Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF APP-ENABLED MEDICINE DISPENSER USING RASPBERRY PI FOR HEALTH CARE APPLICATION

AMIRUL HAKIM BIN BADARUDIN

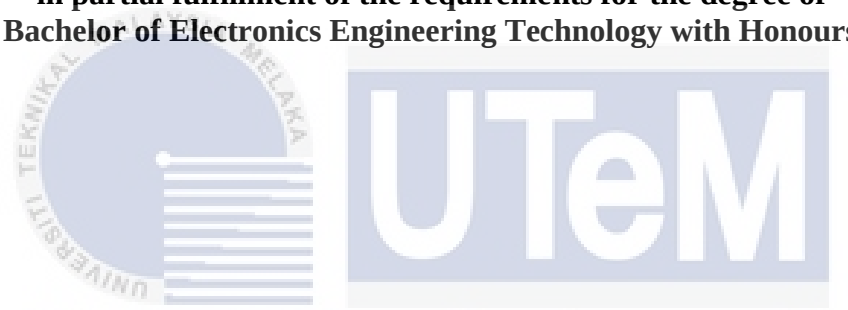
Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

2022

DEVELOPMENT OF APP-ENABLED MEDICINE DISPENSER USING RASPBERRY PI FOR HEALTH CARE APPLICATION

AMIRUL HAKIM BIN BADARUDIN

A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electronics Engineering Technology with Honours



Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2022

DECLARATION

I declare that this project report entitled “Development of App-Enabled Medicine Dispenser Using Raspberry Pi for Health Care Application” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

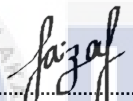
Signature : 

Student Name : Amirul Hakim bin Badarudin

Date : 24/2/2023

APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electronics Engineering Technology (Telecommunications) with Honours.

Signature : 

Supervisor Name : TS Mohd Faizal bin Zulkifli

Date : .....

Signature : .....

Co-Supervisor : .....

Name (if any)

Date : .....

ABSTRACT

With the recent pandemic situation many have fallen ill, a lot of patients are facing health issues severely and they need to have a device that help them to remind them to take their medicine in timely manner. An App-enables medicine dispenser will be designed and developed to cater the need. The app will be created using MIT-App Inventor to set and control the motors that will release all the medicines according to correct time. The medicine dispenser should be able to house a few types of medicines. Raspberry PI will be used to connect the machine dispenser to the app. The app will help to track the time and the machine will dispensethe correct medicine according to set time to take it.

ABSTRAK

Dengan situasi pandemik baru-baru ini ramai yang telah jatuh sakit, ramai pesakit menghadapi masalah kesihatan yang teruk dan mereka perlu mempunyai peranti yang dapat membantu mengingatkan mereka untuk mengambil ubat tepat pada waktu. “App-enables medicine dispenser” akan direka dan dibangunkan untuk memenuhi keperluan tersebut. Aplikasi ini akan dibangunkan menggunakan MIT-App Inventor untuk menetap dan mengawal motor yang akan mengeluarkan semua ubat mengikut masa yang telah ditetapkan. Pengeluar ubat boleh mengisi beberapa jenis ubat. Raspberry PI akan digunakan sebagai penghubung di antara mesin pengeluar ubat dengan aplikasi. Aplikasi ini akan membantu untuk menetapkan masa dan mesin akan mengeluarkan ubat yang betul mengikut masa yang telah ditetapkan untuk mengambilnya.

ACKNOWLEDGEMENTS

Alhamdulillah, Thanks to Allah S.W.T. for giving me strength to complete the final year project. Firstly, we would like to express our gratitude to our helpful supervisor, TS Mohd Faizal bin Zulkifli whose help, stimulating suggestions and encouragement have helped me throughout the researched and thesis writing. The supervision and support that he gave has truly helped the progression and smoothness of the project and his co-operation is much appreciated.

My appreciation also goes to my family members for their fully supports throughout the year to accomplish our final year project successfully. Special thanks also go to my beloved friends who really help me direct or indirect my project.

Last but not least, I would like to sincerely thank to Universiti Teknikal Malaysia Melaka (UTeM) and Faculty members for providing the facilities and equipments for this research process, as well as other individuals who are not listed here for being co-operative and helpful.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

VCC	-	Common Collector Voltage
GND	-	Ground
Tx	-	Transmitter
Rx	-	Receiver
GUI	-	Graphical User Interface
$GPIO$	-	General-Purpose Input/Output
IR	-	Infrared
LCD	-	Liquid Crystal Display
$VSYS$	-	Main System Input Voltage
IDE	-	Integrated Development Environment
$OLED$	-	Organic Light Emitting Diodes
OS	-	Operating System
$WIFI$	-	Wireless Fidelity
PWM	-	Pulse Width Modulation
GSM	-	Global System for Mobile Communication
USB	-	Universal Serial Bus

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Research Background

One of serious concern in the developing country is caring of the aged. Family members are responsible to take care of the old. Nowadays, the present situation of the society give difficulty for family members to take manage of the old and sometime it is impossible because of the busyness of work. A group of professors (Grey, Mahoney, and Blough) from University of Washington conducted a study towards 147 old participants in three different home healthcare agencies and they found under adherent who take three or more medicine is 30.6%. Meanwhile, 18.4% participants were over adherent that take at least one medicine. According patient's safety authority of India, 74% of total death in the hospital happened because overdose of medicines or lack of medicines.

New England Health Care Institute stated that poor adherence in taking medicines can give negative impacts toward patients' health. Estimated, 50% of patients with chronic diseases in developed countries have bad adherence. A report from Sabaté, Eduardo and World Health Organization Noncommunicable stated that non-adherence rates is high in China and Gambia which are 54%and 73%, respectively. A study by Aziz et al. found that 50% of patients that have chronic diseases receive medical treatment at public hospitals and clinics. According to Fürthauer J, Flamm M and Sönnichsen, patients will have a high risk of medication non-adherence if the patients got chronic diseases and/or needs to take multiple types of medicine.

1.2 Problem Statement

Medication adherence is one of the biggest problems in the health care industry. Usually elderly patients forgotten to take their medicine on time and also forgotten the number of pills should be taken. This problem can lead to overdose of medicine. Because of that, it is important to take action as soon as possible in order to eliminate medication adherence.

In order to overcome this problem, there are products can alert patient with alarm to remind them take the medicine according to the correct doses. User can set the time and number of pills to be dispensed by using app. The automated medical system makes things easier for everyone especially for patient who needs reminder to take medicine.

However, the security of the products is not secure because no personal password is developed. Anyone can use the product and change the set time for medicine to dispense. This issue causes the correct information to be incorrect. Besides, the existing automated medical system used less power microcontroller, which can give a lot of deficiency to the product.

Hence, in this work, a lock system will be developed. They are certain users only can log into the system such as doctors or keepers. More powerful microcontroller will be used which is Raspberry Pi Pico.

1.3 Objectives

1. To investigate and to propose reminder system to alert patient to take the medicine on time and correct dosage.
2. To develop a secure health care application and Raspberry Pi coding in controlling the medicine dispenser.
3. To analyse a prototype for the proposed project.

1.4 Scope of Research

The process of the project is to remind the patient to take the medicine on time and correct dosage when patient stay at home by using a medical dispenser which is equipped with Raspberry Pi Pico as the microcontroller. An application is designed using MIT App Inventor for users to set the time to dispense the medicine with correct dosage. Furthermore, the servo motor is installed for the mechanical part. Last but not least, this project is dedicated to health care industry only.

1.5 Expected Result

This project will achieve the project's objectives which are to design a reminder system that can give a signal to patient to take the medicine on time and correct dosage. This medical dispenser is designed to be used by aged people who always forgotten to take to medicine on time and right doses. It can overcome some health issue due to improper medication intake such as drug addicted. Simple components are used to develop this project that easy to find at any component store. The system of this project is high security level because only authorized people can log in and key in all the data in system. The product is equipped with better microcontroller, not bulky and easy to install at home or at hospital. With this product, hopefully people be more alert and responsible in taking medicine on time and right dose.

1.6 Thesis Outlines

There are five chapters in this thesis include of introduction of the project, literature review which is the works of others that related with this project and lastly the method that used to implement the knowledge into project.

Chapter 1: In chapter 1, briefing about general ideas of the project which are introduction, problem statement, target of the project, scope of project, project significant and thesis outlines.

Chapter 2: In this chapter, basically study about literature review which is work that related with the project. It is important in order to obtain some knowledge about the project.

Chapter 3: Will be discussing about methodology, which is consists flowchart of whole project and the description of component that will used to solve the problem statement. Furthermore, this chapter include some explanation about software and hardware development and also about the main component in the project.

Chapter 4: Discusses in details the outcome of the project in a logical way. The analysis of the outcome is also presented within this chapter.

Chapter 5: Summarizes the contributions of all studies to the project and provides concluding remarks. In addition, there are some recommendations and future works from the current project would be discussed.

1.7 Summary of chapter 1

As conclusion, medical adherence is the main problem around the world and to overcome this problem, a device will be created so that the patient will receive proper medication intake. The device will be equipped better microcontroller which is Raspberry Pi Pico. User can key in all the data in an app developed by using MIT App Inventor. All the objectives must be followed to make sure the device works as desired.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter discusses the literature review from previous research about this project. This chapter involves finding the information about the concept and idea related to the project and this chapter also has detail explanation about software and hardware that will be used in this project. The idea of this project come from the problem that faced by certain patients who have health issues and need a device that help to remind them when and what type of medicine should be taken.

2.2 Previous works

2.2.1 Smart Medicine Dispenser (SMD)

Smart Medicine Dispenser (SMD) done by Wissam Antoun, M. Hamad, Abdallah Kassem (2018). There are many types of pill dispensers produced by many companies available in the market. The product equipped with alarm to notify the users but does not have online database to save all the data. An Android application was built to control the whole system. Data will be saved in the cloud and will be synchronized once the user login into the system. This is the primary way to interact with the system. The smartphone will be connected to the Arduino via Bluetooth and commands will be sent to indicate which container and stepper motor should be functioning to dispense the medicines.

The system depends on the android application to make sure the product works as intended. Once the user opened the application, the apps will show information about the pills to be taken either on the same day and on the next day. The system also has History Tab so that the user can see old pills were taken by the patient. Plus, icon is used to add a new pill alarm

by inserting the pill's name, number of pill and time should be taken and also can set the alarm either repeated or vice versa. An alarm will be sounded when the time to take the pill has come and will not stop sounded once the user selects an option of these 3 which is 'I will take it now' or 'Snooze' or 'I will not take'. The users can click on refill button to increase the number of pills if the number of pills is low. Each container has its own LED and can be used up until 7 servings. The cylinders will be rotated by servo motors using PWM signals controlled by an Arduino Uno R3 as shown in Figure 2.1.

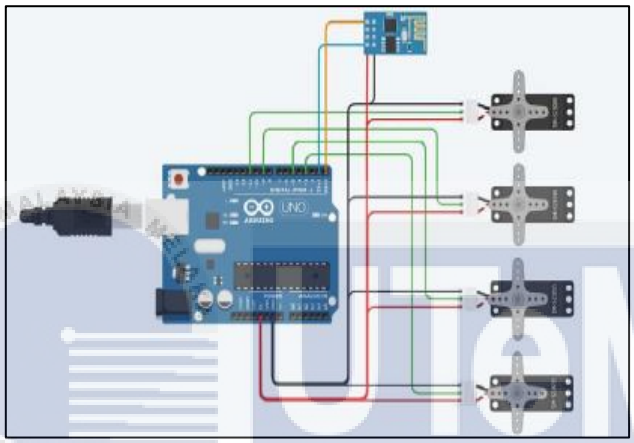


Figure 2.1: Servo motor connection

As conclusion, this project's aim is to help the patients to take the medicine according to the set time and reduce the risk of overdose and underdose of medicine. In this project, Android application is used to control the whole system. All data related to time schedule for patient to take the medicine will be stored in application on the cloud. Smartphone will be connected to Arduino via Bluetooth and sends the commands to Smart Medicine Dispenser (SMD) to dispense the medicine. There will be a modification at the microcontroller where in Raspberry Pi Pico will be used because Raspberry Pi Pico is a powerful controller and cheaper compared to Arduino.

2.2.2 Automatic Medicine Dispenser using IoT

According to Jyothis Philip, Feba Mary Abraham, Ken Kurian Giboy, B J Feslina and Teena Rajan (2020) medication adherence is one of the greatest problems happen in health care industry. Most of elderly people fail to take the medicine on time and chances to get overdose is high if the elderly people need to take more than one medicine. In the Automatic Medicine Dispenser (AMD), when the patient needs to take the medicine, the device can either the premeasured dose can be released into a small compartment or can be sorted manually by patient's caretaker into small compartment according which patient received the notification. The patient will be notified using loud alarm signal. If the medicine did not take by the patient within the given time, the device will send loud signal to catch patient's attention.

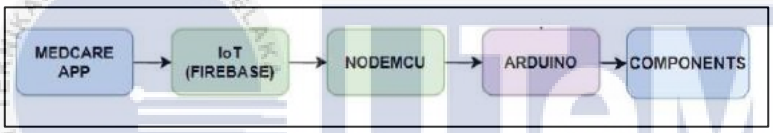


Figure 2.2: AMD block diagram

The whole system is equipped with a rigid outer structure to prevent any types of damage that can affect the performance of the system. MedCare application need to be installed in their mobile devices. Once installation done, the user required to register first and a new database will be created within the Firebase servers for every user registration. The user can log in from there on after registration. The type of pill or liquid that need to be dispensed can be selected as well as the quantity of liquid medicine. The user also needs to set the time and date when to dispense the medicine.

The system will create a 14-digit string value according to the selected data. For example, if the user selects Paracetamol, 10:00 am and 20 July 2020, '20200620113001' will be generated. The corresponding string value will be sent to Firebase to store user's database from the app. This value is sent to the Arduino through the NodeMCU and stored in an array.

