly align medicine form, quantity and timetable for the needs of patients and healthcare providers.

As a result, many patients fail to take their medications as directed, causing unnecessarily worsening of illness, injuries, poorer quality of life, and mortality.

Many citizens would like to be self-sufficient. This will give them more freedom while also reducing the strain on the health-care system. Many elderly patients, on the other hand, are unable to do so because they are unable to adhere to their prescription schedule. This is due to the fact that it is either too complicated or the patient is forgetful. Currently, the patient's only options are admission to an assisted living facility, such as a hospital or nursing home, or relying on volunteer caregivers. [4]

People become disabled when they pass old periods. During old periods, they have less capability to do their work properly. Many diseases attack them then.

So they have to face many difficulties. If there are some intelligent systems to help older people, then the difficulties of older people will be removed apparently. Besides that, when a person is overworked, he does not have time to take his medicine as prescribed, which leads to unnecessarily worsening of illness, a lower quality of life, and mortality. Maintaining good quality and affordability of healthcare facilities while keeping costs down is a difficult task. The key focus topics are healthcare service management, repair, and coordination, user education, and consumer empowerment to maintain their own well-being.

So our system can provide all of these facilities. We have created this device to solve all the above problems and it can be used by people of different ages as well as different classes.

1.6 Contribution of the Thesis

The following is a list of the project's contributions:

1. Developed a dispenser which has three compartments containing medicines.
2. Proposed a system to remind medicine at the right time via buzzer and light.
3. Proposed a model to notify when a storage is low.
4. Tracked down whether users have taken their medications or not.
5. Evaluated the framework with subjectively and quantitatively.

1.7 Thesis Organization

This project paper consists of six chapters. Chapter 1 describes the introductory definition of our work, a brief overview and relevance, history, inspiration, goal, challenges and contribution. Chapter 2 describes the literature review, hardware specifications, and implementation challenges. Chapter 3 describes the overview of the framework, the methodology, Hardware and software requirement, Android applications with an overall framework and implementation. Chapter 4 describes the result and evaluation of the Performance. Chapter 5 contains the overall summary of this project and provides some future recommendations as well.

1.8 Conclusion

Descriptions of an automated and online medicine reminder and dispenser is given in this chapter. In addition to challenges, this chapter provides an overview of the system for automatic and online medicine recall and distributor. Here are also the reasons for this work and the contributions. The following chapter will include the context and current situation of the issue.

Chapter 2

Literature Review

2.1 Introduction

In this part, we will go over general terms and technology that we used in our project. We would also go into previous work performed in this area, as well as their strengths and weaknesses.

2.2 Related Literature Review

Guerrero et al. [5] proposed a system that included a smart solid drug dispenser and a smartphone application for setup and management. The key goal is to provide a remedy that will assist people in avoiding incorrect drug administration. The smart dispenser can deliver the appropriate medication if two requirements are met: (1) it is time for a medication intake, and (2) the person removing the medication from the dispenser can be detected and is allowed to do so. The dispenser uses facial recognition to identify and authorize people, while the mobile app uses a username and password to identify and authorize people. Furthermore, the device alerts users when it's time to take their medication through smartphone notifications and the dispenser's lights and sounds. To ensure consistency and reliability, the framework was developed using a Test-Driven Architecture Methodology for Internet of Things (IoT)-based Systems. Chawariya et al. [6] proposed a Medication Dispensing Device to assist Geriatrics in taking their medications on time. Image processing on the Raspberry Pi is planned especially for users who take drugs without supervision. Python is the programming language used for image processing. Blind and deaf people's physical conditions are also taken into account by the scheme. As a result, it provides both visual and auditory cues for them. The dispensing device is a system that regulates the dispensing of medications at predetermined intervals. Because of its low cost and small size, this device eliminates the need for costly in-home medical care. Minaam et al. [7] proposed a pillbox concept to address this shortcoming in the medical field, since it has the ability to sort out pills on its own, among other advanced features, and is intended for use in hospitals or nursing homes. This prescription pill box is designed for patients who take drugs or vitamin supplements on a regular basis, as well as caregivers who work with the elderly. His programmable smart pill box allows medical caregivers or clients to set the pill number and timing, as well as the service times for each day. His smart pill box is divided into nine sub-boxes. Medical caregivers or clients may set data for nine different pills in this way. When the pill time has been set, the pillbox will use sound and light to alert clients or patients to take their pills. An android application owned by the patient will show a message that pills should be taken. Unlike the traditional pill bottle, which allows clients or attendants to stack the crate every day or on a regular basis. His smart pill box will effectively discharge medical attendants or clients' weight on a regular basis, preloading pills for patients or clients while ignoring the required measurements. Jabeena et al. [8] proposed a working model of an automatic pill reminder and dispenser setup that can alleviate irregularities in taking prescribed dosages of medicines at the right time dictated by the medical practitioner and move from approaches primarily based on human memory to automation with minimal supervision, thereby relieving people from error-prone tasks such as giving the wrong medicine at the wrong time. Zao et al. [9] [10] proposed a smartphone app to assist patients in avoiding these errors. Wedjat will alert users to take their medications on time and keep a record of their intake for further review by healthcare professionals. Wedjat has two distinguishing characteristics: (1) It can notify patients about possible drug-drug/drug-food reactions and help them prepare an in-take schedule to prevent them; (2) it can automatically revise an in-take schedule if a dose is skipped. The program often generates the shortest schedule with the fewest amount of in-takes in both cases. Wedjat issues medication and meal reminders using the calendar program found on most smartphones. It also includes images of the drug and concise in-take instructions. Wedjat can keep medication in-take records on board, synchronize them with a database on a host computer, or upload them to an electronic medical records (EMR) system as a telemonitoring unit. On the Windows Mobile platform, a version of Wedjat has been introduced. The design principles of Wedjat are discussed in this paper, with a focus on its medication scheduling and grouping algorithms.

KeeHyun et al. [11] proposed and built a smart drug dispenser with a high level of scalability and remote manageability. The proposed smart medication dispenser provides scalability by allowing multiple users to use a single medication dispenser. It also helps medical staff and system managers to handle drug dispensers rather than end-users, resulting in cost savings and secure device service.

Ashwini et al. [12] introduce an Android-based application for the patients. This program will automatically set reminders in the user's phone to remind them to take the proper medicines in the proper quantity at the proper time. The application will automatically set these reminders based on the prescription. This reminder would inform their user-patient that it is now time to take their medication.

Tiwari et al. [13] proposed Robotic platforms that show promise for expanding the flexibility of the user interface to make customized interactions engaging and inspiring, as well as for proactively reaching out to older users to support their healthcare delivery. A robot with a touch screen and a voice-based interface, we believe, could provide an effective forum to meet these requirements. This paper presents the results of a feasibility analysis of such a scheme for assisting older people with medication management.

Pak et al. [14] created a smart drug dispenser that is scalable and manageable from a distance. The proposed smart medication dispenser provides scalability by allowing multiple users to use a single medication dispenser. It also helps medical staff and system managers to handle drug dispensers rather than end-users, resulting in cost savings and secure device service.

Emeli et al. [15] suggested a multi-robot prototype device that can deliver pills and water to a person in a practical home environment. A mobile robot with a tray, a stationary dispensing robot, and a smartphone held by the user make up the device. We address the potential for improving quality of life, identify our robotic system, and present the results of an experimental evaluation of the system's delivery efficiency in this paper.

Veazie et al. [16] created a structure that is divided into four state spaces: the decision context, the challenge, the target, and the action space. The importance of uncertainty in knowledge is addressed. The framework is designed to be simple in order to allow for flexibility and choices for research-specific extensions, but enough structure is imposed to direct understanding and investigation.

Wang et al. [10][9] suggested a smartphone application to assist patients in preventing these errors. Wedjat will alert users to take their medications on time and record their ingestion schedules for further analysis by healthcare professionals. Wedjat is distinguished by two features: (1) It can notify patients of possible drug-drug/drug-food reactions and prepare a proper in-take schedule to prevent these interactions; and (2) it can automatically revise the in-take schedule when a dose is skipped. In both cases, the program strives to generate the easiest schedule with the fewest number of in-takes. Wedjat has user-friendly interfaces to assist its users in recognizing the right medications and obtaining the proper instructions for taking these drugs. It can keep track of medication intake records on board, sync them with a database on a host computer, or upload them to a Personal Health Record (PHR) system.

Prakash et al. [17] created a Well-designed robots that assist with drug management tasks may help older adults maintain their independence. We discovered factors that influenced users' attitudes toward a smartphone manipulator for assisting with general medication management tasks at home. The older adults were willing to accept robot assistance, but their priorities differed depending on the scope of the medication management mission.

Tsai et al. [18] designed and built an automated drug dispenser for users who take drugs without near clinical supervision. The system will increase rigor in compliance and avoid severe medication errors by relieving the patient of the error-prone tasks of reading medication instructions and administering medications accordingly. By using the scheduling flexibility offered by medication instructions, the system makes the user's medication schedule easy to stick to and, where necessary, tolerant of tardiness. This work is done collaboratively by the drug scheduler and dispenser controller in an action-oriented manner.

McCall et al. [19] describes the development, prototyping, and testing of RMAIS (RFID-based MedicationAdherence Intelligence System). RMAIS offers a practical and cost-effective way for ordinary patients to safely administer their own prescriptions, taking the correct dose of medication at the prescribed time in a fully automated manner. The following features are included in the device design: (1) completely automated operation for simple medication by using the built-in scale for dose calculation and a motorized rotation plate to deliver the appropriate medicine container in front of a patient, (2) a variety of medication notification notifications for patients, as well as noncompliance warnings for caregivers (such as physicians, families, or social workers who care for patients), and (3) gradual and cost-effective adoption by pharmacies, patients, and insurance providers.

Prasad et al. [1] suggested that must be upheld in all settings, including online, and that patient information should not be posted online. Physicians should use privacy settings when using the Internet for social networking to protect personal information and content to the extent possible. Physicians must maintain appropriate boundaries of the patient-physician relationship in compliance with professional ethical standards if they communicate with patients on the Internet, just as they would in any other environment. Patients should only accept invitations to connect on a physician's professional social networking site; patients should not accept invitations to connect on personal social networking sites.

2.3 Related Technologies

In this portion, we will go through some of the hardware that we used in our system. Understanding the features of these hardware will help us better understand our framework.[20]

2.3.1 Hardware Equipment

2.3.1.1 Medicine Dispenser

We have used a plastic box. It is divided in three sections. The name of my three sections is morning section, noon section and evening section. Every section is denoted by different colour LED light.

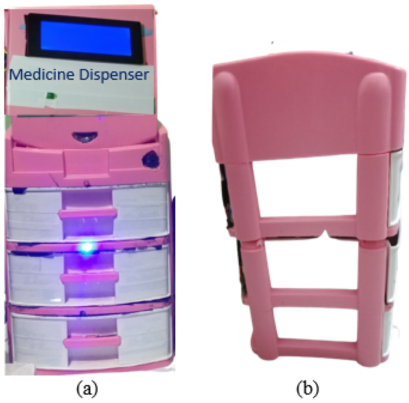
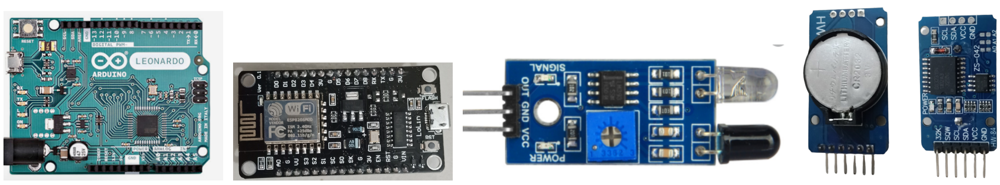


Figure 2.1: Medicine dispenser (a) front view (b) rear view

2.3.1.2 Micro Controller and Other Modules

We have used Arduino Leonardo as the micro controller and also we have used WiFi module, IR sensor module, and RTC module which are shown in Figure 2.2.



