POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

SMART MEDROBOT

NAME:	REGISTRATION NO
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JABATAN KEJURUTERAAN ELEKTRIK

1:2022/2023

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This report submitted to the Electrical Engineering Department in fulfillment of the requirement for a Diploma in Electrical Engineering

JABATAN KEJURUTERAAN ELEKTRIK

1 :2022/2023

CONFIRMATION OF THE PROJECT

The project report titled "Smart MedRobot" has been submitted, reviewed and verified as a fulfills the conditions and requirements of the Project Writing as stipulated

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Verified by:

Project Coordinator name : Nur Hidayah Binti Azizam Noor

Signature of Coordinator :

Date :30/11/2022

“I acknowledge this work is my own work except the excerpts I have already explained to our source”

1. Signature : 

Name : **NUR HIDAYAH BINTI AZIZAM NOOR**

Registration Number : **08DEU 20F1008**

Date :30/11/2022

DECLARATION OF ORIGINALITY AND OWNERSHIP

TITLE : SMART MEDROBOT

SESSION: 1:2022/2023

1. I, **1. NUR HIDAYAH BINTI AZIZAM NOOR (08DEU20F1008)**

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2. I acknowledge that 'The Project above' and the intellectual property therein is the result of our original creation /creations without taking or impersonating any intellectual property from the other parties.

3. I agree to release the 'Project' intellectual property to 'The Polytechnics' to meet the requirements for awarding the **Diploma in Electrical Engineering** to me.

Made and in truth that is recognized by;
a) **NUR HIDAYAH BINTI AZIZAM NOOR**
(Identification card No: - 021029-01-2156)

) .
....……………………………
) **NUR HIDAYAH BINTI AZIZAM NOOR**

In front of me, Click here to enter text. (Click here to enter text.)) ....………………
) Click here to enter text.
As a project supervisor, on the date:

ACKNOWLEDGEMENTS

I have taken efforts in this project. However, it would not have been possible without the kind support and help of many individuals and organizations. I would like to extend my sincere thanks to all of them. I am highly indebted to (“Smart MedRobot”) for their guidance and constant supervision as well as for providing necessary information regarding the project & also for their support in completing the project.

I would like to express my gratitude towards my parents & member of (“Smart MedRobot”) for their kind co-operation and encouragement which help me in completion of this project. I would like to express my special gratitude and thanks to industry persons for giving me such attention and time.

My thanks and appreciations also go to my colleague in developing the project and people who have willingly helped me out with their abilities.

ABSTRACT

The Smart MedRobot is a device that delivers medicine and food. It can be used to deliver medication and food within pharmaceutical centers and hospitals. The device, controlled by a user behind the computer system, delivers medicine to different patients in the hospital, either on a road system or an air system, and it allows the patient to communicate with the medical expert who is controlling the device. The goal of this research is to assist medical facilities lacking medical staff such as nurses, by incorporating technologies (medical dispatch robot) to deliver medications. Instead of having five nurses per ward of ten patients, there can be one nurse and one medical dispatch operator controlling a medical dispatcher robot. There are two major components employed in this research: the hardware (the physical parts that interact with both the operator and the patients) and the software (the instructions that control the physical components). The Smart MedRobot was a success as all the components worked well in achieving the targeted goal. This objective is achieved by designing and developing a medicine and food-controlled robot car built using the Arduino Uno microcontroller. The robot is equipped with tray that allows the medicines to be delivered with an ease to the patients from a safe distance. This will result in making the timely delivery of medicines for the patients and will also reduce the unnecessary contact with the patients, minimizing the risk for medical personnel.

ABSTRAK

MedRobot Pintar ialah peranti yang menghantar ubat dan makanan. Ia boleh digunakan untuk menghantar ubat dan makanan di dalam pusat farmaseutikal dan hospital. Peranti, dikawal oleh pengguna di belakang sistem komputer, menghantar ubat kepada pesakit yang berbeza di hospital, sama ada di sistem jalan raya atau sistem udara, dan ia membolehkan pesakit berkomunikasi dengan pakar perubatan yang mengawal peranti. Matlamat penyelidikan ini adalah untuk membantu kemudahan perubatan yang kekurangan kakitangan perubatan seperti jururawat, dengan menggabungkan teknologi (robot penghantaran perubatan) untuk menghantar ubat. Daripada mempunyai lima jururawat bagi setiap wad dengan sepuluh pesakit, terdapat seorang jururawat dan seorang pengendali penghantaran perubatan yang mengawal robot penghantar perubatan. Terdapat dua komponen utama yang digunakan dalam penyelidikan ini: perkakasan (bahagian fizikal yang berinteraksi dengan kedua-dua pengendali dan pesakit) dan perisian (arahan yang mengawal komponen fizikal). MedRobot Pintar berjaya kerana semua komponen berfungsi dengan baik dalam mencapai matlamat yang disasarkan. Objektif ini dicapai dengan mereka bentuk dan membangunkan kereta robot kawalan perubatan dan makanan yang dibina menggunakan mikropengawal Arduino Uno. Robot itu dilengkapi dengan dulang yang membolehkan ubat-ubatan dihantar dengan mudah kepada pesakit dari jarak yang selamat. Ini akan menyebabkan penghantaran ubat tepat pada masanya untuk pesakit dan juga akan mengurangkan hubungan yang tidak perlu dengan pesakit, meminimumkan risiko untuk kakitangan perubatan