Output time values from the RTC module will be compared constantly with the first 12 digits of all the string values in the array and when any one is equal, the last two digits of string will be checked to make sure the device dispense the correct medicine at the correct time. A signal will be received by servo motor from Arduino based on last two digits value to dispense the pill and if to pump out liquid medicine, the signal will be sent to the centrifugal pump from Arduino.

The servo motor is programmed to make sure the pill falls at the given time. Also, the Arduino will active the pump only for a sufficient amount of time depends on the quantity of liquid. A buzzer will be turned on to give a signal to the consumer to take the medicine on time once the dispensation completed. The presence of the pill or liquid can be detected by using ultrasonic sensor and a message will be sent after a predetermined interval of time to notify the caretaker either the patient has taken the medicine or not. The AMD app is developed on the Android studio and will be connected to the Arduino through firebase and allows user to send data to internet or receive data from the internet without human intervention.

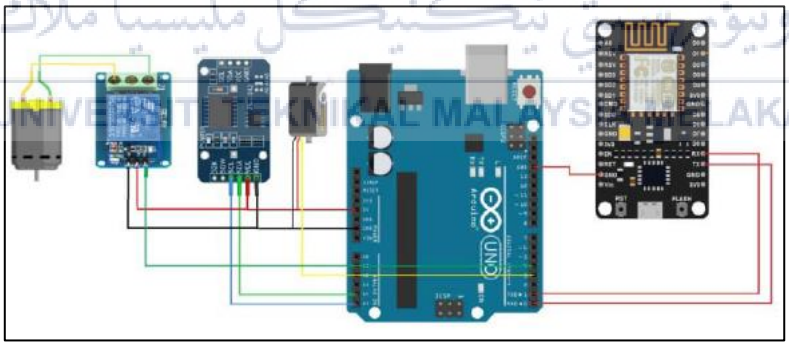


Figure 2.3: Complete Circuit Diagram

The product was designed to dispense the correct quantity of the medicine at the correct time timing controlled and monitored by an application. The AMD application was developed on the Android studio and connected to Arduino via firebase so that all the data can be send or can be received to or from the internet. The device can be upgraded by using better microcontroller to replace Arduino Uno which is Raspberry Pi Pico.

2.2.3 MEDIC-The Smart Medicine Dispenser

Manjunatha Y R N Lohith, Bhavana R, Bindushree S V (2019) stated that taking care of the aged is important and serious concern especially in the developing nation. The one who responsible for the care and management of the old is family members. It is almost impossible and difficult in the current situation for family members to take care of aged due to busy work and time constraints.

A phone will be connected to Arduino controller through Bluetooth and send the commands to indicate which container and which motor should be rotated to dispense the pill from the container. Multiple types of pills can be stored by the device, in case if the patient need to take more than one medicine. The device will send a message to patient to notify the correct time to take the medicine as well as alarm to alert the user that the medicine is ready to be taken. Mobile application will be used to communicate and manage the device.

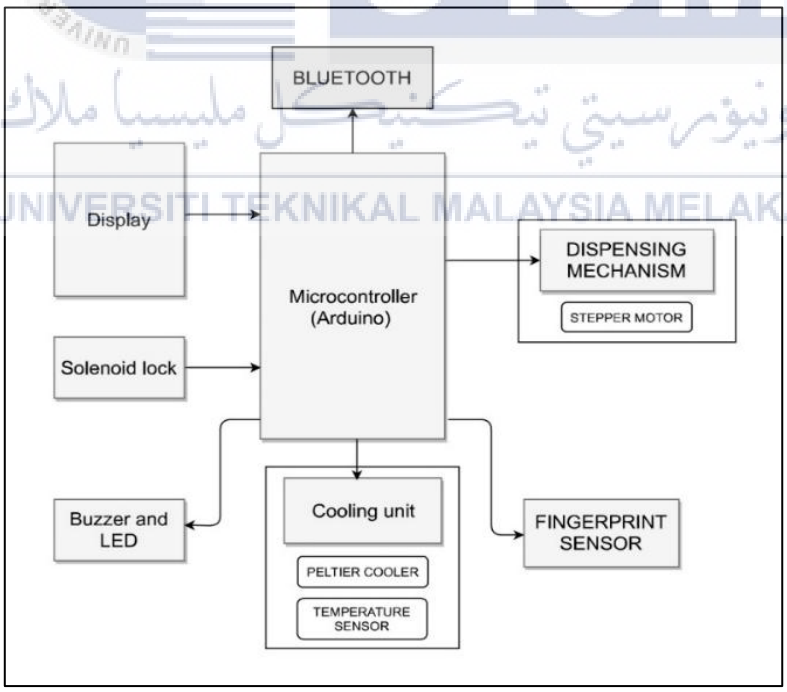


Figure 2.4: MEDIC block diagram

MEDIC has a lot of advantages compared to existing system. MEDIC used many hardware components and each of the component has different characteristics specifications

and working. This device is categorized as INPUT and OUTPUT device and will be connected to Arduino. Each container has its own step motor and can keep up until 7 servings. The function of step motors is to rotate the cylinders, controlled by an Arduino Uno. PWM signals are used to make sure the servo rotates for one bit and stop. The rotation of two stepper motors either in clockwise or anticlockwise direction can be controlled by using four switches and will be interface with Arduino. Fingerprint reader can act as a scanner for security purpose to identify fingerprint of a person.

After receiving a sample fingerprint's image, access to a cooling unit system can be done if the user's fingerprint matches to the stored input database. To maintain 2-9 degree Celsius for vaccines and 10-12 degree Celsius for other medicines, temperature sensor will be used to measure the temperature. It is easy to be used because we can input all data including the medicine names and also can upload the prescription from doctor into the system. This device can be used in a house by more than one patient who is suffering chronic disease and their data can be stored according to the prescription. The user interface can be used by everyone including the elderly population because it is simple and easy.

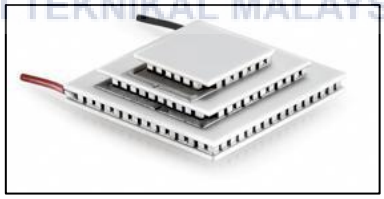


Figure 2.5: Fingerprint sensor module

As conclusion, a device named MEDIC, which patients can take the medicine without require a supervision or guidance from a medical professional such as doctors. MEDIC's components consist of microcontroller which is Arduino, an OLED display, dispensing mechanism, buzzer, a multiple tablet container to store and dispenser the medicine. The future work can be done is change to another wireless technology such as GSM, WIFI or Zigbee because Bluetooth cannot be used to set the time to dispense the medicine from long distance.

2.2.4 Automatic Medicine Dispenser

According to Tahaseen Hasrath, P.Sowmika, N.Rajendra, R.Nishma, U.Gowthami (2021) discovered that more than 60% of persons that aged over 60 have a bad medical history after completing study. The main cause of this problem was failed to adapt with suitable medication. Getting the right amount of medicine to the right person on time is a big difficulty faced by elderly. They might forget to consume the correct amount of medicine on time. A lot of potential offered by IoT-based healthcare services in order to overcome above problem.

The pill box receives all the data including the schedule to take the medicine through the mobile app named Blynk. Smart pill box is equipped with Node MCU, LED, OLED display, buttons and buzzer. All the commands in the pill box can be seen on the OLED display using Node MCU that equipped with built-in Wi-Fi module. The Wi-Fi module will be set up as PILL BOXAP, meaning PILLBOXAP IP address and the Mobile App will be paired to make sure an IP address generated on the local network. The smart pillbox will receive configuration data when the configuration is turned on. At that moment, the concerned LED will turn on and buzzer will be sounded.

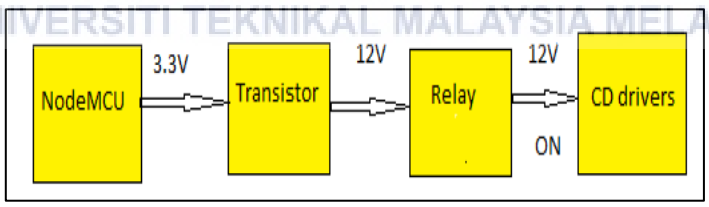


Figure 2.6: Block Diagram

A semiconductive device which is a transistor is used to transfer a weak signal from a low resistance circuit to high resistance circuit. That means the output of microcontroller is 3.3V, but the CD can be operated at 12V. So, the transistor takes NodeMCU's input which is 3.3 V and outputs 12 V to the relay. The circuit will be regulated by using independent low-power signal that has in relay. The tray will be opened at the set time when the transistor's input received by relay.

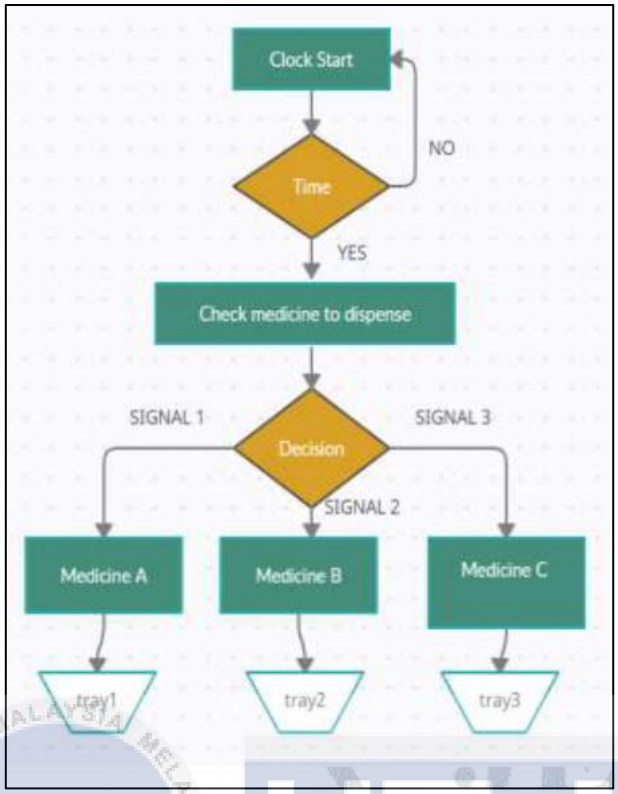


Figure 2.7: Flowchart

If the user logs in to the Blynk app, the screen will appear the current time and date, individual box timings and on/off button. For example, if the user set start time at 14:40:00, the box will be opened at that time, and if the user set end time at 14:40:30, the box will be opened within that period before automatically closed. The time restriction between one box to another box is at least 1 minute. We can set the amount of time we required to take each medicine if we need to consume many medicines in one time. We must turn on the hotspot first in the smartphone and send electricity to the device Then, the gadget's WIFI will be connected to the hotspot.

As conclusion, the function of Smart pill box is to ensure that patient take the correct medicine according to the timetable. Blynk app is being used to receives the schedule/configuration data. the main goal is to create a simple gadget and inexpensive, which can give benefit to elderly. The future work can be done to upgrade the device develop a system wherein can send a message to user to tell that the patient has taken the medicine.

2.2.5 IoT Based Smart Pill Box Using Arduino Microcontroller

K.Divya Sai, Dr.S.SwarnaLatha Dr.B.Shoban BabuOld (2021) claimed that old patients always forget to take pills on correct time which can leads to certain health issues. They noticed these problems occurred in hospitals and people around them who got infected with that kind of diseases and because of these two problems they come out with an idea to made smart medicine box.

The new wave in computing era is different from the conventional desktop. The Internet of Things (IOT) has become important topic as well as become headline news either in specialty press or in popular media. Internet of Things (IOT) is a network can be used to networked objects around us from one object to other objects in one form or another. The usage of IOT can increase the information's availability as well as the production chain value by using networked sensors. The health statistics of medication will be observed by using this kind of technology. In encryption process, pill box will be received the schedule data or prescription from doctor through mobile app. The LED is placed as the indicator and buzzer will acts as an alarm alerts and reset button will works to count the medicine in cloud platform.

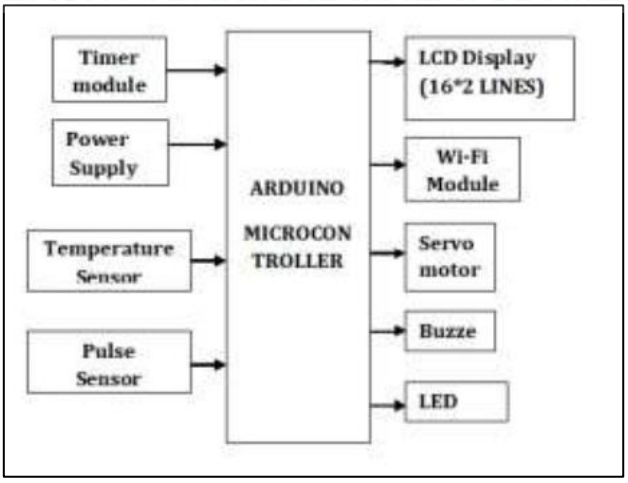


Figure 2.8: Flowchart of IoT Based Smart Pill Box

The pill box received the schedule data or configuration data through IoT. The project is embedded system using Arduino Uno to interface all things in the system. In that Arduino is

an open-source which is easy-to-use hardware and connected software. So, Arduino acts as a path between hardware and software. Arduino boards read inputs from push button and transform it into an output in order to turn on an LED and buzzer. A lot of instructions can be sent to Arduino UNO. 16 x 2 is used to display all the commands and connected to Arduino UNO. Tiny RTC I2C module that has I2C protocol is used because it is useful in project. Buzzer will be sounded to give a signal to patient to take the pills once it is ready. The LEDs are used to tell patient which box should be opened to take the medicine. Three push buttons are placed and the function of first push button is for setting medicine, second push button is for increment and third push button is for next. The heart rate and temperature of patient can be monitor continuously by using pulse sensor and temperature sensor. The box can be opened and closed by using servo motor. IoT will be configured with Wi-Fi module. During configuration is ON mode, the configuration data will be sent to the smart pillbox.