(a) Arduino (b) WiFi module (c) IR sensor (d) RTC module

Figure 2.2: Micro controller and other modules

Arduino

Arduino Leonardo has been used in this project. Figure 2.2 (a) is the arduino whose specification is showed in table 2.1.

Table 2.1: Characteristics of Arduino

Characteristics	**Specifications**
Microcontroller	ATmega328P – 8bit AVR family microcontroller
Operating Voltage	5V
Recommended Input Voltage	7-12V
Analog Input Pins	6 (A0 – A5)
Digital I/O Pins	14 (Out of which 6 provide PWM output)
DC Current on I/O Pins	40 mA
DC Current on 3.3V Pin	50 mA
Flash Memory	32 KB (0.5 KB is used for Bootloader)
SRAM	2 KB
EEPROM	1 KB
Frequency (Clock Speed)	16 MHz

WiFi Module

WiFi module model name ES8266 has been used in this project.Figure 2.2 (b) is the arduino whose specification is showed in table 2.2.

Table 2.2: Characteristics of WiFi module

Characteristics	**Specifications**
Power Supply	+3.3V only
Current Consumption	100mA
I/O Voltage	3.6V (max)
I/O source current	12mA (max)

IR Sensor Module

IR Sensor Module has been used in this project. Figure 2.2 (c) and table 2.3 shows the specification of the IR Sensor Module we have used.

Table 2.3: Characteristics of WiFi Module

Characteristics	**Specifications**
Operating Voltage	5VDC
I/O pins	5V and 3.3V compliant
Range	Up to 20cm
Supply current	20mA

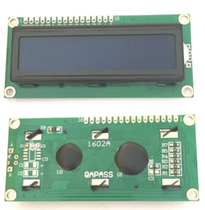
RTC Module

We needed to use RTC module.The acronym RTC stands for Real Time Clock. RTC modules are essentially TIME and DATE remembrance systems with a battery backup that keeps the module operating in the event of a power outage. The TIME and DATE are kept up to date as a result of this. As a result, we can use the RTC module to get accurate TIME and DATE whenever we want. Figure 2.2 (d) is the RTC module we have used. The specification of RTC module are given in the following:

- Serial Clock Pin (SCL) (I2C interface.
- SDA stands for Serial Data Attribute (I2C interface).
- Connected to a positive power source (VCC).
- SQW stands for Square Wave Output Pin.

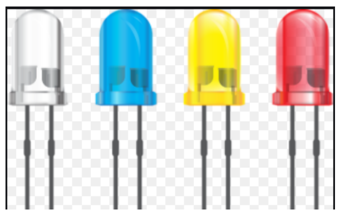
2.3.1.3 Devices Used for Showing Notification

To notify the user we have used an LCD display, a buzzer, and three LED lights. Also, an android application which can be installed in android mobile. Figure 2.3 shows various component we have used in our project to notify the user.



(a) LCD display

(b) Buzzer



(c) LED light

Figure 2.3: Devices used for notify user

LCD Display

LCD Display has been used in this project. Figure 2.3 (a) shows the LCD display and the table 2.4 shows the specification of the IR LCD Display we have used.

Table 2.4: Characteristics of LCD Display

Characteristics	**Specifications**
Operating Voltage	4.7V to 5.3V
Current consumption	1mA without backlight
Alphanumeric LCD display module	Display alphabets and numbers
Character	5×8 pixel box
Working capacity	Both 4 bits and 8 bits

Buzzer

Buzzer has been used in this project. Figure 2.3 (b) shows the Buzzer and the table 2.5 shows the specification.

Table 2.5: Characteristics of Buzzer

Characteristics	**Specifications**
Rated Voltage	6V DC
Rated current	<30mA
Resonant Frequency	2300 Hz
Sound Type	Continuous Beep

LED Light

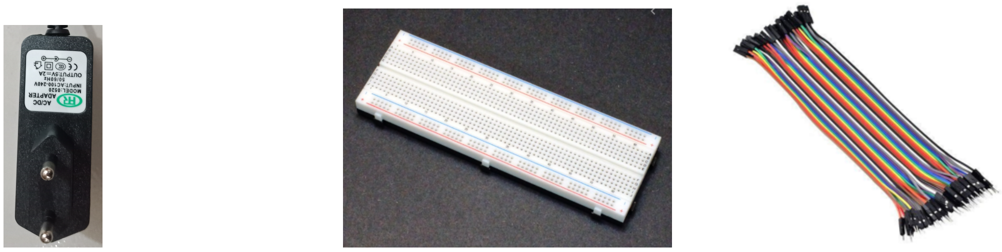
We have used different colors LED to see the signal of our different operations. We have also used a buzzer LED to monitor the function of the drawer. LED light is given in figure Figure 2.3 (c) shows the LED-light and the table 2.6

Table 2.6: Characteristics of LED Light

<table>
<tr><th colspan="2" rowspan="2">Features</th><th colspan="3">Color</th></tr>
<tr><th>Red</th><th>Blue</th><th>Green</th></tr>
<tr><td rowspan="4">Optical Qualities</td><td>Intensity</td><td>6000mcd</td><td>4500 mcd</td><td>6000 mcd</td></tr>
<tr><td>Color frequency</td><td>628nm</td><td>470 nm</td><td>525</td></tr>
<tr><td>Viewing angle</td><td>20 ◦</td><td>40 ◦</td><td>30 ◦</td></tr>
<tr><td>Lens</td><td>Water clear</td><td>Water clear</td><td>Water clear</td></tr>
<tr><td rowspan="2">Electrical Characteristics</td><td>Voltafe</td><td>1.8-2.5 v</td><td>2.9-3.8 v</td><td>3.0-3.6 v</td></tr>
<tr><td>Current</td><td>20 mA</td><td>20 mA</td><td>20 mA</td></tr>
</table>

2.3.1.4 Other Equipment

Besides the equipment mentioned above, we have also used two adapters for the power supply, a breadboard and connecting wires to complete the circuit. Figure 2.4 shows adapter, breadboard, and wire we have used.



(a) Adapter (b) breadboard (c) Wire

Figure 2.4: Others Equipment

Adapter

Breadboard has been used in this project. Table 2.8 shows the specification of the Breadboard we have used.

Table 2.7: Characteristics of Adapter

Characteristics	**Specifications**
Model	CY-0520.
The input voltage range	AC 100-240V
The input voltage frequency	50 to 60Hz
The output voltage	DC 5V
Outer plug diameter	5.5 mm
The output voltage adjustment ratio	5
The rated output current	Upto 2A

Breadboard

Breadboard has been used in this project. Table 2.8 shows the specification of the Breadboard we have used.

Table 2.8: Characteristics of Breadboard

Characteristics	**Specifications**
Dimension	6.5*4.4*0.3 inch
Hole/pitch style	Square wire holes (2.54mm)
ABS heat Distortion Temperature	84° C (183 ° F)
Rating	300/3 to 5Amps
Insulation Resistance	DC500V

Wire

Wire has been used in this project. Table 2.9 shows the specification of the Wire we have used.

Table 2.9: Characteristics of Wire

Characteristics	**Specifications**
Length	200mm (7.87")
Wire Colors	(Combination of 4 colors: brown, red, orange, yellow, green, blue, purple, grey, white, black

2.3.2 Software Module

In this portion, we will go through some of the software that we used in our system. Understanding the features of these software will help us better understand our framework.

2.3.2.1 Cloud Server

Cloud server has been used in this project. Figure 2.5 shows the icon of the firebase we have used. Cloud server is a powerful physical or virtual infrastructure that stores and processes applications and data. Cloud servers are built by dividing a physical (bare metal) server into several virtual servers using virtualization software. Organizations process workloads and store data using an infrastructure-as-a-service (IaaS) model. They can use an online interface to access virtual server functions from anywhere.

Figure 2.5: Firebase

2.3.2.2 Mobile Application

Mobile application has been used in this project. Figure 2.6 shows the icon of the mobile application we have used. The mobile application basically works as an input prescription and shows the outputs simultaneously.

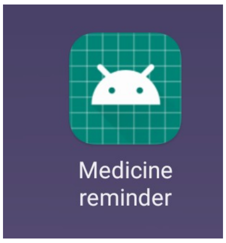


Figure 2.6: Mobile application

2.3.2.3 Operating System Windows 10

Operating system windows 10 has been used in this project. Figure 2.7 shows the icon of the operating system windows 10 we have used. Windows 10 is a set of Microsoft operating systems that are part of the Windows NT family.

Figure 2.7: Windows 10

2.3.2.4 Arduino IDE

Arduino IDE has been used in this project. Figure 2.8 shows the icon of the arduino IDE we have used. A text editor for writing code, a message area, a text console, a toolbar with buttons for common functions, and a set of menus are all included in the Arduino Software (IDE). By connecting to them and downloading programs, it interacts with the Arduino and Genuino hardware.

Figure 2.8: Arduino IDE

2.4 Implementation Challenges

Several Implementation Challenges are also mentioned below:

- Remind the user of the medicine and supply it at the appropriate time.
- It gives an alarm when the medicine supply is running low.
- An option for updating medication in accordance with updated prescriptions must be given.
- It must be cost-effective for low-income people to benefit from it. So Our main goal is to reduce its cost.
- Managing hardware and software, as well as their configuration and interconnection, is a challenge.
- It was very difficult to manage the software and hardware in this pandemic situation.
- Challenge of selecting a well structural flexible medicine box.
- Challenge of creating a well-structured mobile application.

2.5 Conclusion

This chapter discusses a thorough literature review. This chapter has been divided into basic sections of An Automated and Online Based Medicine Reminder and Dispenser for your convenience.The researchers employ a wide range of hardware, which is described here. Specifications of hardware and software are described in this chapter. Our project implementation challenges are also described here. The proposed methodology for An Automated and Online Based Medicine Reminder and Dispenser is outlined in the following chapter.

Chapter 3

Methodology

3.1 Introduction

The proposed medical dispenser consists of two modules: hardware and software. The hardware that houses the medications also alerts the user through a buzzer and an LED light. On the LCD panel on top of the dispenser, the medicine information is also shown. The smartphone has two sections: one for entering medicine information such as the name of the medicine, amount, and time, and the other is the output interface, which displays the medicine information as well as statistics of medicine use, allowing the user to keep track of his/her medication intake. Following the overall architecture of the proposed model, we will discuss the detailed overview of the model in this section.