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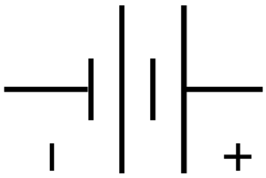
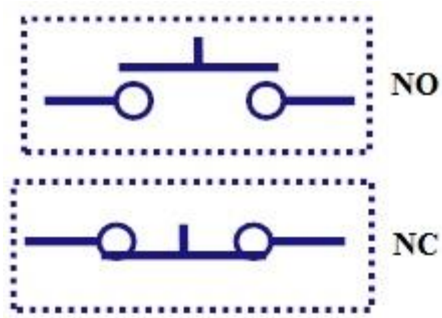
BATTERY	
PUSH BUTTON ON/OFF	
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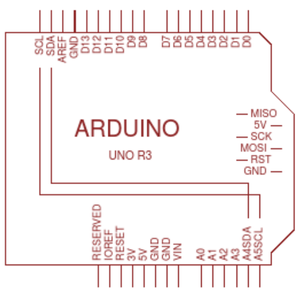
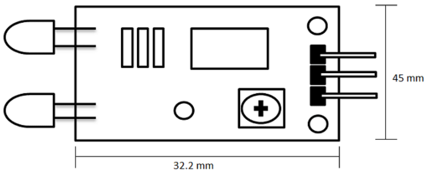
ARDUINO UNO R3	

INFRARED SENSOR	

CHAPTER 1

INTRODUCTION

1.1 Introduction

With the ever-increasing rise in the number of daily covid-19 positive cases in World, which is more than to 1,00,000 as of 10- 06- 2021, there is a need to control the spreading of the virus especially among the doctors and the medical staff because they are our life saviors. This bot will prevent the virus from spreading from the infected patients to the nurses or doctors when they must visit the patient just for delivering medicines as it is a fully contactless system.

1.2 Background Research

Medication plays an important role in healthcare during pandemic covid-19. People are more likely to develop one or more chronic illnesses with advancing age that require medication, and in general, appropriate medication can help someone live longer and more active lives. However, medication use more likely to be associated with safety concerns. Pandemic covid-19-related challenges like increase died can cause the country in danger area.

A number of technological interventions have been proposed to assist the staff in the hospital with these issues, including the use of electronic reminders, smart pill boxes that track and report usage, and stationary pill dispensers that release medicine at appropriate times [3]. Unlike these interventions, robots have the potential to emulate the ability of a human caregiver to physically deliver medicine and food to the patient. Physical delivery can decrease staff during the pandemic. As such, when compared to other technological interventions, I would expect the robot to lower both the physical and mental workload associated with taking medicine and eating food and thereby improve medication adherence.

1.3 Problem Statement

Currently, too many patients who have been infected with the COVID-19 virus cause the hospital to lack staff. So, with the robot medicine can help ease the work of hospital staff to deliver medicines to many patients in a given time. In addition, preventing the infection from spreading more widely to hospital staff. Lastly, be able to monitor patients taking food or medication by having to scan if a food delivery robot arrives.

1.4 Research Objectives

The main objective of this project is to develop hardware maintain a strategic to keep distance from patient during covid-19.

More specifically the principal objective of this research are:

1. To produce robot for delivery medicines and a white potentials spreading of the virus during outbreak of infection.
2. To develop hardware prototype for patient
3. To develop a system which is able to control the delivery according to the specified time.

1.5 Scope of Research

1. This project is focusing hospitalized patients
2. The emphasis is project will be completed within 30 days; cost of developing project is RM350.00
3. The main controller is using staff of hospital able to deliver for the patient by Smart MedRobot.

1.6 Project Significance

- ✓ Ensure that the programmed in Arduino is clear.
- ✓ Detect the patient's delivery room.
- ✓ Avoid the issue of hospital personnel shortages.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

As a result of the research, I liked the three examples in the table below, I will be producing my own SMART door lock. My SMART MedRobot differs slightly in that there are technology upgrades that are more sophisticated and user-friendly than existing projects. Additionally, my project uses multiple component variations to perform food and drug delivery. It can also scan the wristbands worn by the patient. Therefore, the production of projects for today's use is more demanding.

2.2 Motor Skill Challenges In Deliver Medicine And Food.(Literature Review Topic 1)

This paper focuses on the challenges problem of delivering pills and water to a person in a realistic home environment. This entails two major technical challenges. First, the robot must prepare the pills and food. Second, the robot must locate line tracking and proceed to the next with the pills and food.