The project can solve that problem which can set the time to take medicine, notification sound to alert the patient and bright light will be displayed in certain pill boxes. Patient needs to take the medicine at given time because all pill boxes are pre-loaded in the system. The improvement can be done for this project is develop a system that can send a message to user to tell that the patient has taken the medicine and increase the security level by adding lock system such as password.

2.2.6 A Smart Pill Box with Medication Reminders and Confirmation Functions

Sagarika Deshpande, Manasi Choudhari, Doreen Charles, Sarish Shaikh (2018), stated that elderly people have problem to memorize the pills they need to take. They need to take medications over a prolonged period of time because they have chronic disease to stabilize their conditions. The most commonly problems faced in drug abusing are excessive drug usage and disobeying the instructions of medication. Nowadays there are systems or app that can be used to schedule and notify time to take the medicine in smartphone. In additional, there are

pill organizers used to save and remind the patient about the dosages. But, the disadvantages of above systems are pills will not be stored and the system not equipped with alarm system.

In this current world's situation, people faced problem to remember the pills they need to consume from medicine box. Same problem always happened multiple times which is the time to consume the medicine not printed out on medicine box or they cannot read English. Sometime people forget to take the pills and this can be considered as bad habit. Due to this, some medicines will be expired before finish eating by the patient. In order to reduce the family members responsibility, the proposed pill box will be useful by adding required medicine in the pillbox and set the time for particular pill time to be dispense. To identify the pill time, the Real-time clock is used. If the pill time corresponding with system time the buzzer will be sounded continuously until the push button is pressed as sign to user to take pills. The required pill comes out when the push button pressed and it works like this because to avoid confusion in taking medicines.

It is necessary to update the quantity of pills by user if the user requires more than one pill or if the user requires more than one person to utilise the same system. If pills remain less or almost finish, the order will be sent automatically to medical shop. Android application can be used by guardian only. App can be log in through mobile IMEI number. User can use all functionality through android app as well as web application such as add or set medicine schedule and many more.

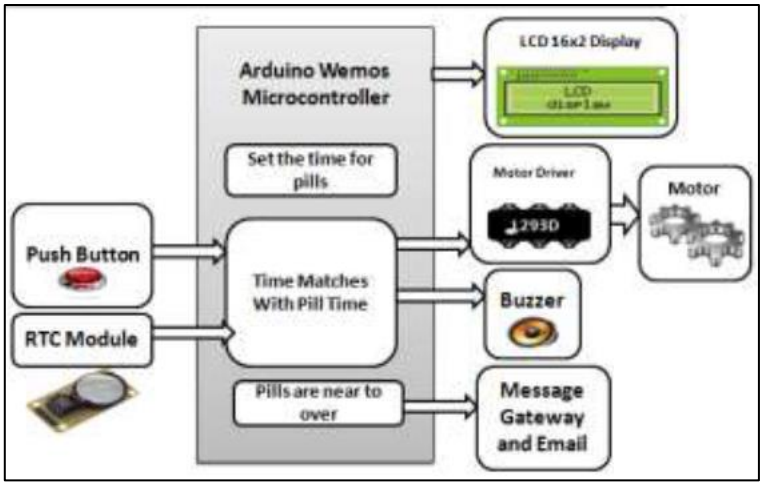


Figure 2.9: Block Diagram of a Smart Pill Box with Medication Reminders and Confirmation Functions

They develop a device using the emerging technology which can improve medication safety and to avoid mistaking the medicine. This device will reduce family member's responsibility in ensuring the patient take correct medicines on time by giving alert to user to eat the pill at the specified time. The lack of this system is we need to update the remaining of number of pills manually.

2.2.7 IOT Platform Based Smart Pill Box System

Prof.Raviraj Kasture, Sanket Borkar, Rahul Shinde, Diksha Waghmare, Snehal Hande (2018) found that most patients with chronic diseases need to take medications on time with correct amount of medicine to maintain their conditions. It is crucial and compulsory for patients to take the correct medication on the right time. An instrumented pillbox has developed, that permits endless observation of drug compliance. This device improves on existing systems that available in the market by providing quality, additional careful data, medicine errors and many more.

With some improvement, the new choices were created in this work to assist the aged people in helping them to take their medications punctual and often. The family members or patients need to fill the drugs in the pill box manually when the medicine finished. This will be

an extra work for family members of aged people or for the patients to refill the medicine. User need to register the details of medication in pill box system. Whenever patient forget how many doses should be taken, the system will send notification to user or whenever patient take wrong medicine, the user will receive warning message from system. This pillbox is different from existing product because it is provided with bag checks and make sure all the medicine at an occasional price.

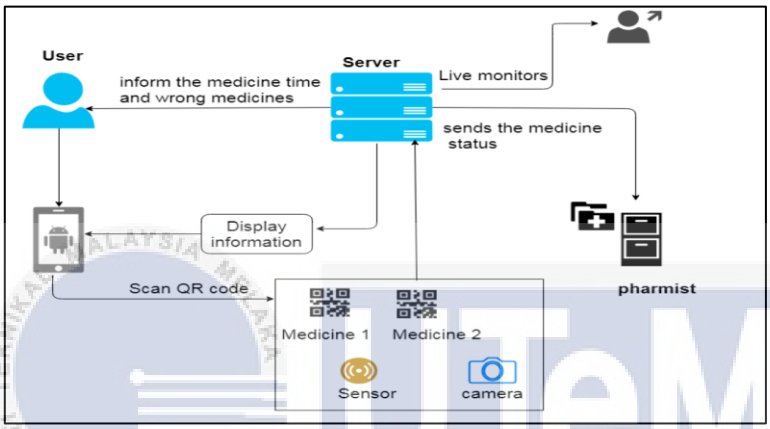


Figure 2.10: System Architecture of Smart Pill Box

In the system user need to register and add all the data regarding medicine then system QR code will be generated for every medicine. The system provided with camera and IR sensors to make sure the medicine is taken out of box by patient. Live patient's monitoring can be done by using camera. Alarm will be sounded if patient consume the wrong medicine. Apart of that, the system will send notification to patient 10 minutes before the set time to take the medicine in case the user needs to go out somewhere, so patient can carry it. The medicine status will be sent to pharmist so that they can monitor the patient continuously.

As conclusion, QR code will be generated for every medicine and the user's responsibility to register into system and add his/her medicine timing. To make sure the medicine is taking out of box, the system will be provided with camera and IR sensor. The lack of this system is the medicine status can be sent to pharmacist only. Meaning we cannot set to

whom we want to send the medicine status. For future work, the system needs to be upgraded so that more authorized people can see the medicine status.

2.2.8 Smart Pill Box

Radha Gandhi, Rohan Dhanawade, Vivek Ambekar, Pranit Chaple, Geetha Chillarge (2019) stated that most of the old age people need to eat multiple medicines to cure their illnesses. Many deaths occur because they take wrong medication on wrong timing. An intelligent pill box is designed to alert the elders to take medicine according to the correct time. Weather the elders took the medicine or not, will be informed to families remotely. Caretaker of elders can check and program the pillbox by using mobile app.

In this work, smart pill box model is equipped with alarm and android phone notification with hardware and software are combined together. It has server, mobile application that has three layers and pill box. The pill box is the combination between electrical and mechanical components like servo motors, wires and other. The user interface which is mobile application is used to take all information regarding the medicine such as pill time, date, schedule. Then, data will be sent to server that has module or programming to operate the smart pill box. Power supply is given to the microcontroller to control sensors and motors. Time and date information will be provided by Real Time Clock (RTC) module. Touch sensor is used to get elder's feedback when the elder close box's lid manually. The output part consists of a LED to indicate the elder to take the medicine from which compartment, servo motor to open and close the lid.

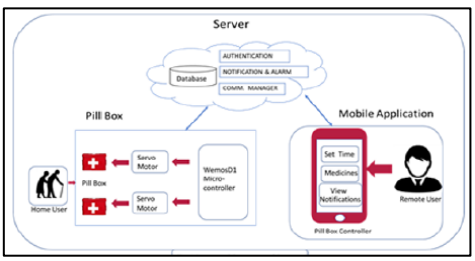


Figure 2.11: System Architecture

The User Interface is easy and simple to be used so that a person who have even the basic knowledge can use it. The function of mobile application is to updated the medicines schedule and also can give the acknowledgement of either the medicine has been taken by patient or not. Cloud database is used to store and retrieve all the data. FIREBASE is used for cloud database. The system will ask to register with e-mail ID when log in for the first time. After the user complete registration, all the details will be kept in the database. Every time user wants to log into the system, the credentials will be verified. Hence, the security is maintained and authorized user has the permission to access the app. After logging into the apps, user can set schedule. The prescription or medicine's timing can be changed by user by updating the schedule quickly, frequently and easily as well as adding the new schedule.

As conclusion, main advantage of this system is it has feedback to the mobile application user using touch sensors. All the patient's data will be saved in the database so that the user no need to worry about memorizing all the data. In future, this device can connect the application with Medical stores and send medicine's list to medical store if the medicines are about to finish.

2.2.9 Smart drugs: Improving healthcare using Smart Pill Box for Medicine Reminder and Monitoring System

Diaa Salama Abdul Minaam, Mohamed Abd-ELfattah (2018) found that Many medical errors happened because that people in charge of patient or elder's medication need to handle with a lot of pills every day. On the other hand, patients need to take high number of pills nowadays is the problem usually found in hospitals or in retirement homes. Lastly, there is a situation where patients take incorrect number of pills due to lack of experience and/or ignorance. It has been proven that there is a risk for people to consume the wrong medication or dose no matter the cause.

Pillbox can work with two working modes which are normal mode and management mode. Normal mode is the default working mode. In this mode the pillbox will be in standby until a pill or dose need to be taken by the patient. Once a pill or dose is due, the pillbox will produce acoustic as well as visual notifications using internal speaker and the LEDs. The notifications can be seen in a short time which can be defined later around 10 seconds and will emit a bleep in every 10 seconds. The LEDs remain blinking until the there is an interaction between patient and the device and the pill has been taken. User need to press the button and the pill will be automatically dispensed by pill box, turning off all the visual and acoustic notifications. Pillbox will produce a wireless notification to alert the nurse or caregiver in charge to state that the pill is pending need to be taken by the patient if the patient did not touch the button within the given time.

Management mode is engaging if the pillbox is managed by mobile application's management. So, the connection is done via wirelessly. Management program might be:

- New pill schedule can be reprogramed.
- Refilling sequence can be active. Each of the compartments in the pillbox will be accessible and program will show which pill corresponds to each compartment so that the compartment can be refill by caregiver or nurse.
- Test function can be run throughout who the nurse/caregiver is responsible to check the correct pillbox's operation.

The charging LED will blink two times once the device in management mode to show that the pillbox has established the correct connection with the managing program.

Smart pill box can be control remotely by developing a mobile application is using android application. After connecting mobile application with smart pill box, click at the middle button "MEDICINES "to write the medicines name that taken by patient. After that move to the last button named "SET ALARM" to set time we want. There are various of tunes

available and in case we forget to set the alarm and click at go out and the device will give warning message. There are five steps to run the system. First of all, turn on the device. Second, connect the phone to the ESP AP. Third, mobile app can be opened via Roboremo. Fourth, pill's timing can be modified and enter it in opposite space. Lastly, wait until notification received for each pill.

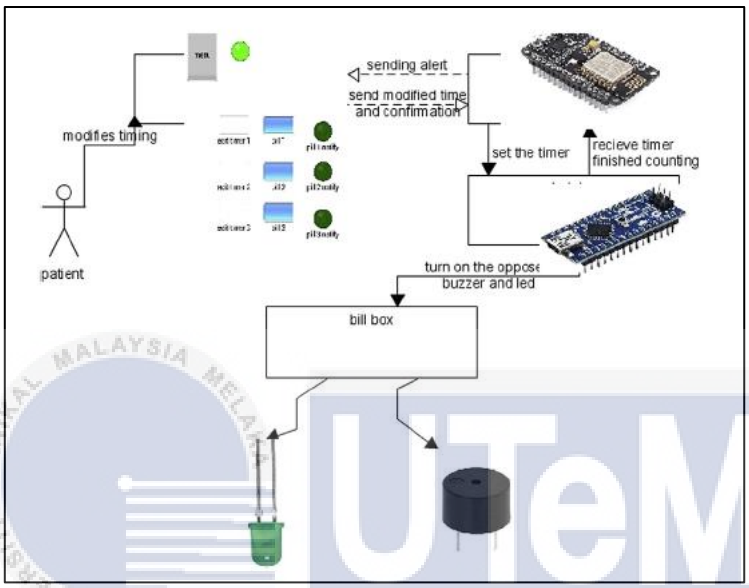


Figure 2.12: Implementation of proposed system

Smart pill box is programmable which the amount and timing to take pills can be determined by medical caretakers or clients. The pillbox will give signal to remind clients or patients to take medicine by using sound and light. The shortage of this project cannot set when to dispense the medicine from long distance because the device using Bluetooth as wireless technology this issue can be overcome in the future.

2.2.10 A Smart Pill Box to Remind of Consumption using IoT

According to Sagarika Deshpande1 Manasi Choudhari2 Doreen Charles3 Sarish ShaikhA (2017) people face difficulty to remember the pills that need to be taken and this problem can lead the medicine go beyond expired date. This problem happened because the schedule to take the medicine is not printed and not put on the medicine's packaging. Most patients with chronic

diseases need to take many medicines in long period of time to maintain their health's condition. It is very crucial for patients to take and to eat the right medicine at right time.

The pillbox has been packed to reduce family members' duty for dividing the medicines in the pillbox and to assume the patients' requirement to eat medicines at specific times. In this system, pill time of specific medicine can be set by using input system. Different time for different pills can be set in this system. If need to consume many pills, give the box number to the system in order to take required pills. We can insert number of pills in the system. Continuous time will be provided by the real-time clock as an output. Time will be monitored continuously by the system monitors using a real-time clock to identify the pill time. Once the pill time matches with system time, the system will give a signal to show that the time to take a pill has come. Alerting the user to take pills within the set time is necessary.