3.2 Overview of the Proposed Framework

The proposed model is summarized in this section. We also go over the features of the suggested medical dispenser. We designed a mobile user interface. This application accepts prescriptions. The data will then be saved as a JSON-formatted text file on the cloud server. After that, Node MCU reads the file and sends it to Arduino. The scripts are read using Arduino. After that, the Arduino starts processing. When it's time to take medication, the node MCU displays the correct medication and how much should be taken on the monitor.The buzzer and LED light are then turned on by Arduino. When the buzzer sounds, the patient comes and takes the medication, which is then recorded in our app.

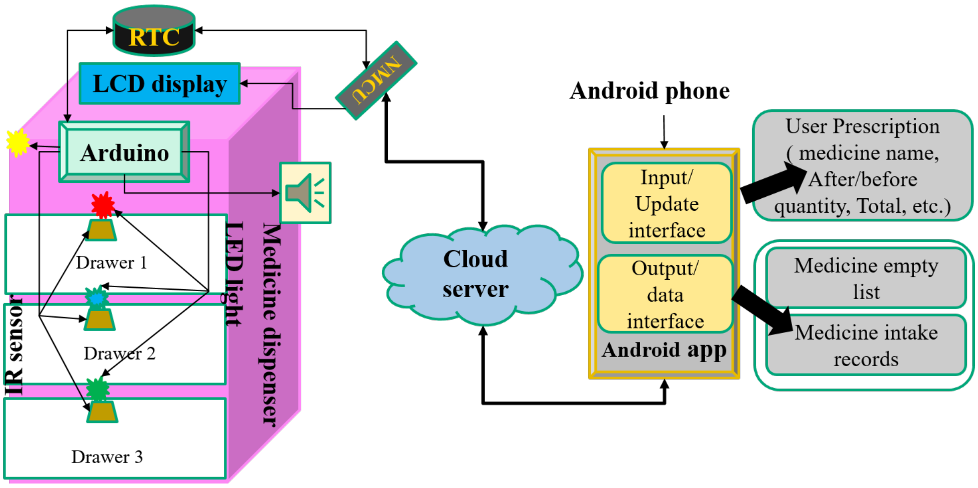


Figure 3.1: Overall prototype of the proposed medicine dispenser

3.2.1 Features of the Proposed Model

The main features of this project are as following:

Provided a box divided into three portions. An LCD top of the box. Buzzer and LED light with different colors. Shows signal when needs to take medicine. Android application. Shows six pieces of information through our android application. Six pieces of information are given below:

Shows the proper time of medication, Displays the medication's name, Shows whether or not medication has been taken, Displays the empty list, Displays the previous data, Displays the total data.

3.3 Detailed Description of the Proposed Model

In this section, we will describe the proposed methodology in detail, as well as explain the software and hardware modules.Figure 3.2 shows the structure of the proposed medicine dispenser. Figure 3.2 (a) shows the front view where we can see the dispenser itself and an android mobile which has the app we have installed. Figure 3.2 (a) shows the top view of the dispenser showing all the circuit components. Figure 3.2 (c) shows the inside view of the dispenser which displays the IR sensor position.

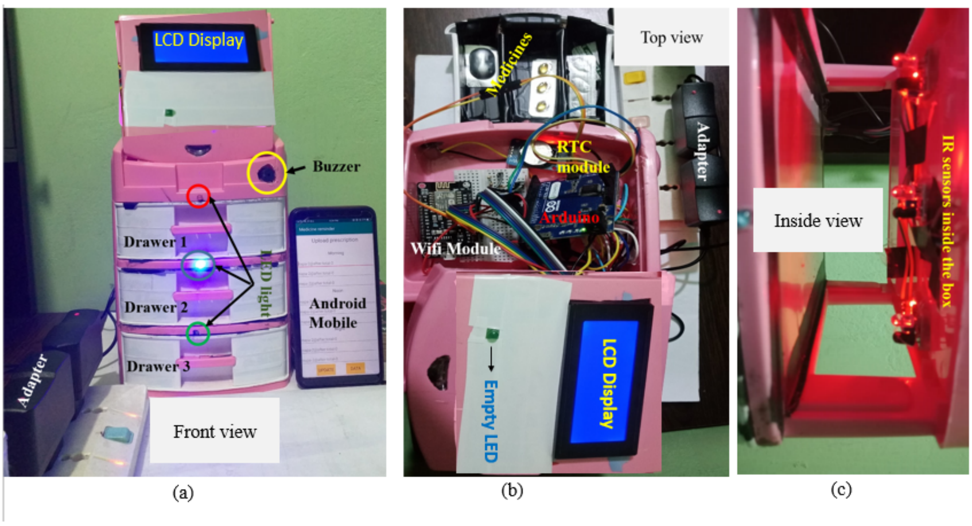


Figure 3.2: Overall structure of the proposed medicine dispenser (a) front view (b) top view (c) inside view

3.3.1 Proposed Approach for the Proposed Medicine Dispenser

There are two parts. One is caregiver part and second is patient part. caregiver part will be controlled the whole process and patient part will be used to give audio alarm as a reminder. Input will be taken from mobile application. The input contains medicine name, quantity, time, Take medicine before meal or after meal etc. These given input will be saved in cloud server in a text file in JSON format. Then it is processed by WiFi module and Arduino then countdown will start. If the time of medication then the proscription will be displayed in the LCD display. All medicine name and quantity that is prescribed is displayed here. Also the alarm is ringing to remind the user to take proper medicine in time.

There are three drawer in our medicine box. Each drawer have three section. Each drawer contains different type of medicine. There are also some LED light in each drawer in the box which indicate the medicine have to take right now. Then the user take medicine in proper time. After taking the medicine the user have to close the drawer. It means the running task is complete then it will go to the next task. In such way the system is running and remind the user in time.When there is a change in the prescription then the input will be changed according to prescription. As input is change so the system reminds the user according to the changed prescription. Also if the the medicine store is low then the alarm ringing and LED light on. We have to re-fill it.

After each drawer opened and closed, its data is stored in the cloud server. we can see every single data in our mobile application and also we can change the prescription anytime through the mobile application.
Our proposed methodology is shown in figure 3.3 and a detailed description of the system is shown by process diagram in figure 3.4

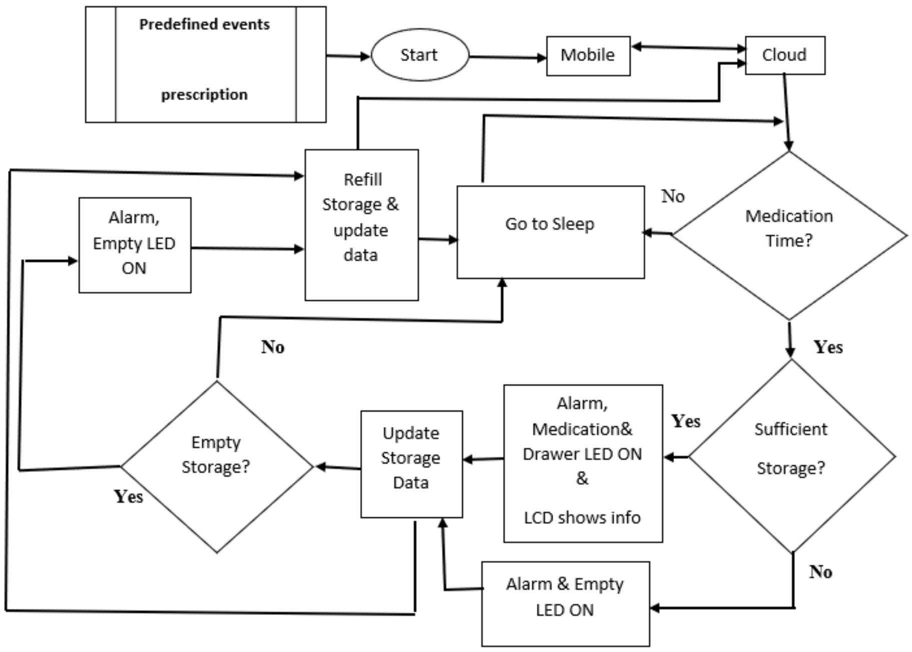


Figure 3.3: Proposed methodology

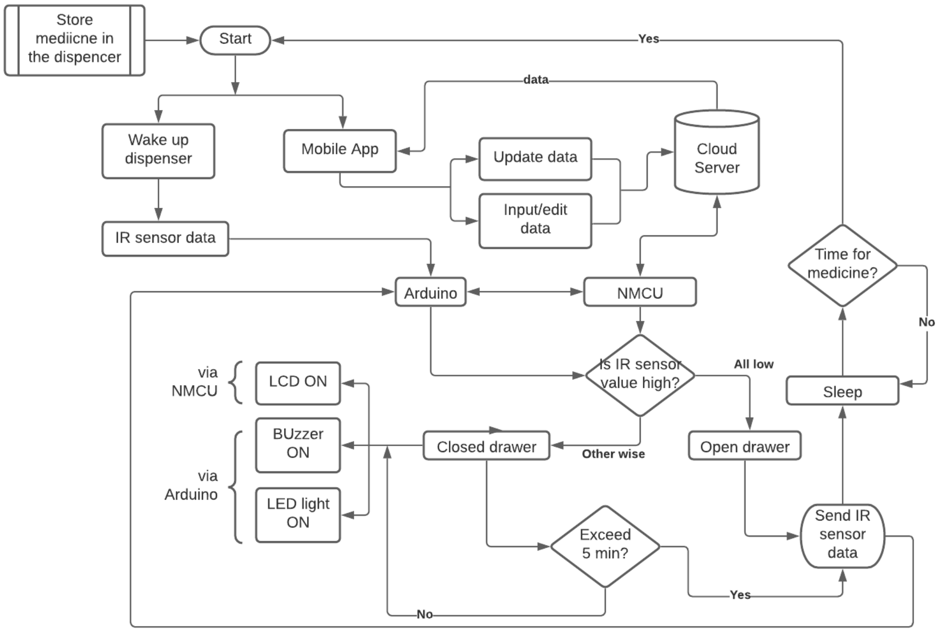


Figure 3.4: Process diagram of the proposed medicine dispenser

3.4 Hardware Platform

The medicine dispenser is permitted to store the medications and warn the patient when it is time to take them. It also informs the consumer if the storage space is running out. The arduino sends data from the IR sensor to an Android app via a cloud server, which is then used to determine whether the medicine door has been opened or not. In the subsequent sections, we'll go through the hardware requirements as well as the comprehensive operation of each function and the circuit diagram.

3.4.1 Hardware Requirements

In this part, we will go over the general hardware that we used in our project. We used an Arduino, WiFi module, IR sensor, Breadboard, Box, Buzzer, Wire, LCD display, LED, etc.

- Arduino Leonardo
- RTC Module
- WiFi module (ES8266)

- IR Obstacle Sensor
- Breadboard
- Plastic Box
- Buzzer
- Wire
- 20*4 LCD Display
- LED Light

3.4.2 Pin Diagram

The RTC module is connected to the Arduino's A2 and A3 ports. The RTC module is connected to Arduino's digital port 3. The Arduino A4 and A5 ports are linked to the RX and TX ports of the Wi-Module. The D2,D3,D4,D5,D6,D7 of the Wi-Fi module are linked to the D2,D3,D4,D5,D6,D7 of the LCD display.