To address the first challenge, we created a Smart MedRobot that places pills and food on a mobile delivery robot's tray. In essence, this robot executes the data from the Arduino required to complete the task. To do this, it uses black line tracking to move in the general direction of the patient room after first performing coarse navigation. The next step is local navigation using a beacon to find the patient room.

2.2.1 Previous Research (Subtopic Literature Review Topic 1)

This chapter extend the literature reviews that cater the information in accordance with the objectives of this project. The relevant information and other extra features were gathered as shown below

2.2.1.1 (Cloud and IoT Assisted Indoor Robot for medicine Delivery –(IoT-Robot)

As known, the important part of good medical care system is the indoor healthcare system. It became focus research in western developed countries with the continuously change of world's population structure in recent years . Zening Shao[2,3] In China, the part of over 60 years old will be the fastest increase and it accounts for 7.63% to 10.35% of the total population since 1982, which became the elderly population structure Moreover, it will reach 15.23% in 2020 and 24.28% in 2040 . which called "The ageing peak stage" Meanwhile, more and more oldster with some common disease like hypertension, diabetes, cerebral thrombosis, and sudden illness like cardiopathy needs to be taken care promptly. With the development of people's living standard and the information technology. provide for the elderly in society or at home is the key to solve the problem of social provide for the elderly in China. However, many problems have been erupted like lack of funds, talents and the Hospital Information System, so that current medical system is hard to fit the actual and development. Therefore, it is necessary to invent new equipment about indoor medical care system.

People from all over the world have done amount of research on it. For example, Marco [4]led his team to make up an indoor health care system which based on embedded system to protect someone who injured in the house, and the results proved the feasibility of that method. Chong [5] and his team designed a home pharmaceutical monitoring system which based on household robot and wireless sensor network, and the results of experiment proved that the household robot may improve the ability of wireless sensor and family monitoring system. In Huiru Cao[6]. the authors developed a new computational algorithm for accurate patient emotional state classification in interaction with nursing robots during medical service Generally speaking, the present research about indoor health care system or other equipment is tending to monitor vital signs. It has lots of shortcomings like the low information and lack of remote monitoring, so we designed a robot who can deliver medicine to cover the above shortage The robot is based on cloud and loTs technology It has remote mobile terminal and PC terminal management system. Last but not least, we tested the system and validated the rationality and feasibility on it.

2.2.1.2 (A Medicine Dispensing Mobile Robot for Senior Citizens - M3DITRACKER)

Despite of the large number of the elderly in Malaysia, a research by Rahim et al. [8] found an interesting finding on the silence of the elderly in Malaysia. The research investigated the role of elderly in applying ICT to support their independent living. However, the outcome of the research concludes that ICT does not facilitate their life. These include the use of ICT gadget and smart phones for communication. Thus, it would be interesting for this research to attempt on getting ICT into the elderly but from a different angle i.e. a robotic application. Existing robotic application related to medicine unstableing and dispensing include fuzzy logic implemented by iMec, the intelligent medicine box to estimate the subsequent time to remind the patients of medicine consumption NorShuhaniZamin[4].The inferencing considers the information received from the sensors to indicate the current situation of the patient and the sensors are activated by placement at specific areas in the house e.g. when the patient draws water from the kitchen tap. Suzuki et al.'s iMec ensures the consumption of the correct dosage by checking the medicine dispensed from the case and alerting of incorrect dosage by sending a message to an email address. Whilst Suzuki et al's device represents a significant improvement on adapted medicine bottles, it is too technically advanced for the majority of elderly people. Moreover, if the patient does not have a computer or email address, he or she is still dependent on a caretaker to monitor and dispense.

Using a social robot, a closed loop medication management supports patients by helping to reduce non intentional, on-compliance of medication . The Healthbots project uses web programming and integrates a medication management module into the robot suite of software to collect essential data to track medicine adherence. This application is useful for those who would want to have a systematic management of their health care and medical issues. However, it is not efficient especially when it comes to users who are not technologically savvy.

2.2.1.3 (Design of Etiquette for Patient Robot Interaction in a Medicine Delivery Task)

As the global pandemic affects people of ages more than 50 years, it puts the most experienced doctors and nurses and hospital staff at risk of catching the virus Akshet Patel [7]. A Tiruchi software company launched their medic robot “Zafi " on 29th March 2020 which can deliver food and medicines to the patients infected with the covid19 virus Akshet Patel [8]. Furthermore, a robotic company named Asimov Robotics unveiled their robot “KARMI-Bot” which is an autonomous robot which can not only deliver food and medicines but also disinfect the area using UV radiations. With almost a lakh positive case and the global epidemic affecting persons over the age of 50, even the most experienced doctors, nurses, and hospital personnel are at risk of contracting the virus. The bot in this project, MedBuddy, is mounted on a plastic cart and is coupled with a smartphone that serves as the robot's eye.

The car can be controlled from an approximate distance of 50 feet which will eradicate any unnecessary contact with the patient thus minimizing the risk of contamination Pranav Sharma[10]. The operation of the robot is very simple and it's like driving a radio-controlled car. This is accomplished by limiting their interaction with infected patients by using a robot car to provide meals and medicine to them . The automobile is mounted on a plastic cart and is outfitted with a smartphone that will serve as the robot's eye. The car may be controlled from a distance of around 50 feet away, avoiding any unwanted interaction with the patient and thereby reducing the danger of contamination .