When the time in system equal to pill time, the buzzer will be sounded continuously if the push button not pressed by user. Buzzer will stop sounding when the push button pressed and the pills need to be taken during the specified time to avoid the user confuse in taking medicines. As the user take the pill, it is important to put the pills number that been removed by the user. User requires more than one pills from same medicine or the system is being used by more than one person. So, that is why it is important to input the number of removed pills by the user.

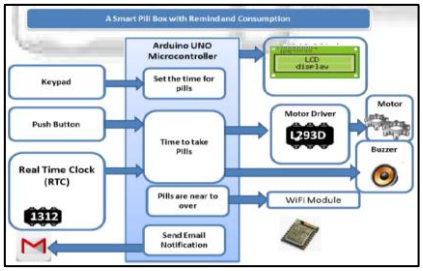


Figure 2.13: System block diagram

The medicine will come out of the box to avoid confusion between tablet among elderly patients. The pills taken by the patient also counted. The correctness of the medicine will ensure

the patient to take the right medicine. The alert sound will turn on continuously in case the patient did not take the medicine yet and if pills are about to finish, a message will be sent to the medical shop. A thermometer will be installed to measure the device internal temperature. An alarm will be activated if the temperature above set limit.

Smart pillbox system with reminder system can give alarm to alerts to the user to take pills according to scheduled. The buzzer will turn on continuously when the pill time equal to system time if the push button not pressed. It is important to alert the user to take pills at a particular time. For future works a more powerful controller will be needed because the project used Arduino Mega Controller. Raspberry Pi Pico can be used because it is better microcontroller. Second, the system security needs to be improved by adding lock system to make sure only authorized user can use the system.

2.2.11 Comparison of previous works

Table 2.1: Comparison of previous works

No	Project's Name	Components	Problem Statement
1.	Smart Medicine Dispenser (SMD)	Arduino UNO R3 Step motor Buzzer	Failure to take medications can result in complications such as delayed recovery, sickness, and even death. There are many types of pill dispensers produced by many companies available in the market. The product equipped with alarm to notify the users

			but does not have online database to save all the data.
2	Automatic Medicine Dispenser using IoT	Arduino UNO NodeMCU Servo motor Centrifugal Pump RTC module	Medication adherence is one of the greatest problems happen in health care industry. Most of elderly people fail to take the medicine on time and chances to get overdose is high if the elderly people need to take more than one medicine
3.	MEDIC-The Smart Medicine Dispenser	Arduino UNO Relay Servo motor DHT 35 temperature sensor Push button Fingerprint Sensor Buzzer LED	Taking care of the aged is important and serious concern especially in the developing nation. The one who responsible for the care and management of the old is family members.
4.	Automatic Medicine Dispenser	Node MCU ESP 8266 LED OLED display Buttons Buzzer.	More than 60% of persons that aged over 60 have a bad medical history after completing study. The main cause of this problem was failed to adapt with suitable

			medication. Getting the right amount of medicine to the right person on time is a big difficulty faced by elderly.
5.	IoT Based Smart Pill Box Using Arduino Microcontroller	Arduino UNO Temperature sensor Pulse sensor LCD WIFI module Servo motor Buzzer LED	Old patients always forget to take pills on correct time which can leads to certain health issues. These problems occurred in hospitals and people around them who got infected with that kind of diseases
6.	A Smart Pill Box with Medication Reminders and Confirmation Functions	Arduino UNO RTC module Push button Servo motor Buzzer LCD	Elderly people have problem to memorize the pills they need to take. They need to take medications over a prolonged period of time because they have chronic disease to stabilize their conditions. The most commonly problems faced in drug abusing are excessive drug usage and disobeying the instructions of medication.

7.	IOT Platform Based Smart Pill Box System	IR sensor Camera	Most patients with chronic diseases need to take medications on time with correct amount of medicine to maintain their conditions. To ensure the patients take the correct medication on the right time is crucial and compulsory.
8.	Smart pill box	Arduino Uno Touch sensor RTC module LED Servo motor	Most of the old age people need to eat multiple medicines to cure their illnesses. Many deaths occur because they take wrong medication on wrong timing.
9.	Smart drugs: Improving healthcare using Smart Pill Box for Medicine Reminder and Monitoring System	Arduino Nano LED Buzzer LCD ESP 8266 NodeMCU 12E.	Many medical errors happened because that people in charge of patient or elder's medication need to handle with a lot of pills every day. On the other hand, patients need to take high number of pills nowadays is the problem usually found in hospitals or in retirement homes. Lastly,

			there is a situation where patients take incorrect number of pills due to lack of experience and/or ignorance. It has been proven that there is a risk for people to consume the wrong medication or dose no matter the cause.
10.	A Smart Pill Box to Remind of Consumption using IoT	Arduino UNO GSM 900 RTC (Real Time Clock) LCD Buzzer Push button Motor	People face difficulty to remember the pills that need to be taken and this problem can lead the medicine go beyond expired date. This problem happened because the schedule to take the medicine is not printed and not put on the medicine's packaging. Most patients with chronic diseases need to take many medicines in long period of time to maintain their health's condition.

2.3 Hardwares

2.3.1 Rasberry Pi Pico

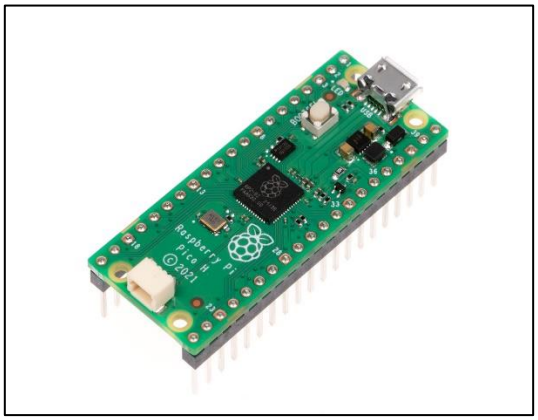


Figure 2.14: Raspberry Pi Pico

A cheap microcontroller is called a Raspberry Pi Pico. Microcontroller is a small computer but it frequently lacks peripheral devices and vast amounts of storage (for example, keyboards or monitors). Similar to the Raspberry Pi computer, the Raspberry Pi Pico contains GPIO pins, making it possible to control and interface with a range of electronic devices.

Any model of Raspberry Pi before is significantly different from Raspberry Pi Pico. It is the first product to utilise the RP2040 "Pi Silicon," a proprietary System on Chip (SoC) created by the Raspberry Pi team that has a dual core Arm Cortex M0+ running at 133 MHz, 264KB of SRAM, and 2MB of file storage flash memory.

The RP2040, introduces a new method of operation. The Pico is not a computer; instead, we must "flash" the code to the microcontroller over USB using an external application that need to be installed on computer. Programming languages supported by the Pico and third-party RP2040 boards include MicroPython, CircuitPython, C/C++, and Arduino.

2.3.3 Servo motor

Figure 2.15: Servo Motor

A servo motor can be used to get good precision in rotating. Commonly, this motor has a control circuit to give feedback on motor shaft current position. This feedback makes it rotate with good precision. So, servo motor can be used if want to rotate an object at some certain angles. The servo motor is made of a simple motor that runs using a servo mechanism. It is called DC servo motor if DC power supply is supplied to motor and if AC power supply supplied to motor, it is called AC servo motor.

A servo consists of a Motor either DC or AC, one potentiometer, gear assembly, and one controlling circuit. Firstly, we must reduce RPM in order to increase motor's torque by using gear assembly. Say at initial position of servo motor shaft, potentiometer knob's position must be at where there is no electric generated at the potentiometer output port. Another input terminal of the error detector amplifier will receive electrical signal. Now, there are two signals, a signal comes from the potentiometer and another signal comes from other sources. These two signals will be processed in a feedback mechanism and the output is in terms of error signal. This error signal will be assumed as the input for motor and motor will start rotating. Now, the potentiometer is connected to motor shaft and it will generate a signal as the motor rotated. So, feedback signal output will change as the angular position of potentiometer change. At some

times the potentiometer's position reaches at a position where the potentiometer's output is as same as external signal.

2.3.4 Bluetooth HC-05

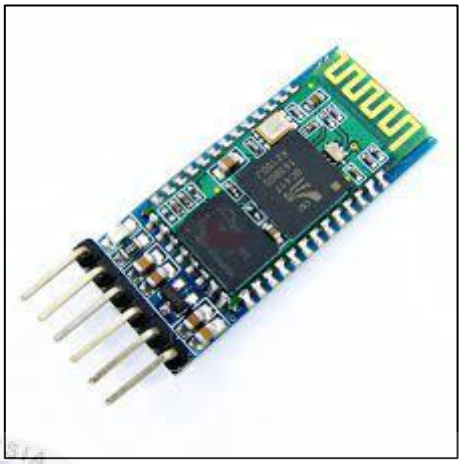


Figure 2.16: Bluetooth HC-05

Bluetooth is used in many applications such as wireless earphone, controllers, wireless mouse and other application. Its range is below than 100m and it depends on atmosphere, geographic and urban conditions. The data will be sent over air by using frequency-hopping spread spectrum (FHSS) radio technology. It communicated with devices using serial communication and using a serial port to connect with the microcontroller (USART).

HC-05 is a Bluetooth module is and this module has two different type of configuration which is master or slave configuration. Bluetooth HC-05 has 6 pins. The first pin is Key/EN and used to active AT commands mode. Second and third pin are VCC and GND. 5V or 3.3V can be connected to VCC while ground need to be connected to GND. The function of TXD and RXD pin is to transmit and receive the data wirelessly. The last pin is State and it used to tell either the Bluetooth connected or not. Bluetooth HC-05 has red LED and it displays connection status, whether Bluetooth is active or not. This red LED continually and periodically blinks and the blinks will decrease to two seconds when it connects to another Bluetooth device.

2.3.5 Buzzer

Audio signalling devices such as a beeper and a buzzer can be electromechanical or can be piezoelectric or can be mechanical type. The main function of audio signalling device is to produce sound by converting the signal from audio to sound. Basically, it is supplied by DC voltage and used in alarm devices, computers and other. Due to various designs, it can produce different sounds such as alarm or music or bell.

Figure 2.17: Buzzer pin terminal

The buzzer pin configuration is shown above. It has two pins which are positive and negative. The positive terminal is represented by '+' symbol or has long terminal. This terminal will be powered by 6 Volts. While, the negative terminal is represented by '-'symbol or has short terminal and this pin will be connected to GND terminal. Buzzers in the market are available in various types such as piezoelectric, electromagnetic mechanical and electromechanical magnetic.

The buzzer working principle is depending on the theory that, once the voltage is supplied to a piezoelectric material, a pressure difference will be produced. A piezo type has piezo crystals located among two conductors. When a potential disparity across these two crystals, they choose one of two conductors and the additional conductor will be drag through internal property. So, this continuous action produces sharp sound.

Magnetic and piezo are the two technologies that are employed in buzzer designs the most frequently. A magnetic buzzer or a piezo buzzer are frequently used in applications, but the choice between the two depends on a variety of factors. When compared to piezo buzzers (12–220 V, 20 mA), magnetic buzzers function at lower voltages and higher currents (1.5–12 V, > 20 mA), however piezo buzzers frequently have higher maximum sound pressure levels (SPL) capabilities. It should be noted, nevertheless, that piezo buzzers require larger footprints due to their higher SPL.

2.4 Softwares

2.4.1 Thonny IDE

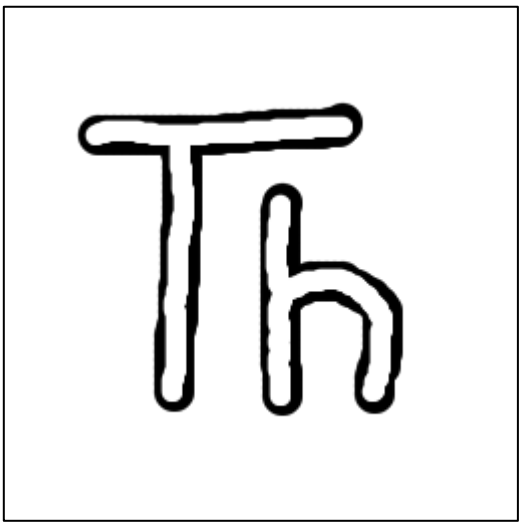


Figure 2.18: Thonny logo

An independence developer by the name of Thonny created a free PC development application. It is an open-source IDE that can be used to develop the program for variety of application by using Python programming language. Thonny makes it simpler for programmers to make code because it already includes the necessary tools, libraries, and dependencies. This specific IDE created with Python in mind and specific for newbie programmers who willing to learn new programming language.

Visual learning experience also available in Thonny IDE. It is a plug-and-play fare because it is already set up and preconfigured for all the thing you needed. In addition, there are various of handy extra features available to improve the usage and highly recommended to use.

2.4.2 MIT App Inventor

Figure 2.19: MIT App Inventor logo

Google provided a web application integrates development environment named MIT App Inventor and currently maintained by the Massachusetts Institute of Technology (MIT). This app allows beginner in computer programming to create an apps for Android and iOS. graphical user interface (GUI) is used and the programming languages is similar with Scratch and the StarLogo. User can drag and drop visual objects in making an application that can operated on Android devices. Cloud data is supported in app Inventor via an experimental Firebase component.

MIT App Inventor can be used by to build mobile apps anyone because it is free and open source web app. Over 8 million people round the world use this apps and more than 30 have been built. Twelve different language are available and can be used by people who 13 years old and above.