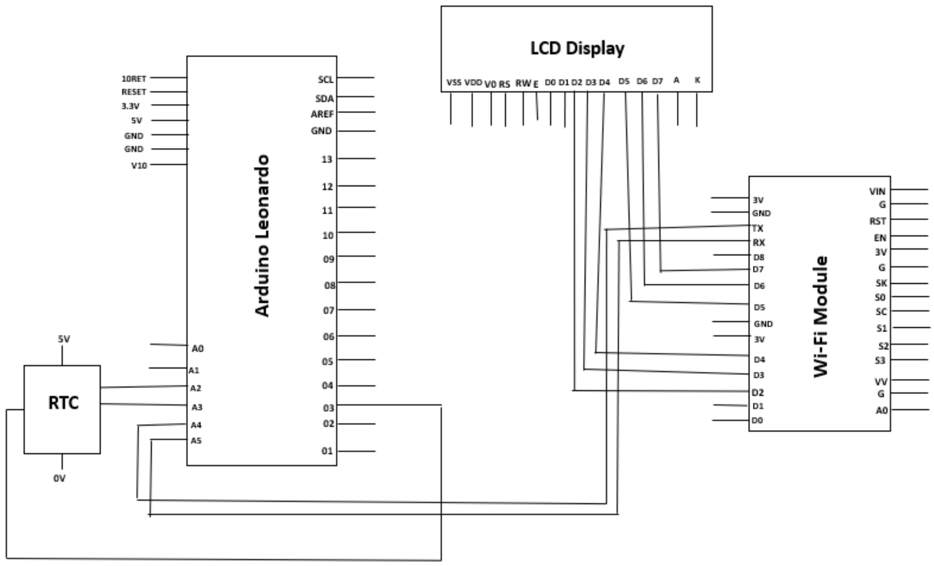


Figure 3.5: Pin Diagram

3.4.3 Circuit Prototype

This is our circuit. An Arduino, a WiFi module, an LCD monitor and an RTC module have all been used.

Figure 3.6: Circuit Prototype

3.4.4 Designing the Medicine Dispenser

The box we used is a plastic box that measures 10 x 8 x 7 inches in size. We purchased the package and made do with what we had. It has four compartments: one for putting the circuit in and the other three for storing the medicines. We split the box into three time zones: morning (5.00 a.m. to 11.59 a.m.), afternoon (12.00 p.m. to 6.59 p.m.), and night(7.00 pm - 4.59 am). Each drawer has three compartments, each with three IR sensors, for a total of nine IR sensors. Each drawer has an LED light in front of it that will turn on when it is time for having medicine. A buzzer has been installed on the top of the box to alert the user when the storage is low and at the scheduled time. The medicine's information is shown on the LCD monitor at a given time.

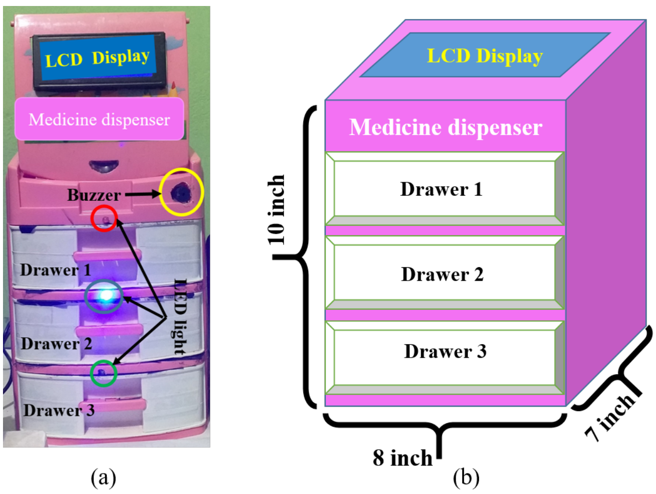


Figure 3.7: Medicine Dispenser Box

3.4.5 Send Signal through IR Sensor to Cloud Server

The IR sensor will be turned on first, and the signal will be sent to Arduino.Arduino will then validate the information using the NMCU. The node MCU will then retrieve the prescription from the cloud to determine whether or not medication should be taken. This process will be repeated until the appropriate medication period arrives. If time=0, this phase will switch to sending and receiving infrared signals. The sensor value will be read by Arduino and sent to the NMCU. If the NMCU is operational, it will attempt to connect to the Wi-Fi network. If the NMCU connects to the Wi-Fi network, the data from the IR sensors is sent to the cloud server via the node MCU.

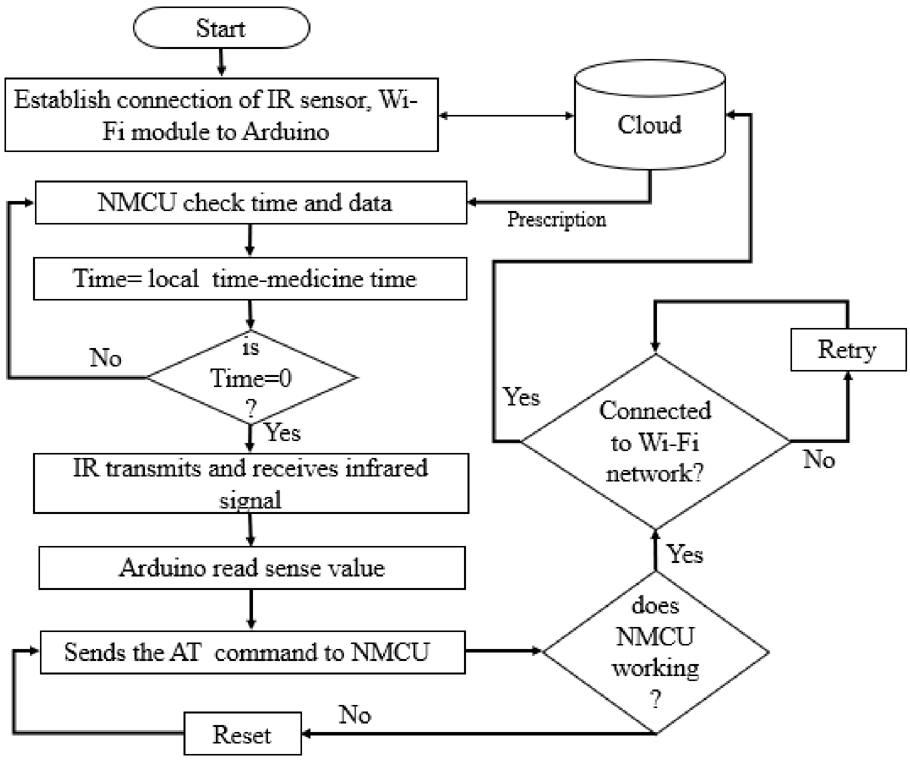


Figure 3.8: Send signal through IR sensor to Cloud Server

3.4.6 Notify medicine time via Buzzer and LED Light

First, the IR sensor is activated, and the signal is sent to Arduino. The information will then be double-checked by Arduino with the node MCU. The node MCU will then retrieve the cloud prescription to determine whether or not it is time to take medication. This process will be repeated until the required prescription time has passed. If time=0, this phase will switch to sending and receiving infrared signals. The sensor value can be read by Arduino and sent to the node MCU. Arduino checks the IR sensor value. In one drawer if all IR sensor's value is low that means drawer was opened and the drawer's LED light along with the buzzer will turn off. Otherwise, the drawer was closed. In this case, there will be two scenarios. If the drawer is empty then the Empty LED light and buzzer turn on. If not then the drawer LED light and buzzer turn on.

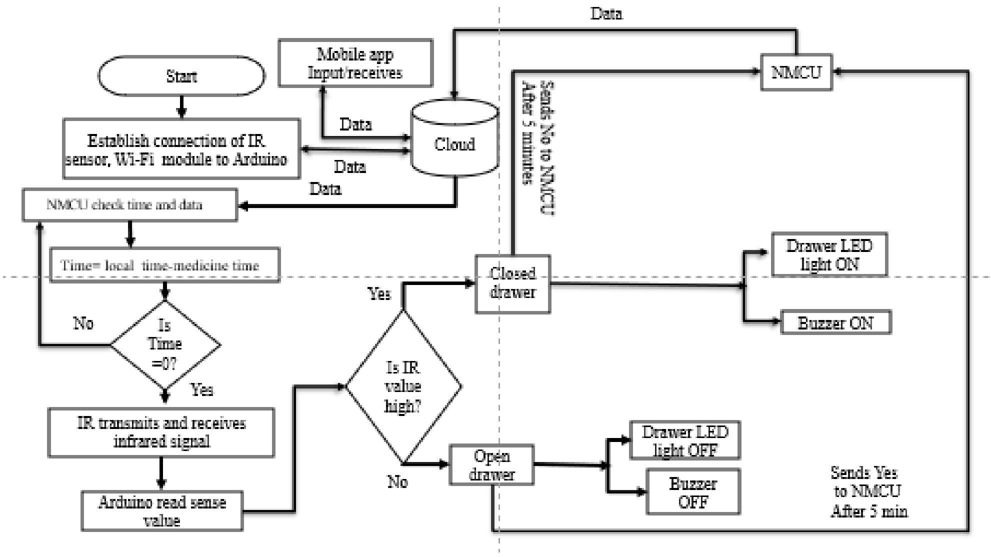


Figure 3.9: Medicine reminder process

3.4.7 Show Information via LCD Display

We used our mobile app to enter the prescription. The data would then be sent to a cloud server. The cloud prescription will then be retrieved by the node MCU to decide whether or not it is time to take medication. This procedure will be repeated until the required prescription period has expired. If time=0, this process will switch to sending and receiving infrared signals. The sensor value can be read by Arduino and sent to the NMCU. If the NMCU is up and running, it will try to connect to the Wi-Fi network. If the NMCU is operational, it will attempt to link to the Wi-Fi network. If the node MCU connects to the Wi-Fi network, the data from the IR sensors will be sent to the cloud server via the NMCU and also will show the prescription on the LCD display. At the same time, Arduino checks the IR sensor value. In one drawer if all IR sensor's value is low that means drawer was opened and the drawer's LED light along with the buzzer will turn off. Otherwise, the drawer was closed. In this case, there will be two scenarios. If the drawer is empty then the Empty LED light and buzzer turn on. If not then the drawer LED light and buzzer turn on.