2.2.1.4 (Robot for Delivery of Medicines to Patients Using Artificial Intelligence in Health Care)

Though in the literature there has been a considerable amount of work, there is not much work found where the theme of autonomous vehicles is taken to hospitals for medicine delivery through the RMDS to minimize the time delivery of medicine. The prototype of robot was a firebird used for testing the execution of the plan. Keeping this in view, the functionality of RMDS is a challenging task for an autonomous system if an arena of a hospital ward is considered. Although similar work has been developed for tuberculosis patients. The manuals of e-Yantra have been use d for setup of the test bed as indicated in . have discussed how to use IOT and Artificial Intelligence techniques in the scenario of COVID-19. Marat et al [10] investigates the control algorithms under the influence of varying dynamic parameters. Emily[11] illustrated about tele-robotics in stroke care, although a direct integration of these concepts is not seen to the work, this paper is being cited that a leaflet from tele-robotics can be taken and used for improving the aspects of mobility.

Margaret et al[12] reviews applications of robotics in nursing and implications in nurse education. Wireless sensor networks usage and performance improvements with integration in robotic environments are said by Hailong[13]. Piver[14] described how robot technology is used in Gynecology and an important take away point from this is the usage of robot assisted devices in surgeries as well. Russell[15] discussed about the common safety and regulatory compliance issues associated with robot architectures. The application of the studies on autonomous mobile robots to minimize delivery time is an important issue in view of persistent delays that exist with the system and speed of operation.

The method proposed can be extended to tuberculosis patient wards and other dangerous diseases which require isolation and proper care of patients without physical contact. The contactless delivery system through RMDS is a strategic method for better delivery of medicines in a timely fashion which is in the development stage. The development of this kind of system will not help hospitals, but the technology can be leveraged to other areas of research like parking, missions in outer space where physical contact needs to be avoided.

2.3 Control System (Literature Review Topic 2)

According to CNN-Health and as of June 2021, authorities have claimed over 174.4 million coronavirus cases and 3.8 million deaths since China reported the first case in December 2019. The objective of the project "MedBuddy" is to reduce the number of coronavirus cases among the medical staff and doctors when they must tend to the patients and administering the medications who are isolated in the general ward. This objective is achieved by designing and developing a project-controlled robot car built using the Arduino Uno microcontroller and equipped with a spare application Arduino whose ultrasonic will be used to provide live feed to the patient room. The robot is equipped with tray that allows the medicines to be delivered with an ease to the patients from a safe distance. This will result in making the timely delivery of medicines for the patients and will also reduce the unnecessary contact with the patients, minimizing the risk for medical personnel.

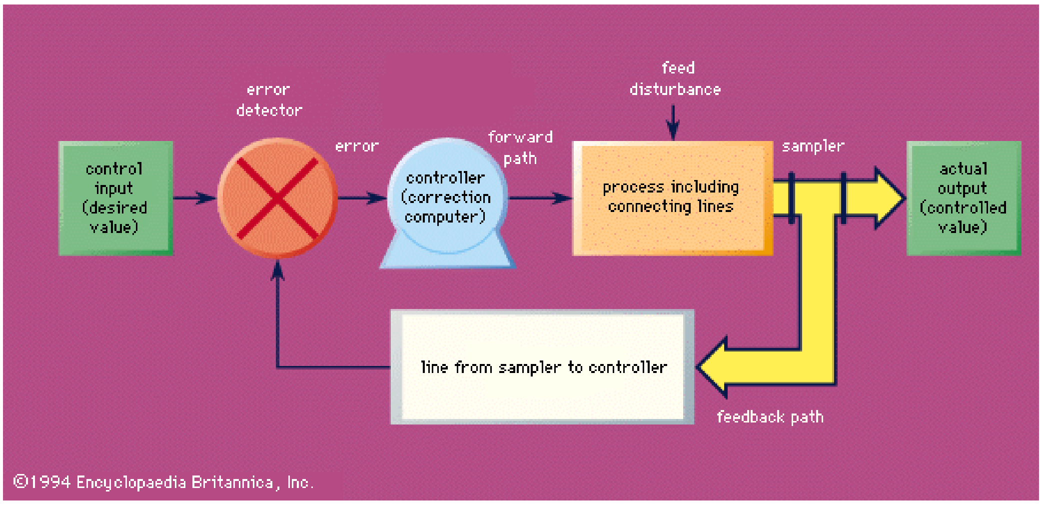


Figure 2. 1: Block diagram of open loop and closed loop system

2.3.1 ATMEGA BASED MICROCONTROLLER (ARDUINO UNO)

Arduino boards are physical programmable board that are used for flexible programming, customizable signal types and easy adaptation to the existing installations can offer many benefits to world.