CHAPTER 3

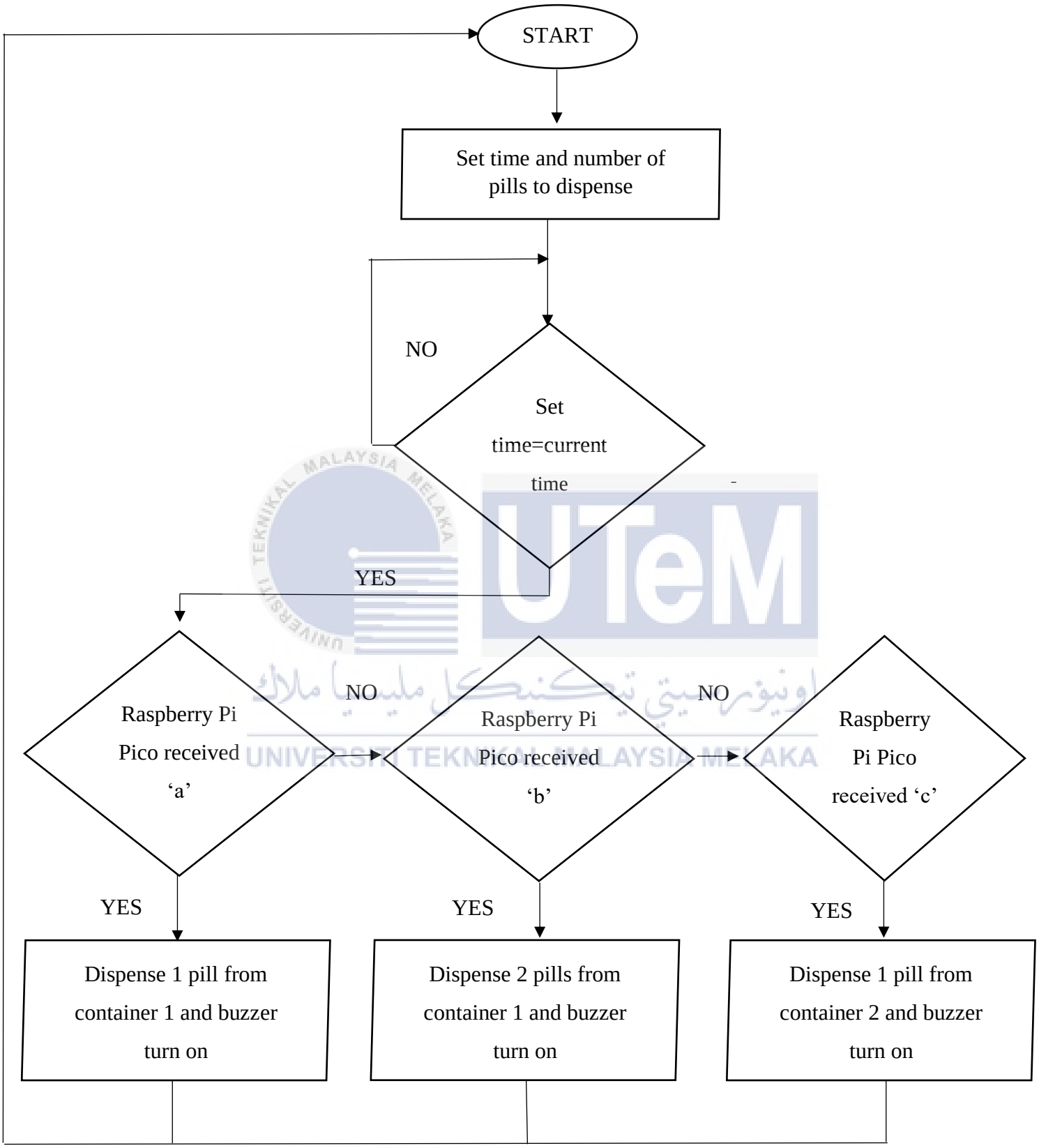
METHODOLOGY

3.1 Introduction

This project will be included hardware design and software design. Raspberry Pi Picoc is used as a microcontroller and will connected to the Bluetooth, step motor and buzzer. Bluetooth HC-05 is used to transfer the data from MIT App Inventor to Raspberry Pi Pico. Servo motor will be used to open and close the container. For the software design, MIT App Inventor, Thonny IDE software are used. MIT App Inventor is used to develop a software wherein user/caretaker of patient can set all the data regarding the medicine. Thonny IDE is used to write all the program for Raspberry Pi Pico to make sure it operated as desired. Buzzer will be installed to notify the patient to take the medicine.

Figure 3.1: Block Diagram

3.2 Flowchart



3.3 Hardware Implementation

3.3.1 Interface Bluetooth HC-05 with Raspberry Pi Pico

In electronics or in communication, wireless connectivity is quickly displacing traditional connections. HC-05 uses serial communication to connect with the electronic device instead of using cable. Typically, a short-range wireless connection is used to exchange files between small devices like mobile phones.

Table 3.1: Interface Bluetooth HC-05 with Raspberry Pi Pico

Bluetooth HC-05	**Raspberry Pi Pico**
VCC	VSYS
GND	GND
Tx	Rx
Rx	Tx

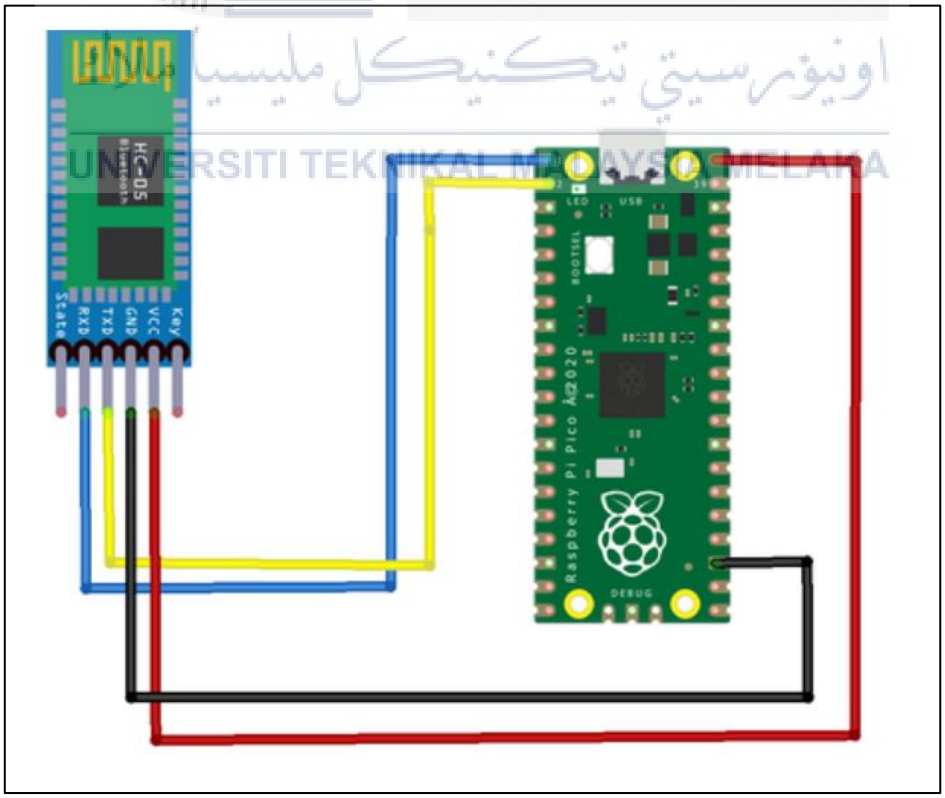


Figure 3.2: Connection between Bluetooth HC-05 with Raspberry Pi Pico

3.3.2 Interface buzzer with Raspberry Pi Pico

Components required:

1. Raspberry Pi Pico
2. 5V Buzzer
3. Mini Breadboard
4. Connecting Wires
5. Power Supply
6. Computer

It could not be much easier. The buzzer's ground pin is connected to the Pico's GND pin, and the buzzer's positive pin is connected to one of the Pico's common GPIO pins, in this case GPIO 15 as shown in the image below. Passive buzzer does not have positive or negative label and can functioning if one of pin connected into Pico pin. Thonny IDE is used to program the buzzer to turn on the buzzer for short period.

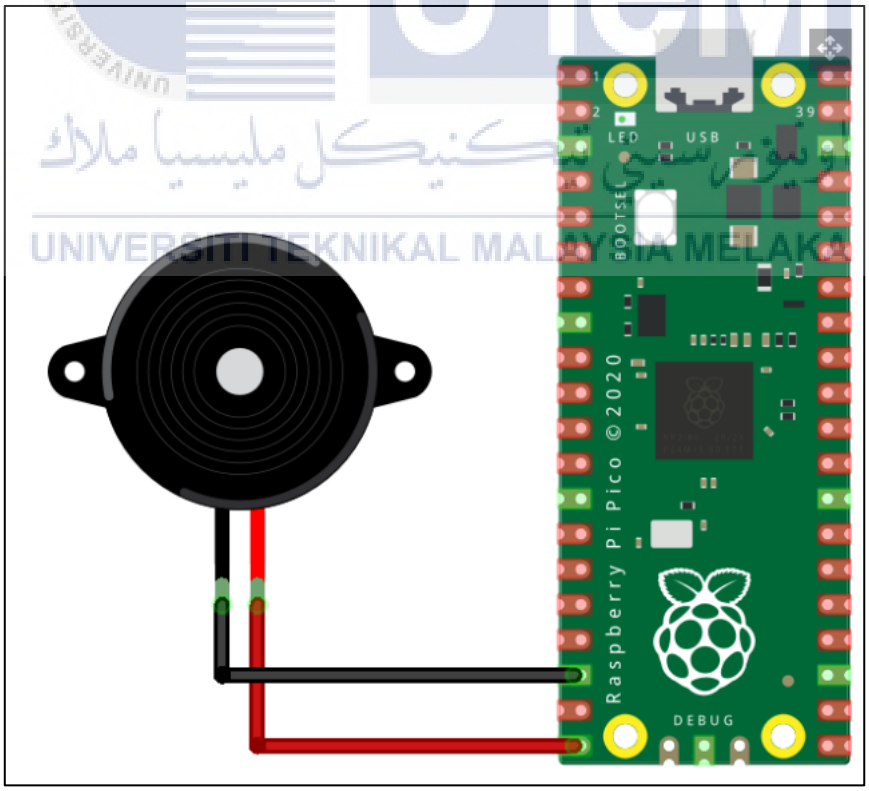


Figure 3.3: Connection between buzzer with Raspberry Pi Pico

3.3.3 Interface servo motor with Raspberry Pi Pico

Materials needed:

1. Raspberry Pi Pico
2. Jumper wires
3. Servo motor
4. Computer
5. Mini breadboard

This project's hardware is relatively simple. Connect the three wires from the servo to Raspberry Pi. Connect jumper wire to servo pin, then connect the red wire to VCC, the black wire to GND, and the green wire to pin 20 which is GPIO 15 configured as the output as shown in the image below. For the second servo motor, connect the signal pin at the servo motor to the pin 16. Servo motor is used to open and close the medicine container.

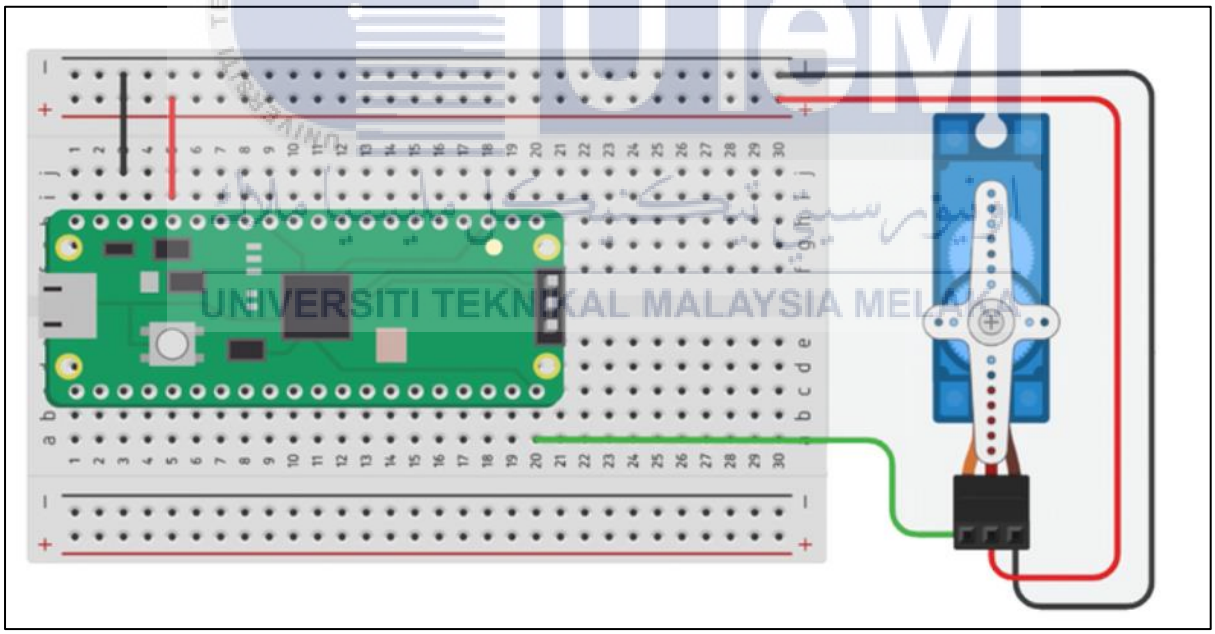


Figure 3.4: Connection between servo motor with Raspberry Pi Pico

3.4 Board of Materials

Table 3.2: Board of Materials

COMPONENTS	COST PER ITEM	QUANTITY	COST
Raspberry Pi Pico H	RM 25.00	1	RM 25.00
Bluetooth HC-05	RM 13.90	1	RM 13.90
Servo motor	RM 16.00	2	RM 32.00
Buzzer	RM 3.00	1	RM 3.00
Jumper (1 SET)	RM 3.00	2	RM 6.00
		TOTAL COST	RM 79.90

3.5 Software Implementation

3.5.1 MIT App Inventor

Figure 3.5: MIT App Inventor Environment

MIT App Inventor is used to develop an application and this application can be opened using smartphone. In this application user/caretaker of patient can key all the data regarding the medicine such as number of pills to dispense and time to dispense the medicine. User can keep or delete the data without feeling worry about losing it. The application is equipped with password to make sure only authorised user can log into the system.