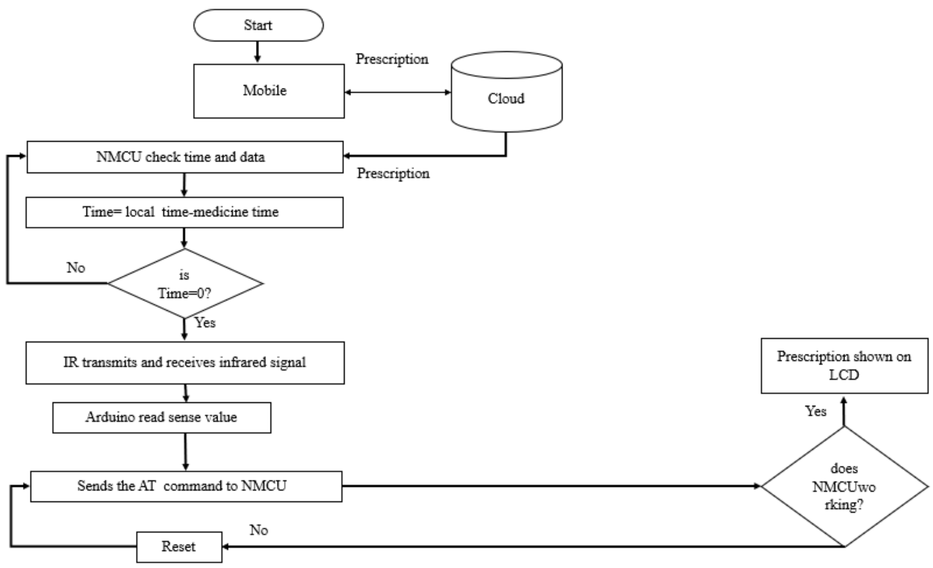


Figure 3.10: Show information via LCD display

3.4.8 Notify Empty Storage

We used our mobile app to enter the prescription. The data would then be sent to a cloud server. The cloud prescription will then be retrieved by the node MCU to decide whether or not it is time to take medication. This procedure will be repeated until the required prescription period has expired. If time=0, this process will switch to sending and receiving infrared signals. The sensor value can be read by Arduino and sent to the node MCU. If the NMCU is up and running, it will try to connect to the Wi-Fi network. If the NMCU is operational, it will attempt to link to the Wi-Fi network. If the node MCU connects to the Wi-Fi network, the data from the IR sensors will be sent to the cloud server via the NMCU and also will show the prescription on the LCD display. At the same time, Arduino checks the IR sensor value. In one drawer if all IR sensor's value is low that means drawer was opened and the drawer's LED light along with the buzzer will turn off. Otherwise, the drawer was closed. In this case, there will be two scenarios. If any drawer section is empty, the Empty LED will activate, the drawer LED will activate, the buzzer will activate, and empty storage data will be sent to the node MCU. Node MCU sends it to the cloud server and the cloud server saved it and sends to it our mobile. If not then the drawer LED light and buzzer turn on.

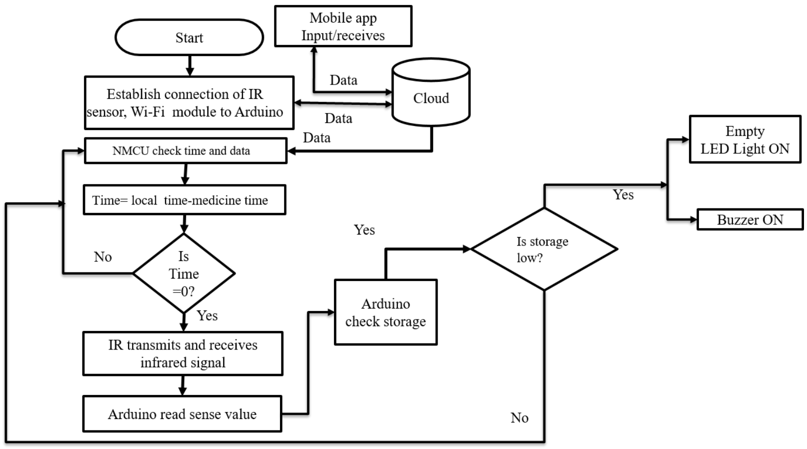


Figure 3.11: Storage low notification

3.5 Software Components

The medication dispenser can store the medications and notify the patient when it is time to take them. It also tells the buzzer that there is no storage space. The Arduino sends data from the IR sensor through a cloud server to an Android app then used to determine whether the medicine door has been opened or not. We will discuss the software and the detailed execution of each feature in the following sections.

3.5.1 Software Requirements

- Arduino IDE
- Operating System- Windows 10
- Google Firebase (Cloud server)
- Android Application (Medicine App)
- XML
- Java

- C
- C++

3.5.2 Input/Update Interface

We have created a mobile application and this is our input interface in that application. It has many features that are given below. Figure 3.12 shows the input interface we have created.

- Medicine time(Morning, Noon or Night)
- Medicine name
- When you take medicine its before meal or after meal
- Total number of medicine
- Updated total number of medicine
- How many medicine taken in one meal
- Edit or update prescription.

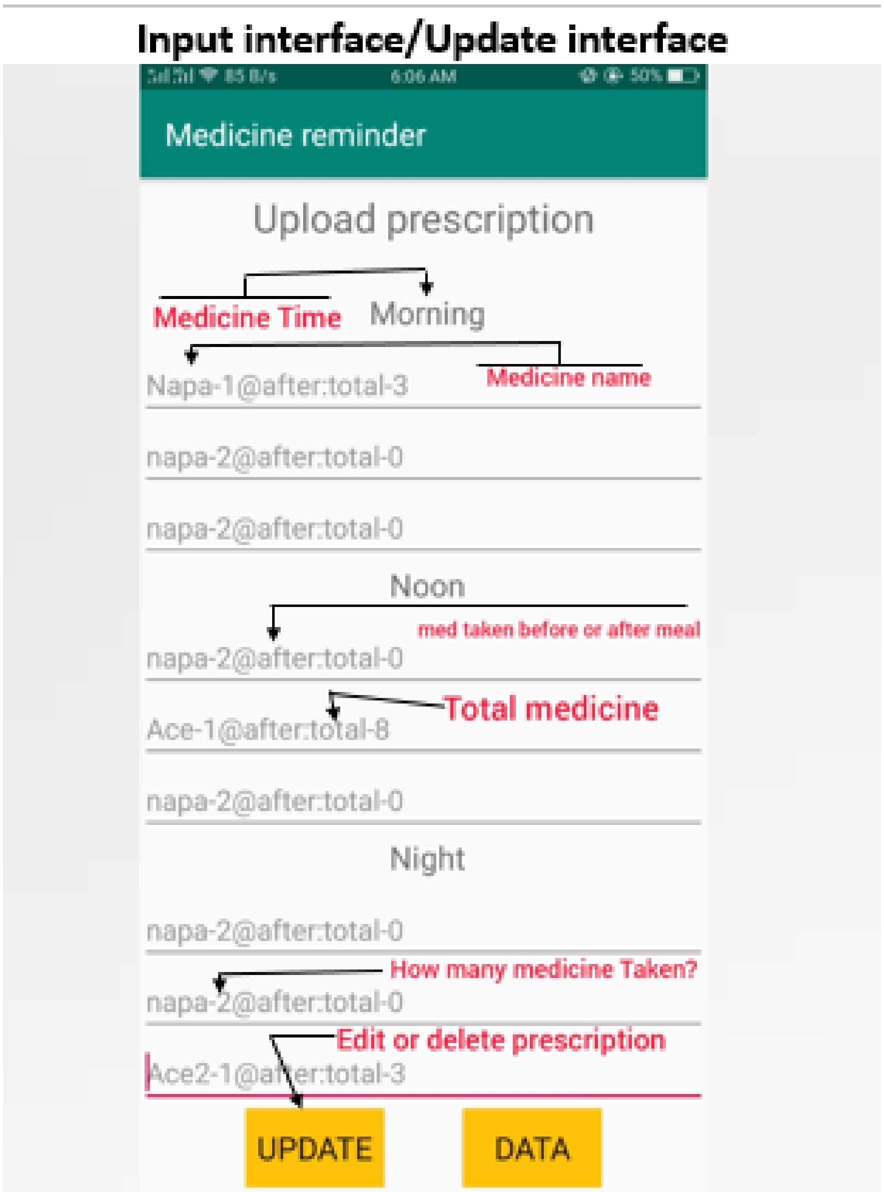


Figure 3.12: Input/Update Interface

3.5.3 Output/Data Interface

We have created a mobile application and this is our Data interface in that application. It has many features that are given below. Figure 3.13 shows the Data interface we have created.

- Empty list
- Medicine taken or not

- Previous data

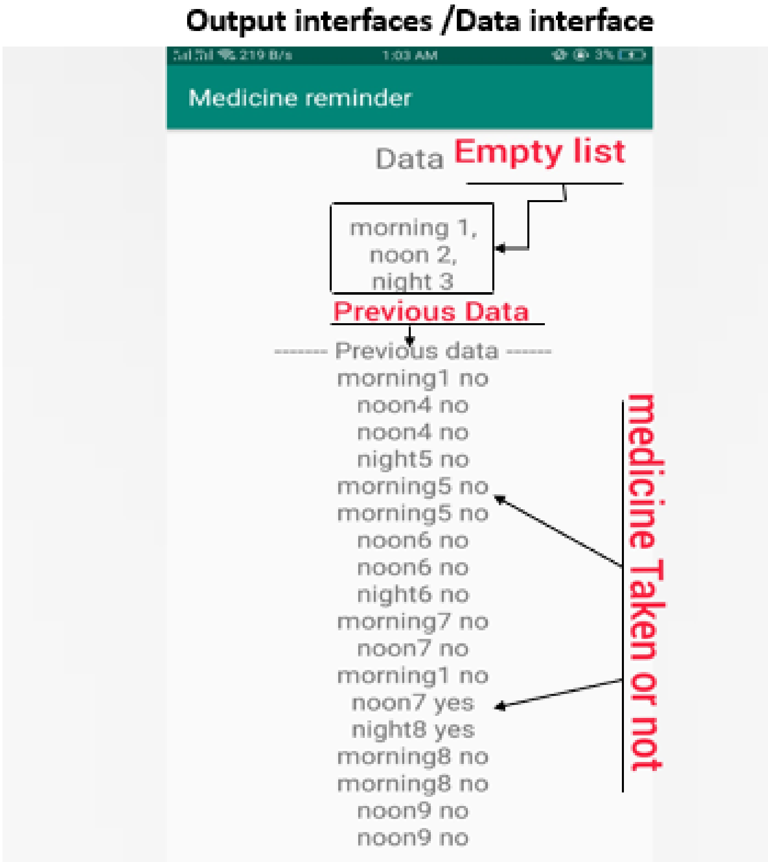


Figure 3.13: Output/data Interface

3.5.4 Tracking medicine consumed or not

We have created a mobile application and this is our input interface and data interface in that application. It has many features that are shows above. Figure 3.14 shows the medicine tracking method with the flow chart we have created.

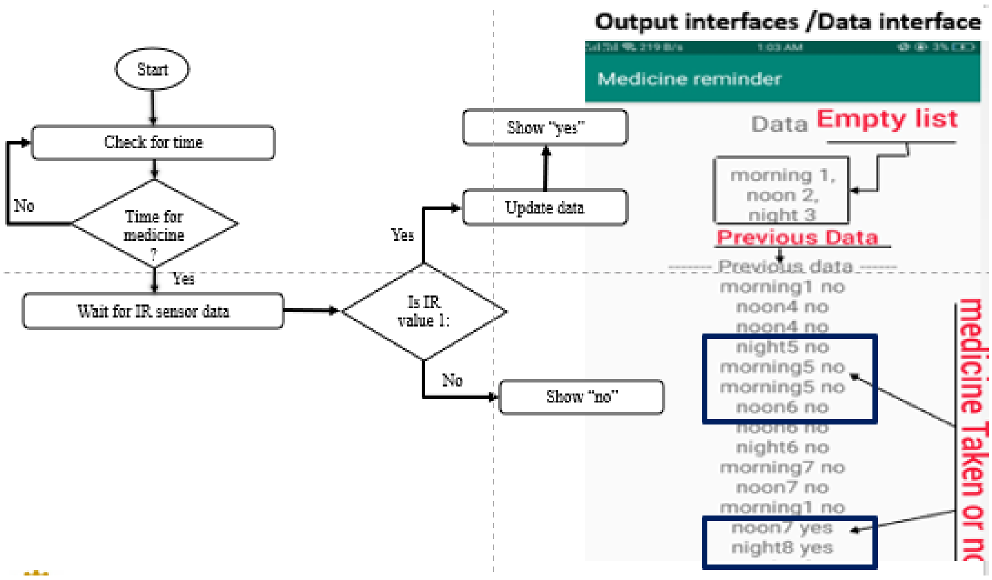


Figure 3.14: Medicine tracking method

3.6 Implementation

In our project we have introduced some features hoping that will help the patient and the caregiver in need. We're demonstrating a two-day trial of our system.