Arduino UNO is the commonly used board that is also known as classic Arduino. This board has 14-digital I/O pins, where 6- pins can be used as PWM, 6-analog inputs, a reset button, a power jack, a USB connection and more. This board can receive and send information over the internet with the help of Arduino shields.

2.3.2 INFRARED AVOID MODULE

An Infrared Sensor (IR Sensor) is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called as a passive IR sensor. Usually in the infrared spectrum all the objects radiate some form of thermal radiations

2.3.3 ULTRASONIC SONAR (HC-SR04)

Ultrasonic is an excellent way of figuring out what's in the immediate vicinity of your Arduino. The basics of using ultrasound are like this: you shoot out a sound, wait to hear it echo back, and if you have your timing right, you'll know if anything is out there and how far away it is.

This is called echolocation and its how bats and dolphins find objects in the dark and underwater, though they use lower frequencies than you can use with your Arduino.HC-SR04 Ultrasonic Sensor is a very affordable(proximity/distance) sensor that has been used mainly for object avoidance in various robotics projects. It has also been used interred applications, water level sensing, and even as a parking sensor.

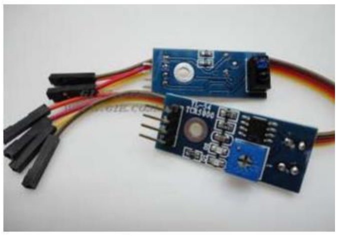
2.3.4 EXPANSION BOARD

The Arduino sensor shield V 5.0 allows you to hoop up the sensors directly to Arduino Uno without the use of the breadboard. It allows plug and play connection to various modules like sensors, servos, relays, potentiometers and more.

2.3.5 SG90V Servo

The SG90 (Figure 1) is a light weight, low-cost hobby servo. It is controlled by Pulse Width Modulation (PWM), with a duty cycle of 600µs to 2400µs (measured), and a total period of 20ms (50Hz). With the specifications provided by the manufacturer (Table 1), this completes all the data easily available in Internet.

2.3.6 IR Line Tracking Module



IR Line Tracking Module consists of a IR reflex sensor, it is a sensor with optoelectronic transmitter and receiver in a package. It functions by illuminating a surface with infrared light; the sensor then picks up the reflected infrared radiation and, based on its intensity, determines the reflectivity of the surface in question. Lightly colored surfaces will reflect more light than dark surfaces; therefore, lightly colored surfaces will appear brighter to the sensor. This allows the sensor to detect a dark line on a pale surface, or a pale line on a dark surface.

2.4 Chapter Summary

The basic idea is to create an unmanned robot car using an Arduino Uno Microcontroller with an onboard ATMega328P integrated circuit (IC), a medicine tray attached on top, and an IR Line Tracking Module so that it can be controlled easily from a distance of at least 50 feet. The bot also has an ultrasonic distance sensor that sends the real-time distance to the same mobile app, alerting the operator to the dynamic obstacles around it. This project can be improved by connecting it to the internet and adding artificial intelligence. This can be accomplished by executing techniques on a Raspberry Pi or another microprocessor.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

In order to realize this project as a product that ready to use with safety characteristic, a very comprehensive plan is undertaking. A step-by-step procedure is done so that the project can be completed in time. This include collecting data of sample patient finger, design the mechanical part of patient to get their food, circuit tracking testing and verification.

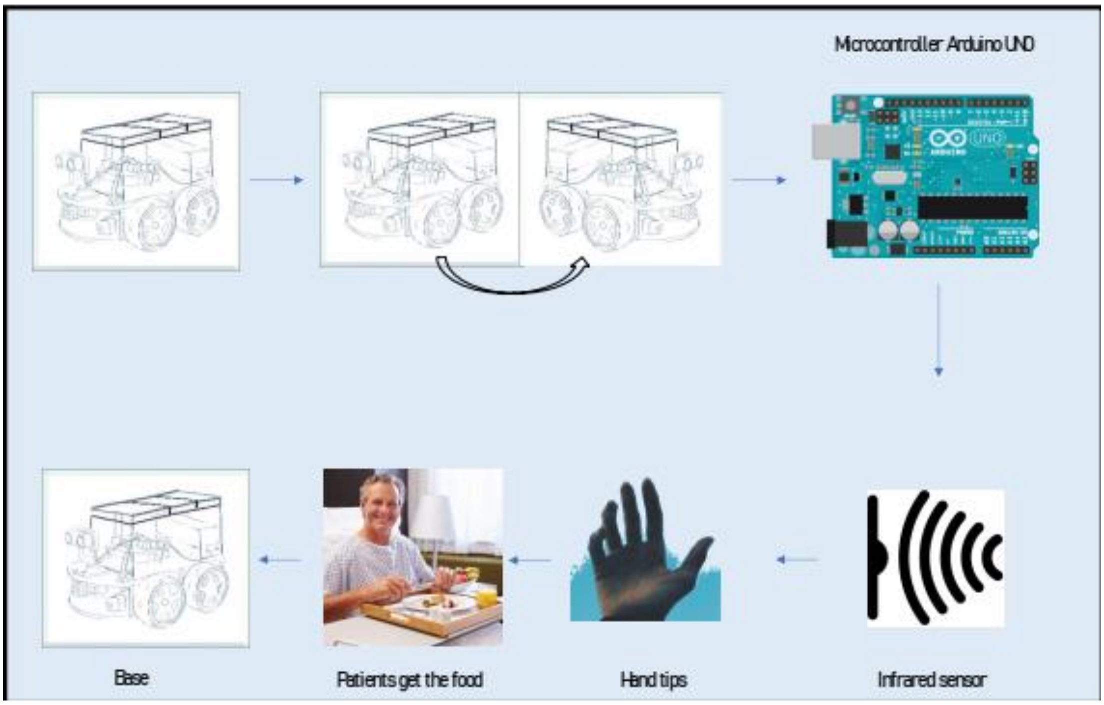
3.2 Project Design and Overview.