3.5.2 Thonny IDE

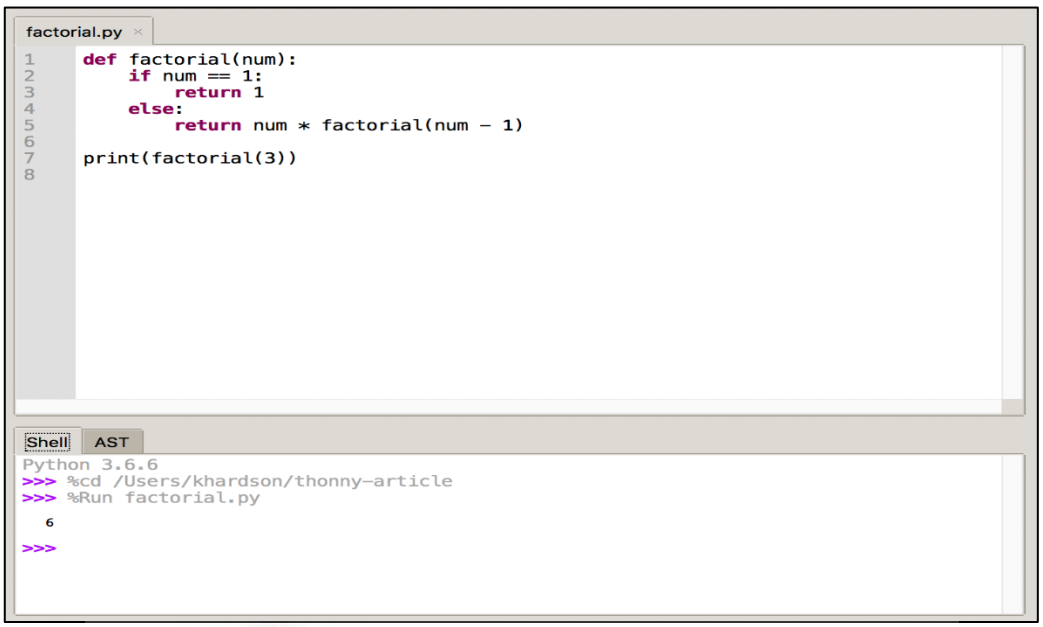


Figure 3.6: Thonny IDE Environment

Thonny IDE is used to develop a program for Raspberry Pi Pico. Buzzer and servo motor are connected to Raspberry Pi Pico. An application will be developed by using MIT App Inventor. The information of pills such as amount and time to dispense the medicine can be set in this application. When the set time equal to current time, the data in the string type will be send to the Raspberry Pi Pico through Bluetooth HC-05 to command the buzzer and servo motor. Buzzer will turn on to notify the patient to take the medicine while servo motor will open to dispense the medicine and close it once done.

3.6 Project Design

The device has two containers to store the medicine. Servo motor will be connected to each container to open the container and close it once done. One buzzer will be installed to alert the patient and one temporary container used to place the medicine for temporary before the patient take it. All the medication data can be set, saved and deleted through an application. Raspberry Pi Pico is used to give the command to all components to make sure the device functioning as desired.

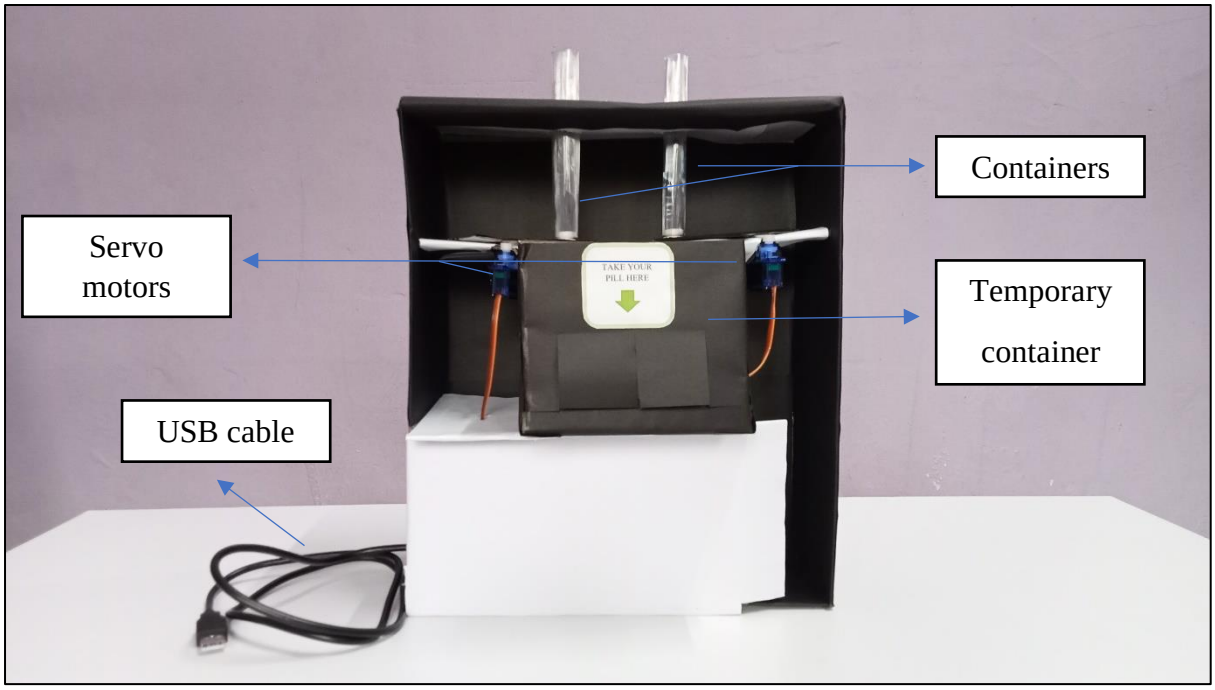


Figure 3.7: Product's photo (Front)

3.7 Summary of chapter 3

Methodology is a methodological system that may be applied to any process. This chapter contains information about the project. Furthermore, each project has its own approach to resolving the issues that develop. After that, details regarding the project's concept were released. Aside from that, the role of each component used in this project is well described. Furthermore, the approaches employed for this project are divided into two parts which is hardware installation and software programming. The most crucial aspect of the project are the materials and procedure.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

For the result, would like to create a medicine dispenser device that dispense the medicine according to set time. User or caretaker can set all the medicine information using an application developed by MIT App Inventor. The device dispenses the correct medicine at the correct time with correct dose and make sure the caretaker knows the status of medicine either has taken or not.

4.2 Hardware Development and Experiment Result

Bluetooth is connected to Raspberry Pi and used to transfer data from MIT App Inventor to the device. Two servo motors used to dispense the medicine. The first servo connected to GPIO 10 while the second servo connected to GPIO 12. The device equipped with buzzer to notify the patient. To make sure the servo motor rotating, duty cycle needs to be set in nanosecond.

Table 4.1: Duty cycle in nanosecond (Plate close)

Servo motor	Plate Close (ns)
First	2700000
Second	1450000

Table 4.2: Duty cycle in nanosecond (Plate open)

Servo motor	Plate Open (ns)
First	1400000
Second	2200000

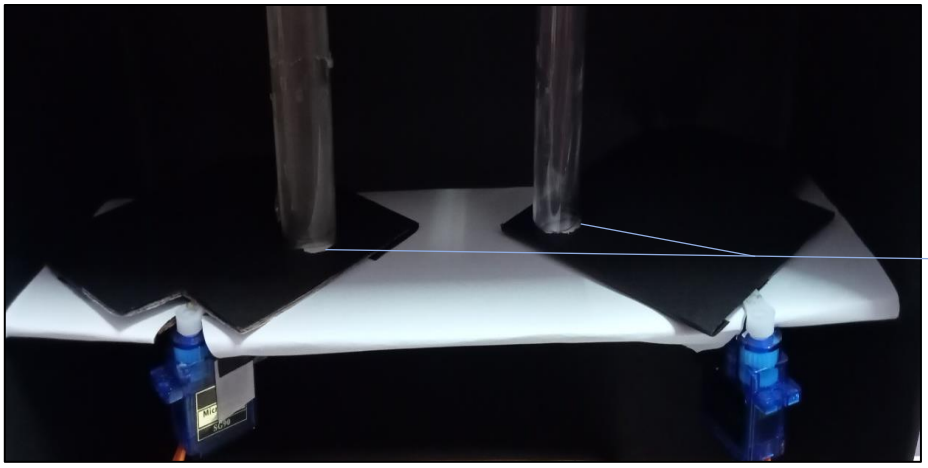


Figure 4.1: Container when its close

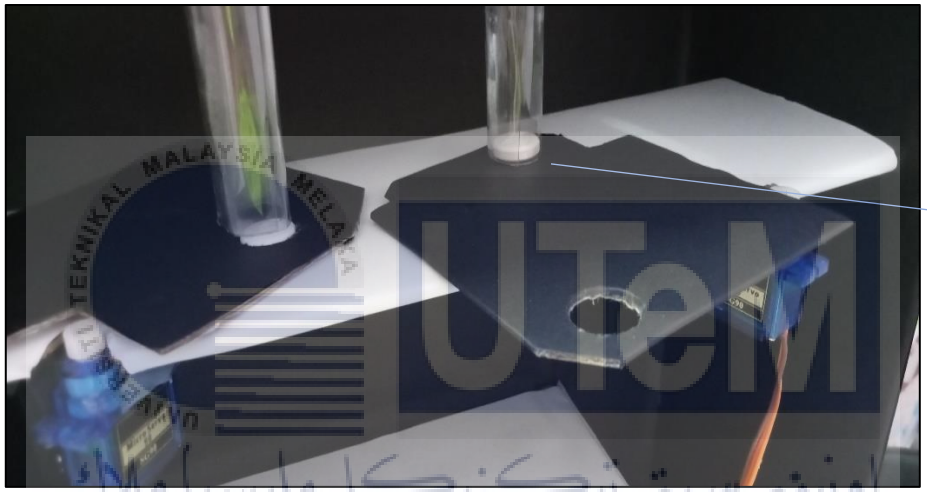


Figure 4.2: Container when the plate open (moving forward)

The pill will move down through the container and reach at the hole of each plate. When the plate moved forward (container open) the medicine will be dragged out from the container and at the same time the backside of the plate will block the container to make sure the remaining pill(s) not spill out of the container.

4.3 Software Development and Experiment Result

Bluetooth is used to send data from the application to the device through Raspberry Pi UART communication. The data will be sent in term of string type. To dispense 1 pill of fever medication and 2 pills of fever medication, ‘a’ and ‘b’ will be sent. To dispense 1 pill of flu medication and 2 pills of flu medication, ‘c’ and ‘d’ will be sent to the device.

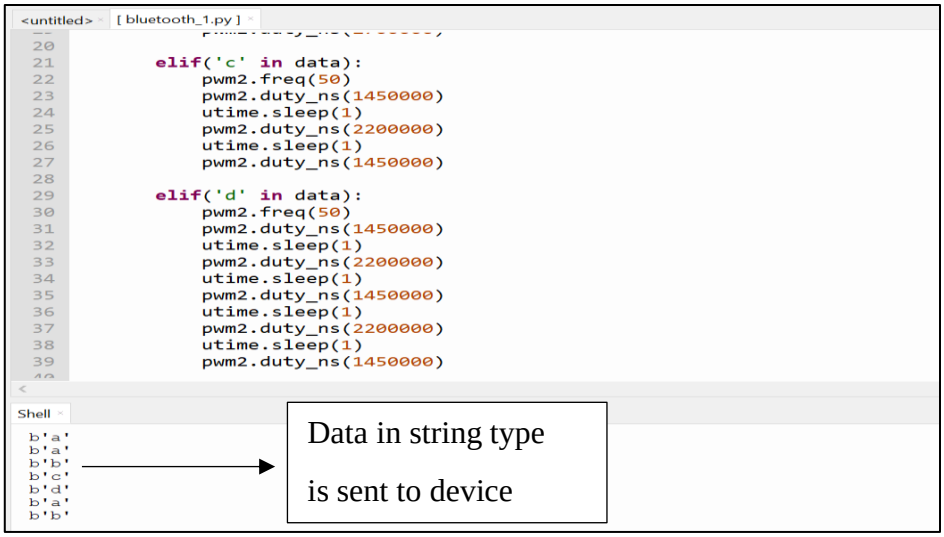


Figure 4.3: UART communication

User can set and save all the data related to medicine through an application. User need to choose time to dispense the medicine, type of medicine and number of medicine(s) need to dispense. All the steps to use the application are shown below.

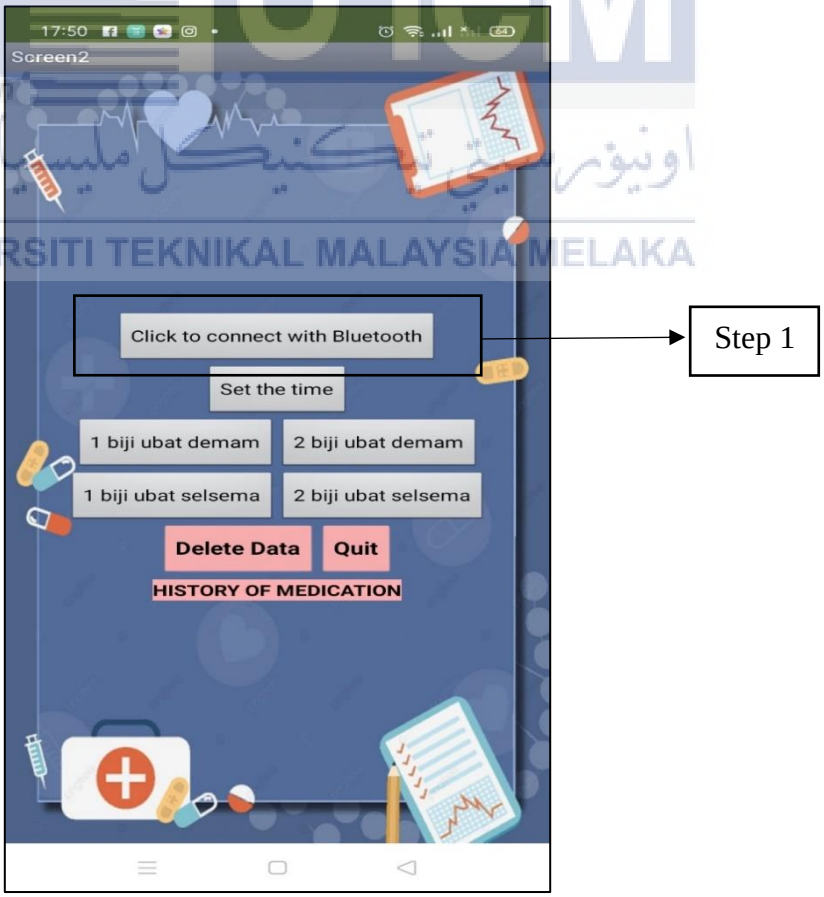


Figure 4.4: Application GUI

First, user need to click “Click to connect with Bluetooth” button to pair the Bluetooth HC-05 with the smartphone.