3.6.1 App Open and Prescription Input

First of all, we have opened our mobile application and input a prescription.

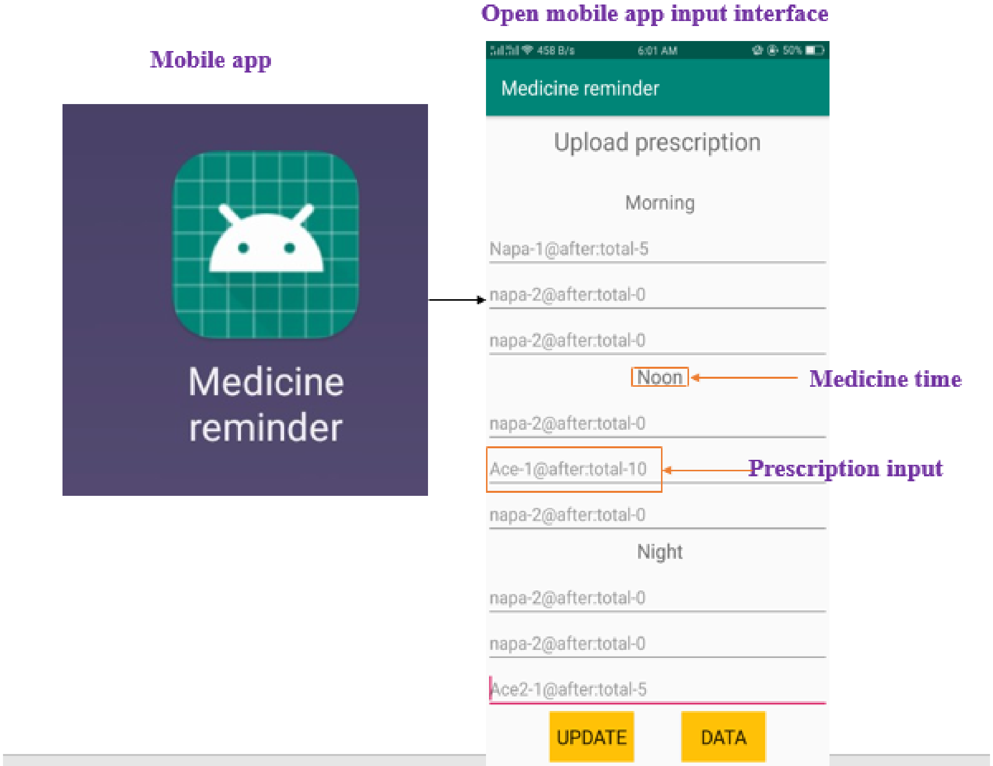


Figure 3.15: App open and prescription input

3.6.2 Input Medicine in the Box and Adapter On

After that, we put medication in the noon drawer and switched on the adapter.

Figure 3.16: Input medicine in the box and adapter on

3.6.3 Medicine Taken

When it's time to take medication, the LED and Buzzer in the noon drawer turn on. The medication for noon has also been shown on the LCD monitor. After that, the patient opened the drawer. The LED and buzzer were then switched off. The patient has closed the drawer since taking the medication. As the storage came to an end after closing the drawer, the empty LED light switched on and buzzer.

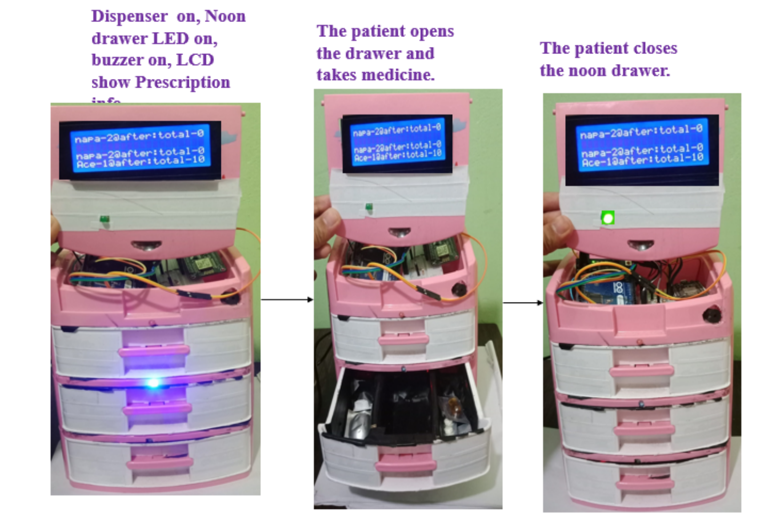


Figure 3.17: Taking the medicine and close the drawer

3.6.4 Updated Mobile Application Data

After the process is completed, all data will be updated in our mobile application.

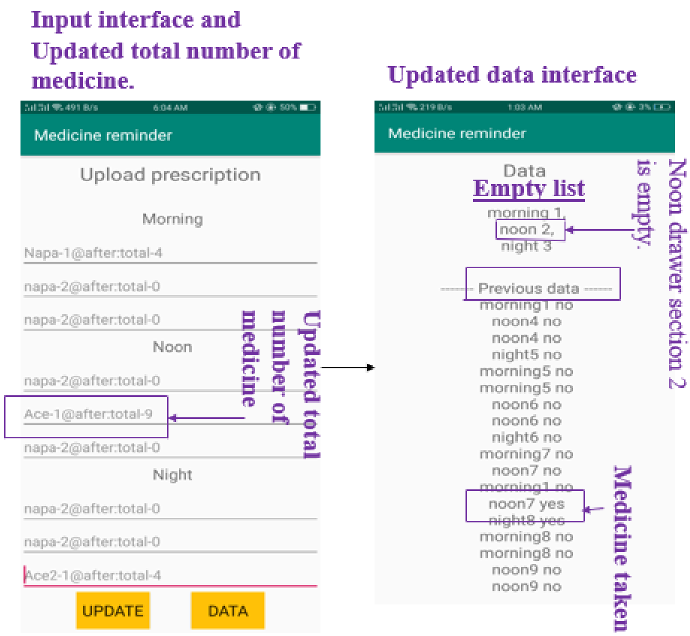


Figure 3.18: Updated app data

3.6.5 Medicine Not taken

The LED and Buzzer in the noon drawer switch on when it's time to take medicine. The prescription for the noon has also been shown on the LCD monitor. Following that, the patient did not open the drawer. After that, the LED and buzzer were turned off. The patient hasn't been taking his medicine. As the storage space was empty, the empty LED light and buzzer turned on.

Figure 3.19: Medicine not taken

3.6.6 Updated Mobile Application Data

All data are updated to our mobile application after completion of the operation.

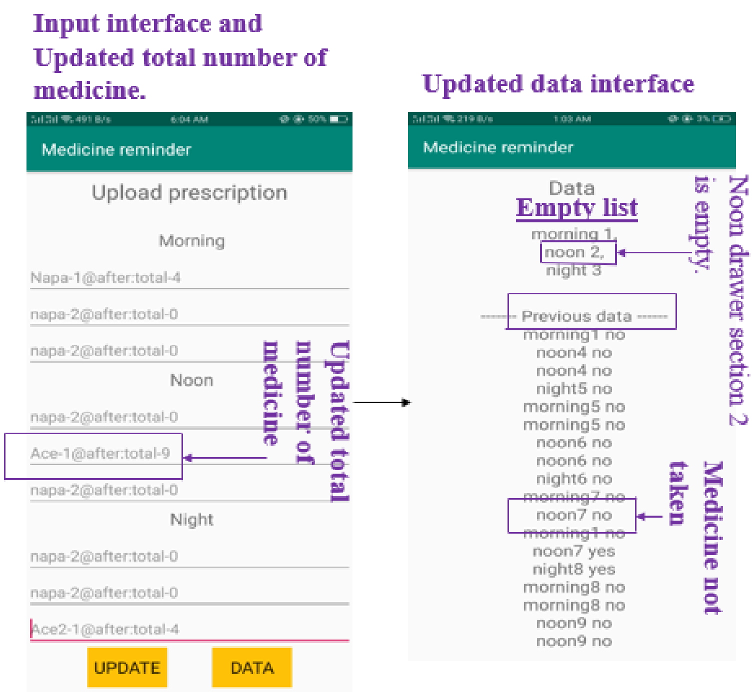


Figure 3.20: Again updated app data

3.7 Conclusion

We discussed the structure of the project in general in this section. We also discussed the proposed framework's overview, features, methodology, hardware requirements, pin diagram, circuit prototype, software requirements, programming language, and implementations. We analyzed the results and discussed them in the chapter that follows the methodology.

Chapter 4

Results and Discussions

4.1 Introduction

This chapter includes an evaluation of the experimental result and discussion of An Automated and Online Based Medicine Reminder and Dispenser.

4.2 Impact Analysis

Every IoT-based system has a variety of consequences, including social, financial, and ethical consequences. The following is a list of these impact analyses:

4.2.1 Social Impact

When we introduce this system to our society, other people will see us and start using our system. This will reduce the dependence of people on other people to take medicine and increase the quality of life of the people.The Internet of Things (IoT) creates webs of connections to change the way humans and things interact with one another. It violates the privacy of employees, depending on technology and losing jobs. It is modernizing our life in society.

4.2.2 Environment Impact

Patients normally keep the medicine shells anywhere. But with this system, we can now keep them all in one place. As a result, we can dispose of any leftover medication shells after we've taken them. That's why our environment will be cleaner than before. Reducing the energy consumption of IoT devices and making the environment safer.

4.2.3 Ethical Impact

As a result of using our system, a person will know that if he or she maintains a good relationship with another human being, he or she will receive much more help and support from that person than from this device. As a consequence, what is ethical about our people will be developed further.In general, technologies raise a slew of ethical concerns. There are a variety of mechanisms that can be used for good or bad. For example, video inspection could encourage senior citizens to remain in their homes longer and parents to keep an eye on their newborn child. They can also reveal private activity to interference and unwanted viewers.

4.3 Experiments

The central concern of this work is to design a medical reminder dispenser which is easy to use and track the medicine accurately. In our proposed architecture there is a box which contains medicines assigned by the user. An android app is installed in the patient and caregiver mobile phone. Thus, we conducted independent experiments to evaluate the proposed framework. We've set up an experiment to see how effective our proposed approach is compared to current methods. We were able to gather forty participants means twenty patients and twenty caregiver and split them into two groups of twenty users each. Then, using the Likert Scale questionnaire, we gathered information from forty participants. Our system's performance interface and report generation will also be discussed.