I tested my system on the cardboard. I tried two different routes to see if my Smart MedRobot could complete the delivery task. There are two lanes marked A and B. The transmission experiments were carried out with discovered patient rooms at A or B. These two locations were chosen because they represent different delivery environments in which to check the status of Smart MedRobot.

Room A is the first room and is located on the left side path, which can provide a consistent and flat navigation system. Room B is heading in the right direction. When navigating in this area, the system encounters a shift due to the difference in direction. I ran up to 5 experiments with two volunteers as the target users. Two different locations in each room were marked with tape for the experimenter to measure time.

3.2.1 Block Diagram of the Project

The project shows the block diagram of the development of Smart MedRobot. The arrows indicate the direction of the communication. The ultrasonic distance sensor acts as input sensors to the Arduino uno. In the same way, the motors. Motor driver and line tracking sensor are the output devices also known as actuators since they produce or facilitate in producing mechanical movement. The motors are connected to the motor driver which gets input from the Arduino itself.



3.2.2 Flowchart of the Project 2

Figure 3. 1 The flowchart of the working of the working of MedRobot. The process is begun by loading MedRobot with the medicines; it is then controlled by the Arduino by observing the feed from the camera and the distance sent by the distance sensor. After building and making all the connections, the robot is loaded with medicines and is controlled from a safe distance of 50 feet at the minimum. The live feed from the camera on the bot is transmitted wirelessly to the application running on the Arduino.