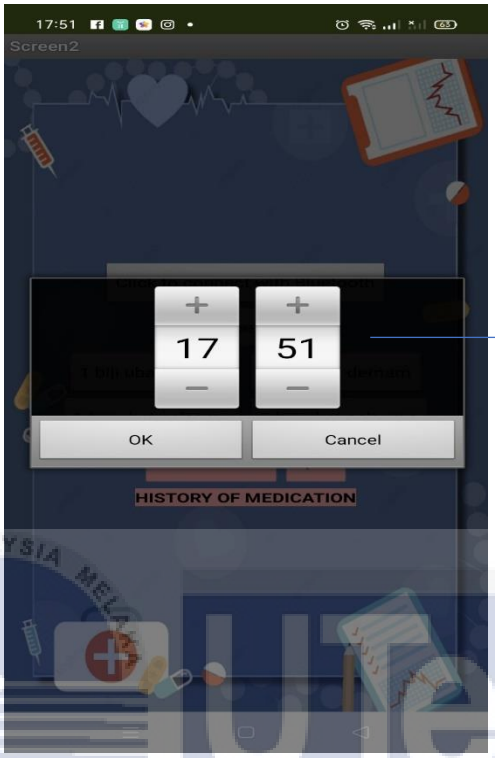


Figure 4.5: Setting the time

Second, user need set the time to dispense the medicine. The time in 24 hours format.

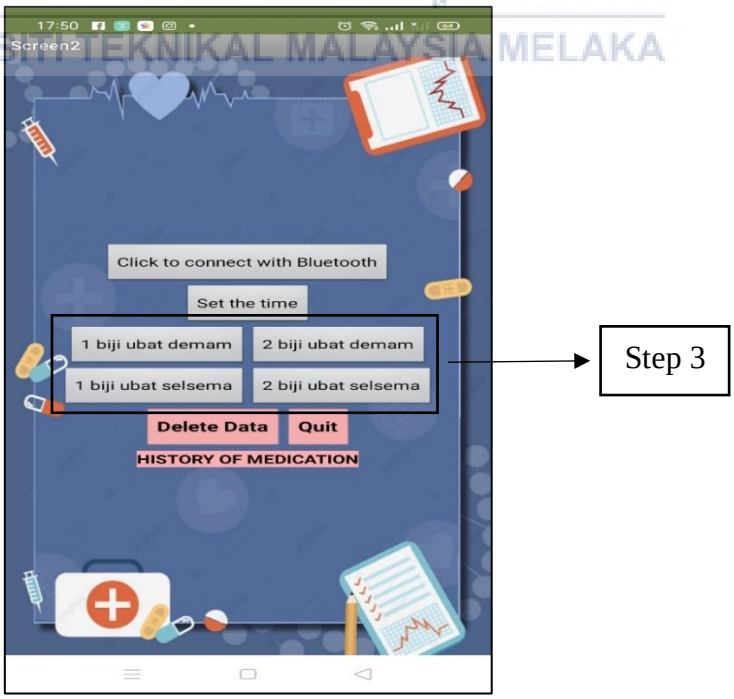


Figure 4.6: Choosing the type and number of pill(s) that need to be dispensed

Third, user need to choose the type of pill and number of pill(s) that need to be dispensed. All the data will be automatically saved at the history of medication section.

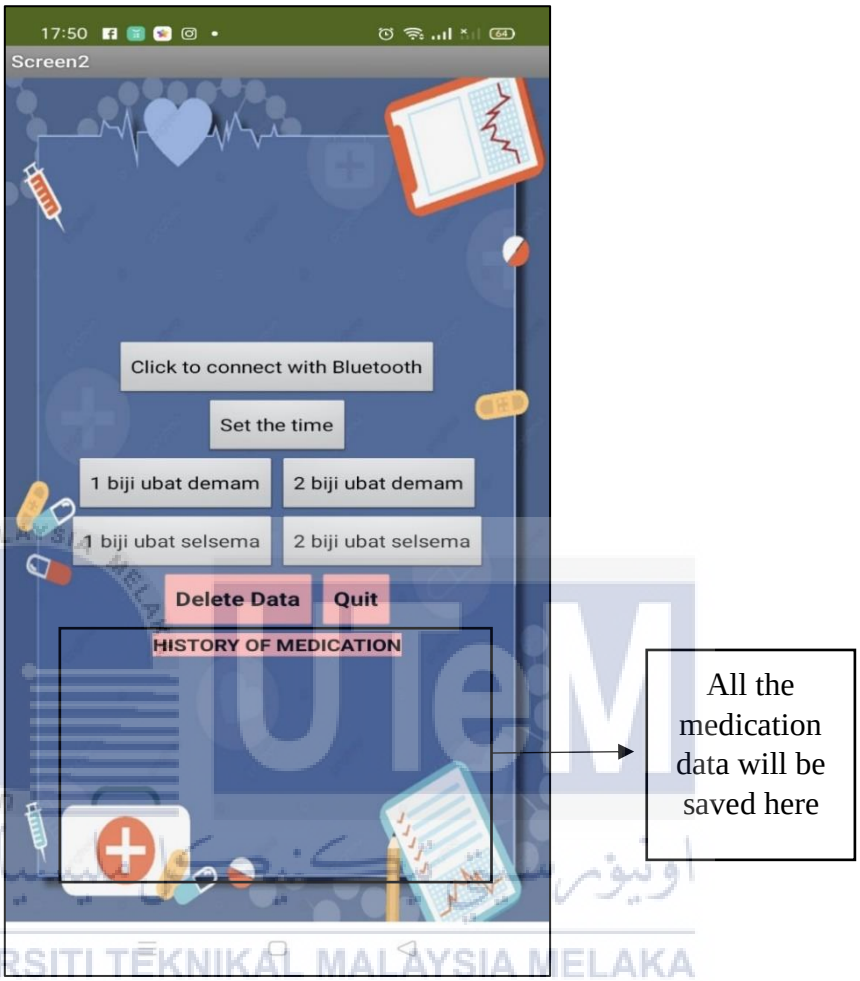


Figure 4.7: History of medication's section

4.4 Project Analysis

All the data recorded and shown below. The result based on time to dispense the medicine (24 hours), type of medicine and number of medicine(s).

Table 4.3: Fever medication's data

Time to dispense the medicine (24 hours)	Type of medicine	Number of medicine(s)
1656	Fever	1
1657	Fever	2
1701	Fever	2
1702	Fever	1
1708	Fever	1

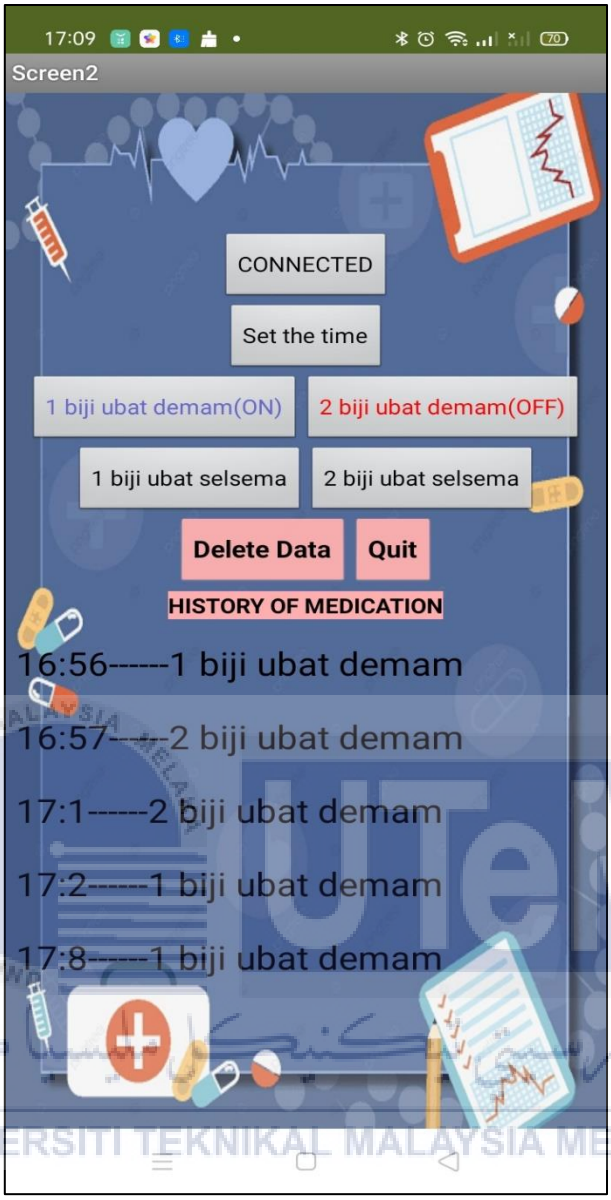


Figure 4.8: Fever medication's data

In figure 4.8, five different times chosen and fever medication dispensed according to the right time and right dosage. As we can see here, all the data will be automatically saved in 'History of Medication' section. Same situation occurs when to dispense flu medication. All the data recorded in table 4.4.

Table 4.4: Flu medication's data

Time to dispense the medicine (24 hours)	Type of medicine	Number of medicine(s)
2001	Flu	1
2002	Flu	2
2006	Flu	2
2007	Flu	1
2013	Flu	2

Figure 4.9: Flu medication's data

4.5 Discussion

The device able to dispense the medicine according to set time with correct dose and medicine. The medicine data's can be saved in the application and user can view or delete the data. The application managed to pair with the smartphone and can send the correct command

and successfully received by the Raspberry Pi Pico before processing the next process. The servo motors rotate correctly according to the duty cycle that written in the program and functioning as desired because rotating according to the number of pill(s) that need to be dispensed.

CHAPTER 5

CONCLUSION

5.1 Introduction

The system for medicine dispenser has the alarm system, and mechanical container which ensures that the medicine dispense on time with correct. The main advantage of this system is user can set the time and number of pill(s) to be dispensed by using mobile application. All the data related to the medicine will be saved in the application and the data can be deleted. With this device, it can solve medication adherence problem which contribute to one of the biggest problems in the health care industry.

5.2 Conclusion

This device can assist in reminding elderly patients to take their medications on time. MIT-App Inventor is used to programme and manage the motors that will release all of the medications at the proper moment in an app-enabled medicine dispenser, which is designed and created to meet the need. The medication dispenser includes two housing units for the medication. The Raspberry Pi is used to link the app and the machine dispenser. The app will assist in keeping track of the time, and the machine will dispense the appropriate medication at the appropriate time to take it.

5.3 Recommendation of Future Work

a) Add more housing so that more medicine can be stored.

b) Camera can be installed for live monitoring of the patient to make sure the patient do not cheating or mistaking the medicine.

c) Develop a system to calculate number of remaining pills in the system by using the total number of pills and the number of pills used by patient.

d) Use better wireless communication such as Wi-Fi. Due to its quicker connection speeds, greater base station coverage, and superior wireless security (when configured correctly), Wi-Fi is more suitable for running large-scale networks.

REFERENCES

[1] Wissam Antoun, Abdallah Kassem, and M. Hamad, "Smart Medicine Dispenser (SMD)," Conference: 2018 IEEE 4th Middle East, March 2018.

[2] Jyothis Philip, Feba Mary Abraham, Ken Kurian Giboy, B J Feslina, and Teena Rajan, "Automatic Medicine Dispenser using IoT" Vol. 9 Issue 08, August-2020.

[3] Manjunatha Y R N Lohith, Bhavana R, Bindushree S V, "MEDIC-The Smart Medicine Dispenser" ISSN: 2277-3878, Volume-8, Issue-1C, May 2019.

[4] Mrityunjaya Hatagundi, "Automatic Pill Dispenser"]10.17148/IJARCCE.2016.57107, July 2016.

[5] K.Divya Sai, Dr.S.SwarnaLatha, and Dr.B.Shoban Babu, "IoT Based Smart Pill Box Using Arduino Microcontroller" 2021 JETIR January 2021, Volume 8, Issue 1.

[6] Sagarika Deshpande, Manasi Choudhari, Doreen Charles, Sarish Shaikh, "A Smart Pill Box with Medication Reminders and Confirmation Functions" Volume: 05 Issue: 05 | May-2018.

[7] Prof.Raviraj Kasture, Sanket Borkar, Rahul Shinde, Diksha Waghmare, Snehal Hande, " IOT Platform Based Smart Pill Box System" Volume 5, Issue 12, December -2018.

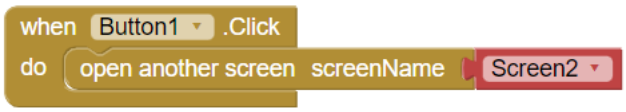
[8] Radha Gandhi, Rohan Dhanawade , Vivek Ambekar , Pranit Chaple , Geetha Chillarge " Smart Pill Box" Volume 67 Issue 5- May 2019.