4.4 Experimental Environment

We placed the dispenser in the Tilpapara, Khilgaon, Dhaka-1219, Bangladesh to evaluate our proposed system. We also installed the android app in patient's and caregiver's mobile.

4.5 Participants

A total of forty people of the Tilpapara, Khilgaon, Dhaka-1219, Bangladesh participated in evaluating participated in the analysis of the automated and online based medicine dispenser. Total forty older people also young and busy people from 20-75 years old have participated in this experiment. Each of them had the dispenser for one day trial.

4.6 Procedure

We installed the mobile app in the participants mobile, also we were present while including the prescription. We collect the information for each participant and prepared a list based on the prescription how the database will be look at the end of the day manually. After each day we checked the statistics from the both mobile app and from the cloud server with our manual data. We have collected responses from older people also young and busy people who are unable to take their medicine in proper time. We gave them a questionnaire. We said them to select the rank in this questionnaire. They give their feedback on the basis of given questionnaire. In this way, we have collected responses from forty older people also young and busy people from a given questionnaire.

4.7 Testing

Before the evaluation we performed two tests to find out the effectiveness of the proposed system.

4.7.1 Power Consumption

The electrical energy supplied per unit time to run anything, such as a home appliance, is referred to as power consumption. Power consumption is usually estimated in watts (W) or kilowatts (KW) (kW). The energy consumed by machinery is often greater than the energy required.

4.7.2 Black Box Testing

Black Box Testing is a software testing method that involves testing software applications' functionalities without understanding the internal code structure, implementation details, or internal paths. Black Box Testing is a form of software testing that is entirely motivated by software requirements and specifications and focuses on the input and performance of software applications. It's also known as behavioral assessment.

4.8 Evaluation Methods

To evaluate the proposed system both quantitative and subjective evaluation have been done. In order to evaluate our system, we administer a questionnaire to the participants. We have collected questionnaire responses from forty participants of different ages. After interaction with our system, they have given their valuable opinion.

4.8.1 Subjective Evaluation

To evaluate the system qualitatively, we have performed a subjective evaluation by asking some questions to the participants, caregivers and collecting the score their answers based on a 1 to 5-point Likert scale.

4.8.1.1 Likert Scale

A Likert scale is an ordered scale in which respondents choose the choice that most closely matches their point of view. Respondents on a symmetric agree-disagree scale specify their degree of agreement or disagreement for a series of statements when responding to a Likert questionnaire object. As a result, the range reflects the strength of their feelings for a particular object. The basic number of questionnaire responses over the entire scale range can be used to build a scale. As a result, the Likert scale assumes that the distances between each object are identical. A key distinction to remember is the difference between a Likert scale and a Likert object. The number of responses to many Likert things makes up the Likert

scale. A Likert item is simply a statement that the respondent is asked to rate by assigning a numerical value to it on some subjective or objective parameter, the most common of which is degree of agreement/disagreement. Both "symmetry" and "balance" can be found in well-designed Likert pieces. Symmetry refers to the presence of an equal number of positive and negative positions with bilaterally symmetric intervals between them around the "neutral"/zero value (whether or not that value is presented as a candidate).Balance ensures that the difference between and candidate value is the same, allowing quantitative comparisons like averaging to work across items with multiple candidate values. Likert scaling is a bipolar scale that measures a statement's positive or negative reaction.
The rating questionnaire scale which is used for choosing rank is given below:

- Strongly Disagree
- Slightly Disagree
- Neutral
- Slightly Agree
- Strongly Agree

4.8.2 Quantitative Evaluation

To evaluate the system quantitatively we find out the success rate in the experiment.
Success Rate:
Success rate is determined by the fraction or percentage of total number of successful attempt among total number of attempts.We count down the successful attempts and then find out the success rate by the following equation. We have arranged an experiment to test our proposed method how efficiently it can work rather than existing methods. We have managed forty participants and divided them in two groups so that each group contains twenty users. Then we have collected information from forty participants using the questionnaire of the Likert

Scale.

$$\text{Success rate} = \frac{\text{total number of successful attempt}, T_S}{\text{total no of attempt}, T_N} \tag{4.1}$$

4.9 Result Analysis

The hardware and software have been tested for the proposed framework.Besides this framework is evaluated in terms of quantitative and subjective ways. Forty people have observed one day with two times taking medicine total (20 x 2 + 20 x 2) = 80 experiments while evaluating this experiment.

4.9.1 Power Consumption

Wake up current = 20 mA

Sleep current = 0.002 mA

Wake up time (5%) = 3 min

Sleep time (95%) = 57 min

Wake up current in an hour = 0.001 Ah

Sleep current in an hour = 0.0000019 Ah

Total current in an hour = 0.001+0.0000019 = 0.0010019 Ah

2 Adapter uses total current an hour = 2* 0.0010019 = 0.0020038 Ah

One day adapter uses current = 0.0020038*24 = 0.0480912 A day

One month adapter uses current = 0.0480912*30 = 1.442736 A month

4.9.2 Black Box Testing

Black Box Testing is a form of software testing that is entirely motivated by software requirements and specifications and focuses on the input and performance of software applications. It's also known as behavioral assessment. To ensure that the black-box testing was accurate, we tested the input and output of our mobile application.

4.9.3 Quantitative Evaluation

We allow patients and caregivers to use the six features of our project for quantitative analysis. The total number of attempts was forty. Thirty-eight attempts were successful, and two attempts were unsuccessful. As a result, we determined that our project's success rate is 95%. The quantitative evaluation analysis is given in table 4.1

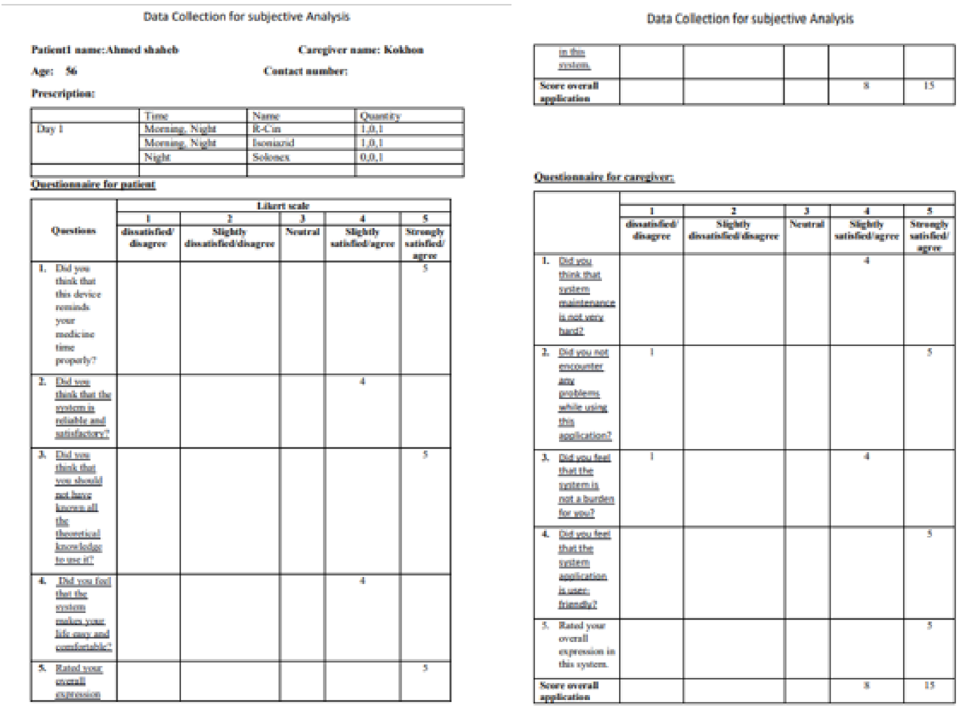
Table 4.1: Quantitative analysis

# of Participants		**Total attempts, T_N**	**Successful attempts, T_S**	**Unsuccessful attempts**
Patient	**Caregiver**			
20	20	40	38	2
Success ratio $= \frac{T_S}{T_N}$ *** 100%= 95%**				

So our project quantitative analysis success ratio = 95%

4.9.4 Subjective Evaluation

Create a form like the following. We will take feedback from the patient and caregiver who will use both the dispenser and the app, and the caregiver who will monitor remotely using the app. The data collection form that we have used for evaluation is given in figure 4.1



Data Collection for subjective Analysis

Patient1 name:Ahmed shaheb **Caregiver name: Kokhon**

Age: 56 **Contact number:**

Prescription:

	Time	Name	Quantity
Day 1	Morning, Night	R-Cin	1,0,1
	Morning, Night	Isoniazid	1,0,1
	Night	Solonex	0,0,1

Questionnaire for patient

Questions	Likert scale 1 dissatisfied/ disagree	2 Slightly dissatisfied/disagree	3 Neutral	4 Slightly satisfied/agree	5 Strongly satisfied/ agree
1. Did you think that this device reminds your medicine time properly?					5
2. Did you think that the system is reliable and satisfactory?				4	
3. Did you think that you should not have known all the theoretical knowledge to use it?					5
4. Did you feel that the system makes your life easy and comfortable?				4	
5. Rated your overall expression in this system.					5
Score overall application				8	15

Data Collection for subjective Analysis

Questionnaire for caregiver:

	1 dissatisfied/ disagree	2 Slightly dissatisfied/disagree	3 Neutral	4 Slightly satisfied/agree	5 Strongly satisfied/ agree
1. Did you think that system maintenance is not very hard?				4	
2. Did you not encounter any problems while using this application?	1				5
3. Did you feel that the system is not a burden for you?	1			4	
4. Did you feel that the system application is user friendly?					5
5. Rated your overall expression in this system.					5
Score overall application				8	15

Figure 4.1: Data Collection form

The question we asked the patients are given below.

- Did you think that this device reminds your medicine time properly?
- Did you think that the system is reliable and satisfactory?
- Did you think that you should not have known all the theoretical knowledge to use it?
- Did you feel that the system makes your life easy and comfortable?
- Rated your overall expression in this system.

The question we asked the caregivers are given below.

- Did you think that system maintenance is not very hard?
- Did you not encounter any problems while using this application?
- Did you feel that the system is not a burden for you?
- Did you feel that the system application is user friendly?
- Rated your overall expression in this system.

After preparing this type of file we will get some data. After getting the data we will create a patients score on questions bar chart is given in figure 4.2 and patients mean score bar chart is given in 4.3

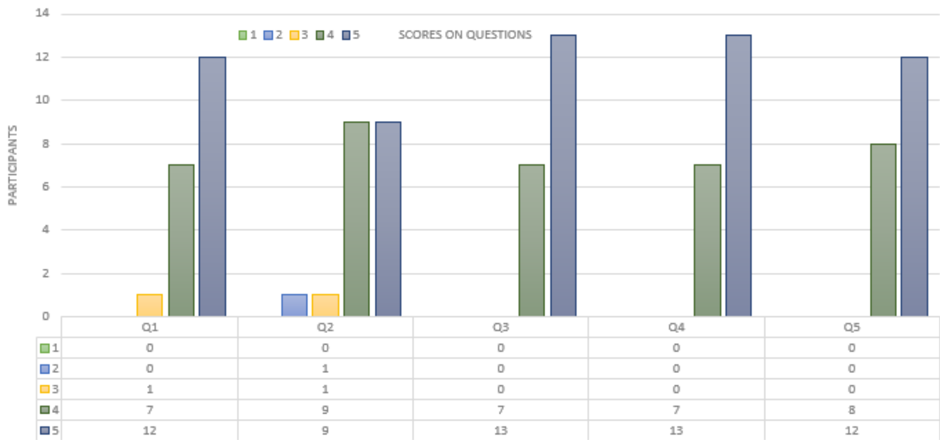


Figure 4.2: The bar chart of patients' scores on the questions

After taking data from patients for all questions, we created a bar chart of all that data. We can see from the bar chart that Twelve people strongly agree, seven people only agree, and one person has neutral in question number one. From the bar chart, We can see that nine people strongly agree, nine people just agree, one person has neutral, and one person has slightly disagreed on question number two. Thirteen people strongly agree on question number three, although seven people just agree. In question four, we can see from the bar chart that thirteen people strongly agree and seven people just agree. In question five, we can see from that bar chart that twelve people strongly agree and eight people just agree.