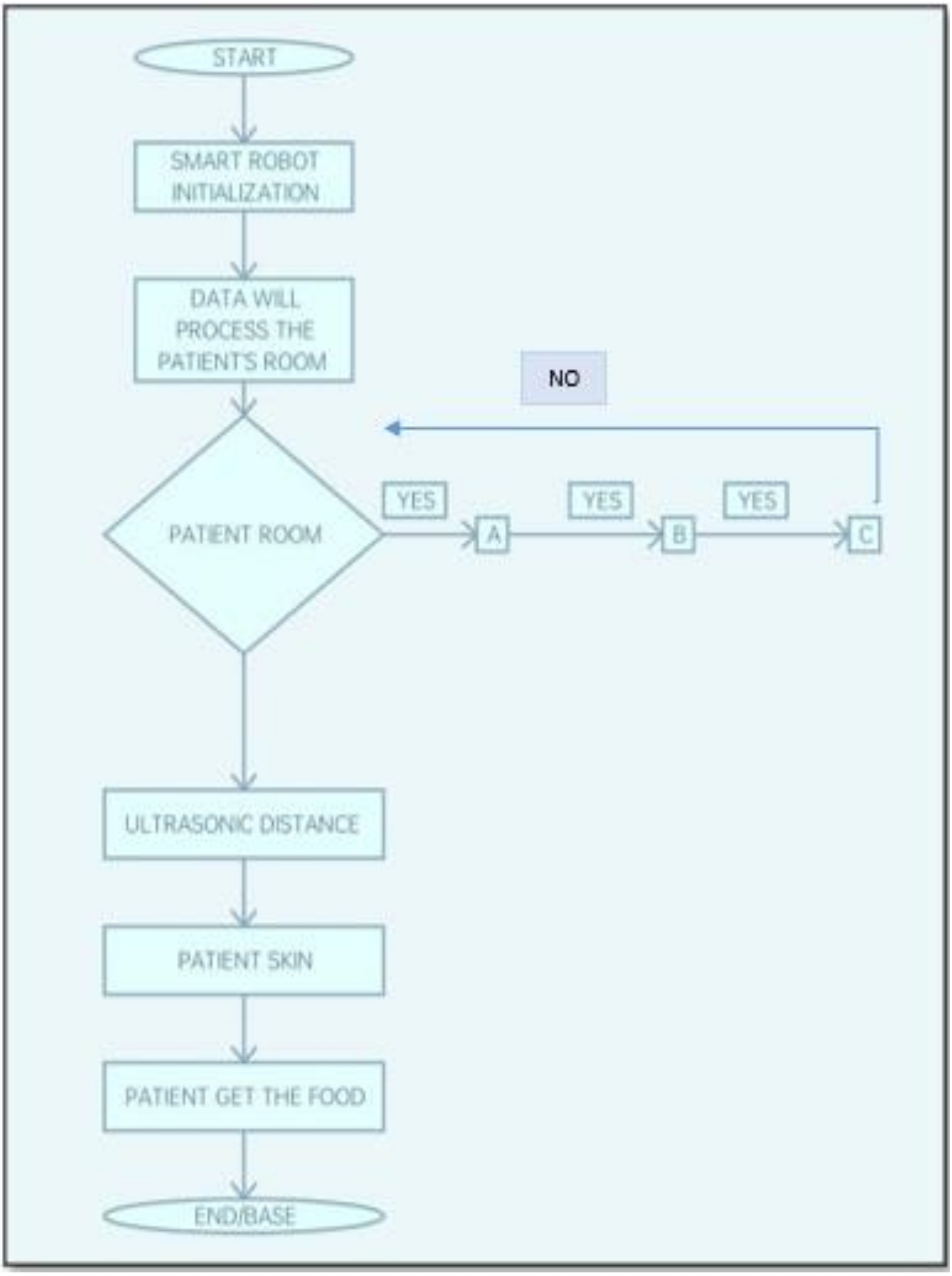


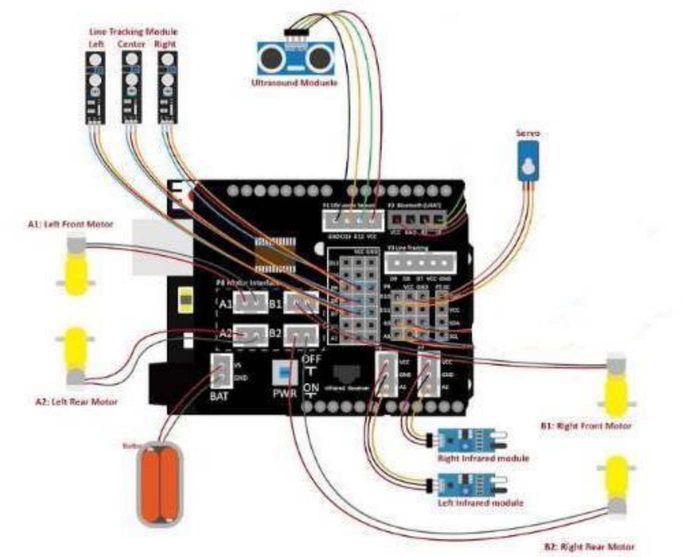
Figure 3. 1: Flow chart of operation of the system

3.2.3 Project Description

Future in-house hospital medicine delivery will use autonomous driving systems, which will represent state-of-the-art technology. The Smart MedRobot is similar to autonomous driving systems that are commonly found in the basements of shopping malls, technology parks, apartments, and other commercial buildings. The major parameters are operational speed, accuracy, safety, reliability, cost-effectiveness, convenience, space; efficiency and eco-friendliness play a key role in these kinds of systems. a difficulty in providing medicine to some patients who are undergoing difficult surgery. The research in these operations has been significantly low due to a lack of trained experts for the Smart MedRobot to do its job efficiently. The most important parameter that would decide the logistics would be the gross time taken by a vehicle to enter and deliver medicine. If this time is kept as low as possible, then entire logic involved in the delivery of the medicine and health issues in diseases like COVID-19 (Corona Virus Disease) would be minimized.

3.2.4 Schematic Circuit

Error! Reference source not found. shows the overall circuit diagram of this p roject will undergo the process of design development. The process of designing is one of the crucial parts in developing Smart MedRobot. Hardware that uses in this project is divided into 8 types which is DC Geared Motor, Arduino Uno, IR sensor, Motor Driver, Ultrasonic sensor, servo motor, line tracking and Rechargeable Li-On Battery. DC Geared Motor is used to rotate the walker wheel. This DC motor will be attached to the walker wheel. Next, Arduino Uno. Arduino Uno allows to construct programs in code segments to perform individual tasks The code will be programmed in Arduino Uno to give instructions to other hardware to work. Rechargeable Li-On Battery is also used as a power source of DC Motor.



3.2.5 Description of Main Component

3.2.5.1 ULTRASONIC

- To detect obstacle such hand to make smart robot move to another patient room
- To measure the distance to the target by measuring the time between the emission and reception

3.2.5.2 LINE TRACKING

- A Line Tracker mostly consists of an infrared light sensor and an infrared LED. It functions by illuminating a surface with infrared light; the sensor then picks up the reflected infrared radiation and, based on its intensity, determines the reflectivity of the surface in question. Lightly colored surfaces will reflect more light than dark surfaces; therefore, lightly colored surfaces will appear brighter to the sensor. This allows the sensor to detect a dark line on a pale surface, or a pale line on a dark surface.The Line Tracker allows your robot to follow a pre-marked path and allows humans to indirectly control the robot while it is autonomous.

3.2.5.3 MOTOR

• Enables wheels to rotate and move.

