Faculty of Electrical and Electronic Engineering Technology

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

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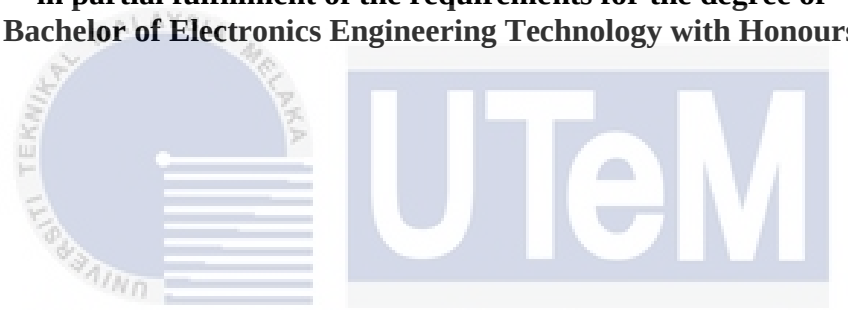
Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

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

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FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

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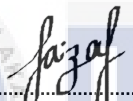
Signature : 

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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.

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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

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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.

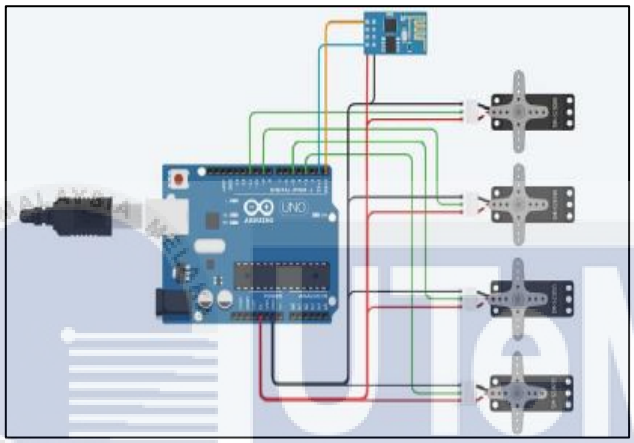

Figure 2.1: Servo motor connection

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.

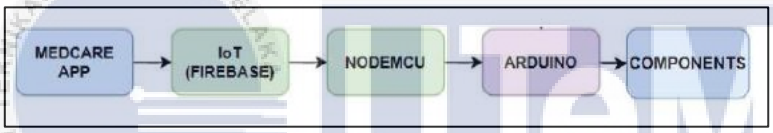

Figure 2.2: AMD block diagram

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.

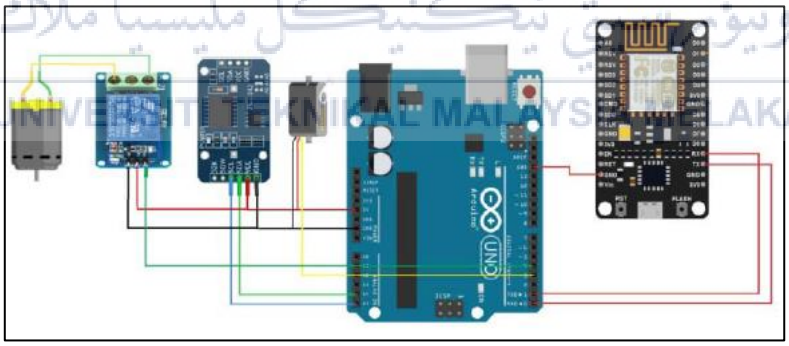

Figure 2.3: Complete Circuit Diagram

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.

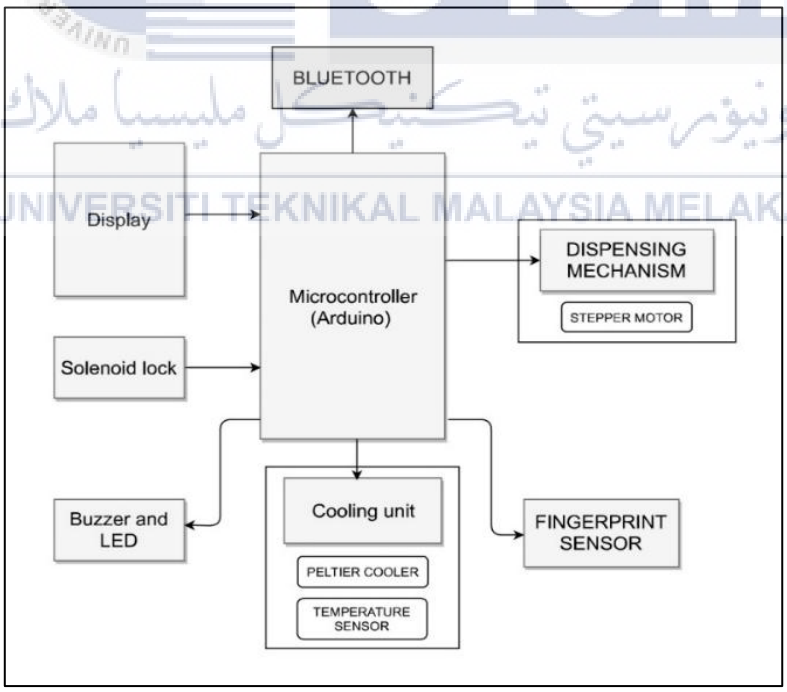

Figure 2.4: MEDIC block diagram

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