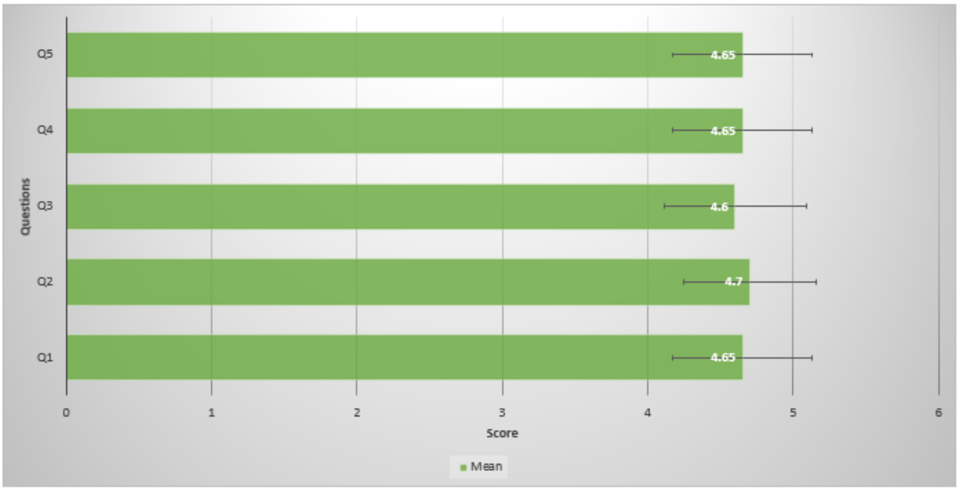


Figure 4.3: Patients' mean score bar chart

We calculated the mean and the standard deviation values for all questions after collecting data from all patients. The mean value of the number one query is 4.55, and the standard deviation is 0.5895, as seen in the bar chart. The mean score for the second question is 4.3, with a standard deviation of 0.781. The number three query has a mean value of 4.65 and a standard deviation of 0.477. The standard deviation of the number four query is 0.477, and the mean value is 4.65. The standard deviation of the number five-question is 0.4899, and the mean value is 4.6.
We can see from the two bar charts above that patients have taken to our system very well.

After preparing this type of file we will get some data. After getting the data we will create a caregivers bar chart is given in figure 4.4 and caregivers mean score bar chart is given in 4.5

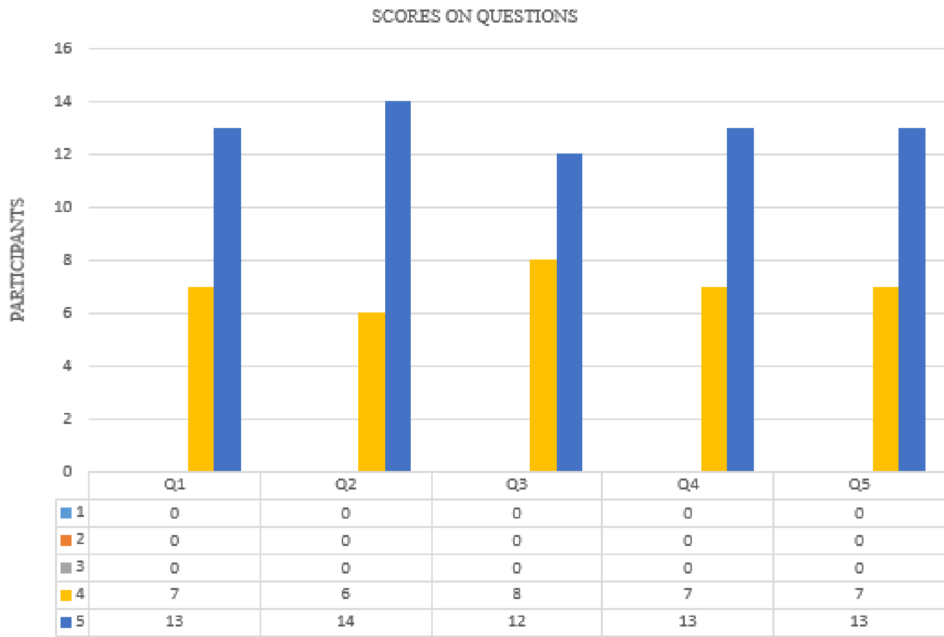


Figure 4.4: The bar chart of caregivers' scores on the questions

We created a bar chart of all the data we collected from the caregivers for all of the questions. We can see from the bar chart that thirteen people strongly agree with our question, while seven others just agree in question number one. In the case of question number two, fourteen people strongly agree, while only six people agree. Twelve people strongly agree on question three, although eight people only agree. In question four, we can see that thirteen people strongly agree and seven people just agree. In question five, From the bar chart, we can see that thirteen people strongly agree and eight people just agree.

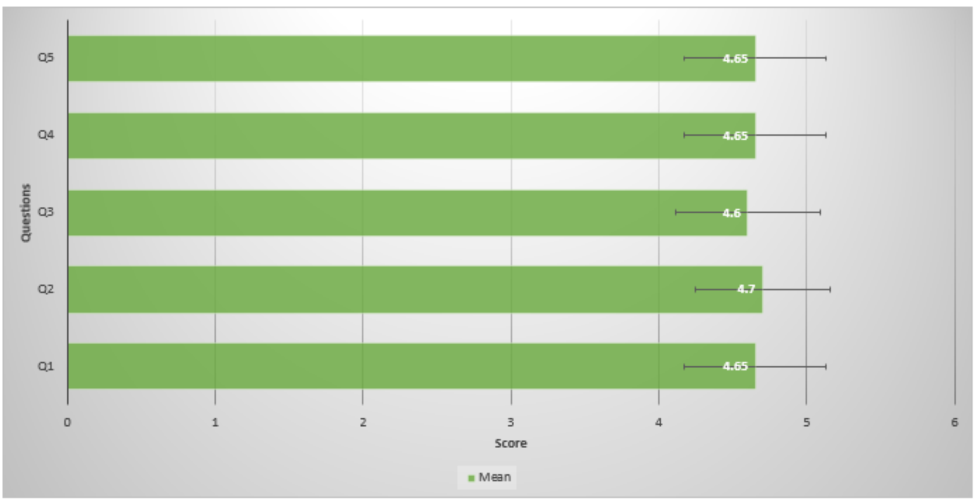


Figure 4.5: Caregivers' mean score bar chart

We determined the mean values and the standard deviation values in all questions after receiving data from all caregivers. According to the bar chart, the mean value of the first question is 4.65, and the standard deviation is 0.477. The mean value of the second question is 4.7, with a standard deviation of 0.4583. The mean value for the third question is 4.6, with a standard deviation of 0.4899. The mean score for the number four question is 4.65, with a standard deviation of 0.477. The mean value of the number five-question is 4.65, with a standard deviation of 0.477.

The two bar charts above show that caregivers have taken to our system very well.

4.10 Conclusion

This chapter contains an evaluation of the experimental results as well as a discussion of An Automated and Online-Based Medicine Reminder and Dispenser. We visited various areas to collect people's responses for evaluation. Their important feedback assists us in evaluating our system. We gathered responses from older people also young and busy people who are unable to properly take their medication. We distributed a questionnaire to them. We encouraged them to choose a rank. As a result, we were able to collect responses from forty older people also young and busy people through a given questionnaire. Everyone was pleased to see our system.

Chapter 5

Conclusion

5.1 Conclusion

Many different platforms have been used to build medication reminder systems. Many of these systems necessitate the use of specialized machinery to alert patients about medication ingestion times. Purchasing new hardware devices is becoming more expensive and time consuming. As a result, an effort has been made in the provided work to incorporate a scheme that is cost-effective, easy to use, and increases medication adherence. Non-adherence to medication decreases the efficacy of a prescription while also putting a financial strain on health-care systems. The work's main feature is the development of a reminder system for elderly people who often forget to take their drugs on time. A new technology-based drug system is the focus of this proposed system. To raise awareness among the elderly, the reminding system provides services that enable them to live a comfortable and stress-free life. Our proposed framework distinguishes core features of our work by describing such a critical problem. In every way, the device is capable of meeting requirements. The proposed system will run in any place. This does not need any fixed room to be placed in. As a result, the topic of space in settings is unimportant. As a result, it is simple to implement and operate.The main purpose of this device is to remind them to take their medications at the correct times. For the life cycle, age is a critical factor. Man grows older after a certain period of time, and this stage prevents him from performing a routine role on a daily basis. Since age is such a sensitive subject, nothing is beyond their grasp. People feel less reliant on others when they engage in independent activities. Our goal is to develop a machine that can take the place of a human being. The reminder device functions as if it were a self-contained system that is not burdened in any way. Many new features have been introduced to the system to make it more user-friendly and reliable.

5.2 Discussion

In this work we have introduced a hardware and a software module. For hardware purpose, we used local equipment that is why it is cheaper. The cost estimation table 5.1 shows the cost estimation for our project.

Table 5.1: Cost estimation

No	**Materials**	**Cost(TK)**
1	Arduino	600
2	WiFi Module	500
3	20*4 LCD Display	500
4	Buzzer	100
5	Adapter*2	100*2=200
6	IR sensor*9	60*9=540
7	Customize plastic box	400
8	RTC Module	200
9	breadboard	100
10	LED, Wire & Others	200
	Total	3340

We have introduced some new features which minimize the limitation of the previous works which is shown in table 5.2

Table 5.2: Comparison with previous works

Features of previous works	**Features of the proposed model**
developed only a android application [12]	developed both a dispenser and android application
emphasized only on elder people [13]	kept in mind all ages
no specific result has been shown [10] [9]	both subjective and quantitative evaluation have been performed
proposed a medical dispenser but did not implement [18]	implementation has been done
did not give low storage warning [5],[6], [8]	low storage alarm has been introduced
used Bluetooth module to control by the mobile [7]	used WiFi module to control by the mobile

5.3 Limitations

There are some limitations of our project which are listed below.

- Before or after taking the medication, our mobile application receives data but does not receive any notifications or notifications alarm.
- Our medication dispenser drawers are not automated.

5.4 Future Work

There are a lot of rooms for research in the area of medication systems for the elderly. In the future we'll work on our mobile application user interface and we intend to build multi-user mobile application. We will update our mobile application so that we get notifications before and after the patient takes medication. Also, we will automate our medicine dispenser drawers. Furthermore, this work can be extended by adding more parameters in order to obtain more accurate results.

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