[9] Diaa Salama Abdul Minaam, Mohamed Abd-ELfattah " Smart drugs:Improving healthcare using Smart Pill Box for Medicine Reminder and Monitoring System" Future Computing and Informatics Journal 3 (2018) 443e456.

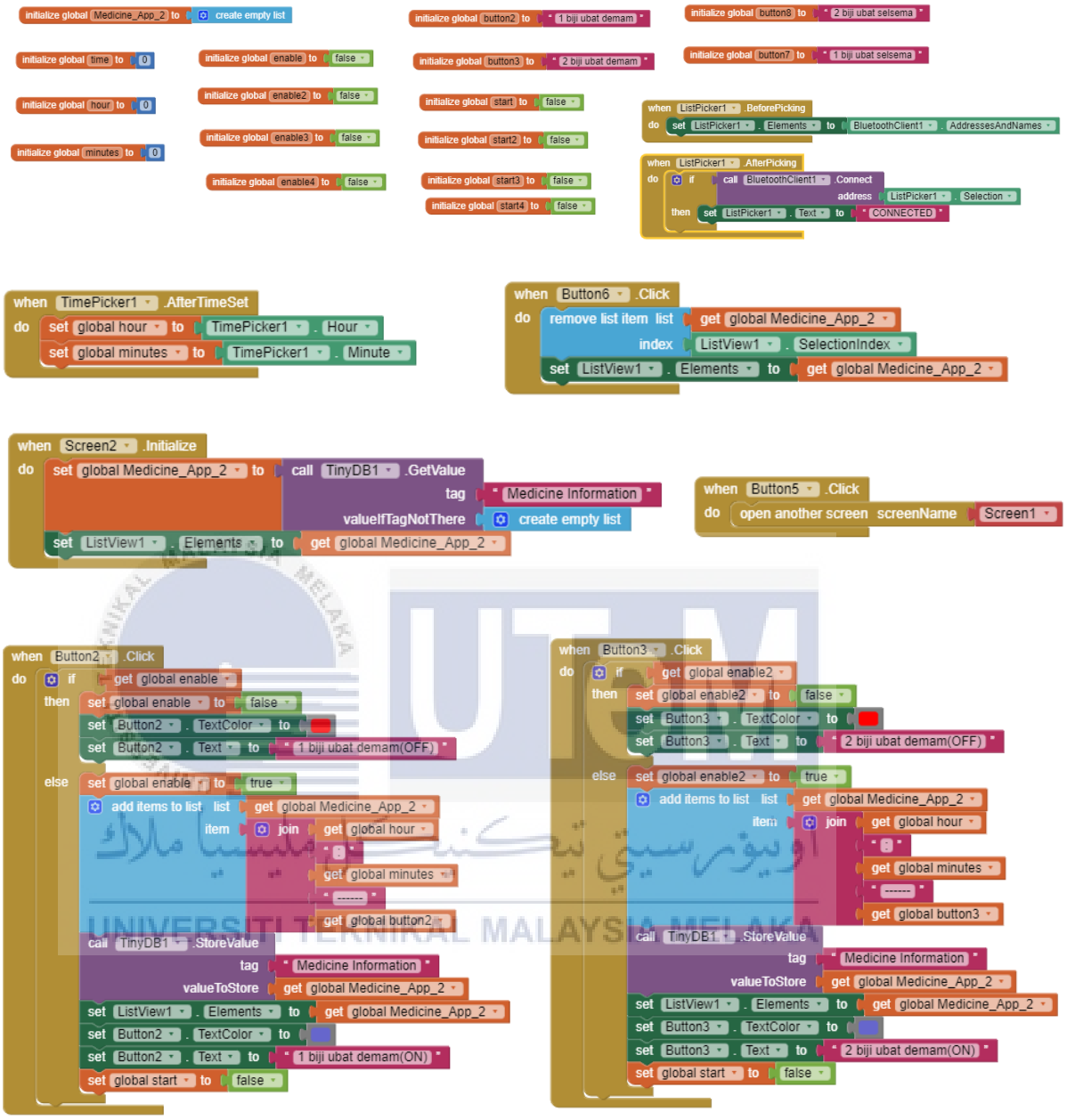
[10] Sagarika Deshpande, Manasi Choudhari, Doreen Charles, Sarish Shaikh " A Smart Pill Box to Remind of Consumption using IoT" Vol. 5, Issue 10, 2017.

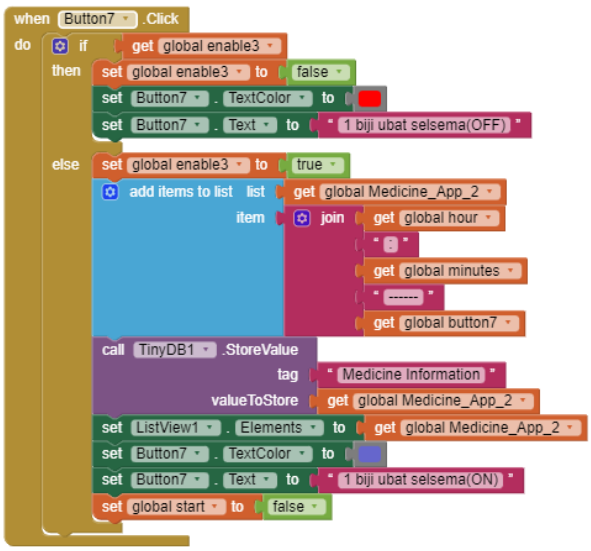
APPENDICES

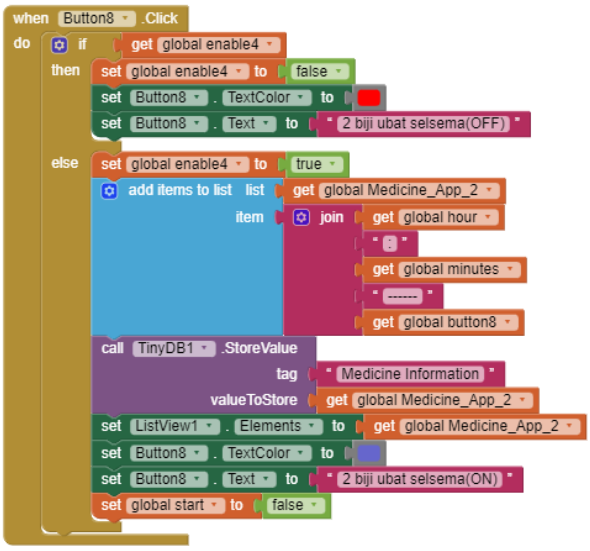
Appendix A Screen 1 block in MIT App Inventor

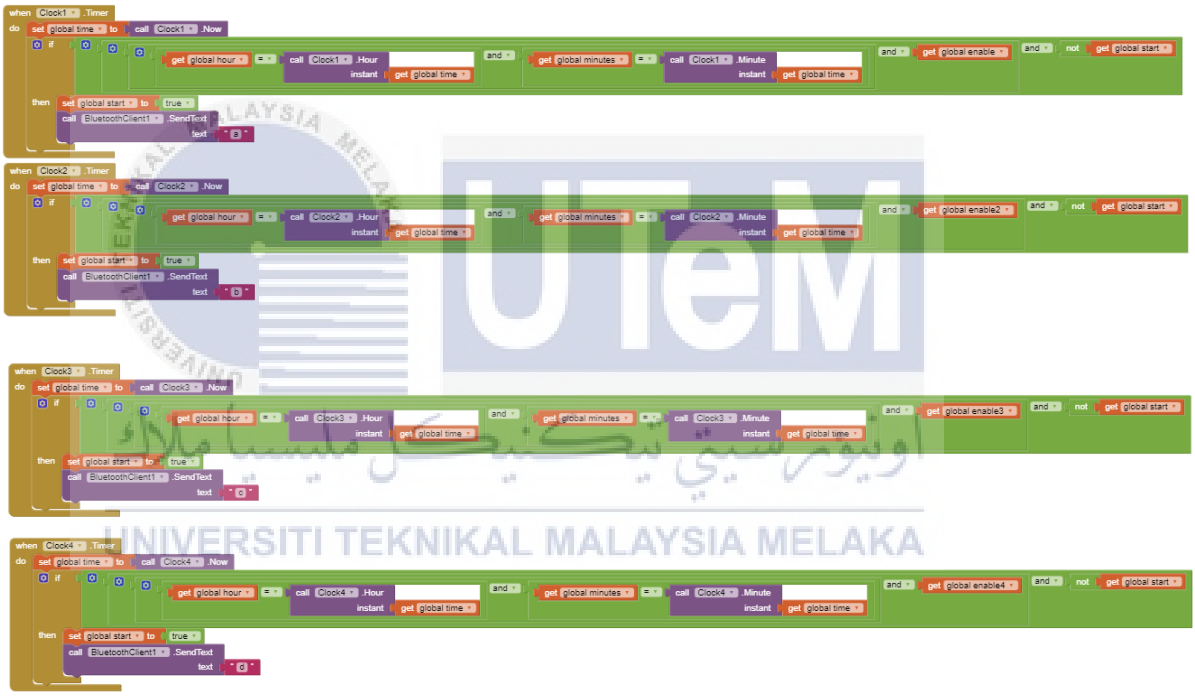


Appendix B Screen 2 block in MIT App Inventor









Appendix C Coding in Thonny IDE

```
from machine import Pin,UART,PWM
import utime
uart = UART(0,9600)
pwm1 = PWM(Pin(10))
pwm2 = PWM(Pin(12))
buzzer = PWM(Pin(15))


while True:
    if uart.any():
     data = uart.read()
     data = str(data)
     print(data)

     if('a' in data):
        pwm1.freq(50)
        pwm1.duty_ns(2700000)
        utime.sleep(1)
        pwm1.duty_ns(1500000)
        utime.sleep(1)
        pwm1.duty_ns(2700000)
        buzzer.freq(500)
        buzzer.duty_u16(1000)
        utime.sleep(1)
        buzzer.duty_u16(0)
```

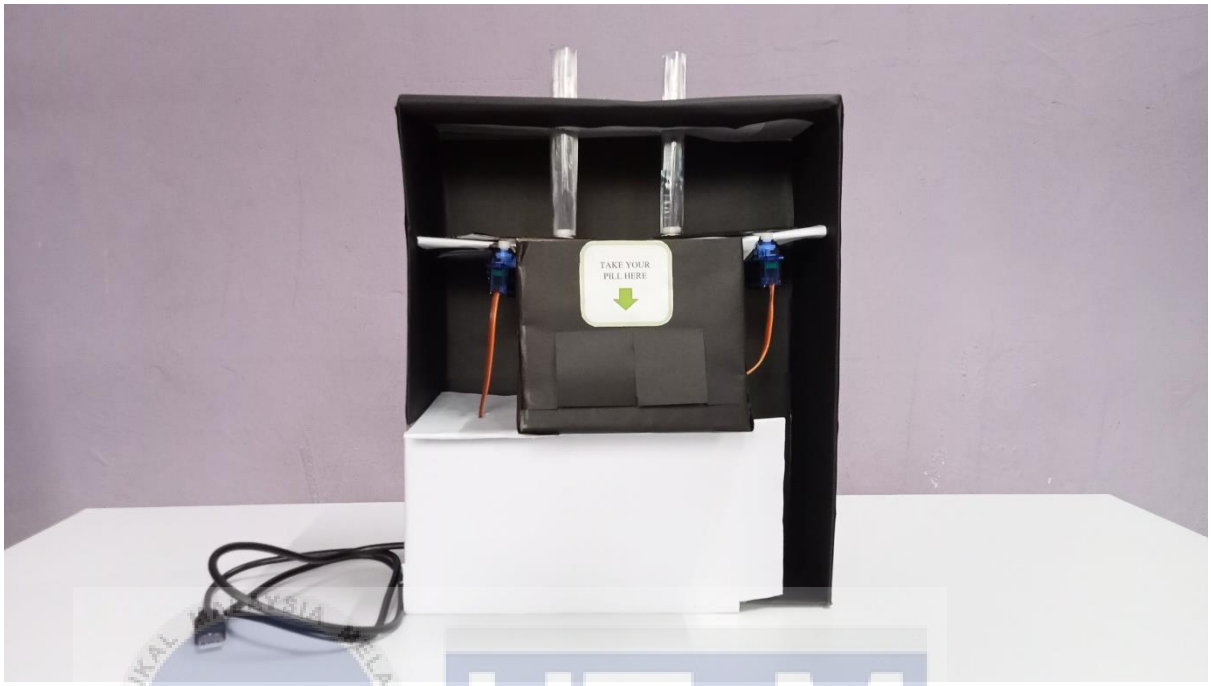
```
elif('c' in data):
    pwm2.freq(50)
    pwm2.duty_ns(1450000)
    utime.sleep(1)
    pwm2.duty_ns(2200000)
    utime.sleep(1)
    pwm2.duty_ns(1450000)
    buzzer.freq(500)
    buzzer.duty_u16(1000)
    utime.sleep(1)
    buzzer.duty_u16(0)

elif('d' in data):
    pwm2.freq(50)
    pwm2.duty_ns(1450000)
    utime.sleep(1)
    pwm2.duty_ns(2200000)
    utime.sleep(1)
    pwm2.duty_ns(1450000)
    utime.sleep(1)
    pwm2.duty_ns(2200000)
    utime.sleep(1)
    pwm2.duty_ns(1450000)
    buzzer.freq(500)
```

```
    buzzer.duty_u16(1000)
    utime.sleep(1)
    buzzer.duty_u16(0)

elif('b' in data):
    pwm1.freq(50)
    pwm1.duty_ns(2700000)
    utime.sleep(1)
    pwm1.duty_ns(1500000)
    utime.sleep(1)
    pwm1.duty_ns(2700000)
    utime.sleep(1)
    pwm1.duty_ns(1500000)
    utime.sleep(1)
    pwm1.duty_ns(2700000)
    buzzer.freq(500)
    buzzer.duty_u16(1000)
    utime.sleep(1)
    buzzer.duty_u16(0)
```

Appendix D Photo of Product (Front)



Appendix E Photo of Product (Left Side)