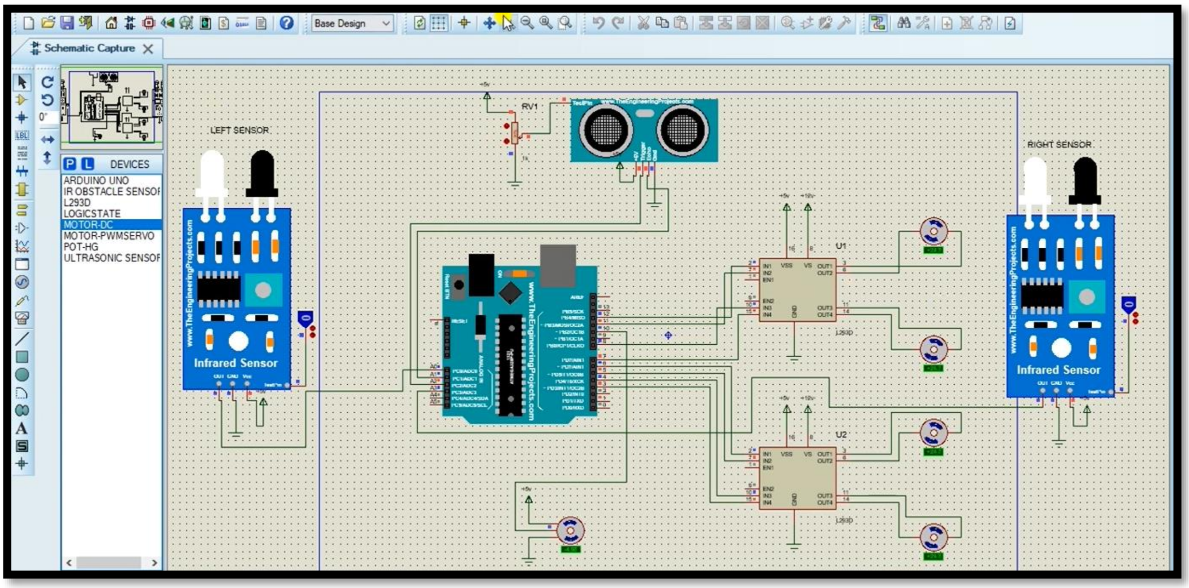
• Motor is also able to turn a system of gears.

• Smart MedRobot uses the motor to move the wheels in order to track and deliver medicine to the elderly

3.2.5.4 IR SENSOR

- IR sensors are now widely used in motion detectors, which are used in building services to switch on lamps or in alarm systems to detect unwelcome guests. In a defined angle range, the sensor elements detect the heat radiation (infrared radiation) that changes over time and space due to the movement of people.

3.2.6 Circuit Operation



CHAPTER 4

RESULTS AND DISCUSSION

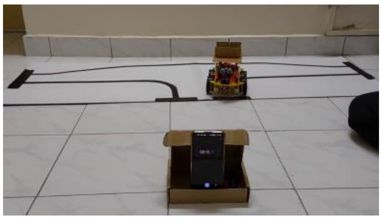
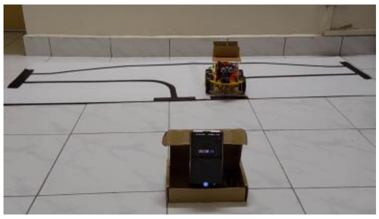
4.1 Introduction

The programs were developed in engineering room and where loaded to the smart medrobot using Arduino uno which is a high speed. The programmer takes power directly from PC's USB port which eliminates need of external power supply. The programmer can also power the target board from PCs USB port with limited supply current of up to 100mA. If the total number of patients to be delivered are preprogrammed and designated as in the arena, the markers would help the robot to deliver the medicine efficiently. the robot used an imprint of a black line and followed the line to look for the vacant positions. The ultrasonic sensor used an infrared sensor to identify the presence of a patient in a particular ward and then moved along the line to find the patients who were not delivered the medicine.

The smart medrobot was programmed in such a way that it identifies the spot closest to the exit gate and stops for 2 minutes itself automatically for the patient to pick his medicine. The interesting part of this work is that it has not used any camera for finding the patient which helps in not interfering with the privacy of the patient and strictly the smart medrobot is working on coding and not working without hindering the privacy of the patients concerned and only completely relied on the sensor information for delivery of the medicine. The difficult part of the task was to complete the activity in the least possible time. Based on the position of the delivery, the time for delivery changes dynamically; however, it could be identified that the system designed was fail-proof and would be a good asset to hospital and nursing staff.

4.2 Results and Analysis

FIGURE 1: SITUATION FOR THE DELIVERY MEDICINE AND FOOD

THREE SITUATIONS		
ROOM A	ROOM B	ROOM A & B
 -BASE TO ROOM A (5.64s)	 -BASE TO ROOM B (11.65s)	
 - ROOM B TO BASE (13.97s)	 -ROOM B TO BASE (15.71s)	 -BASE TO ROOM A& B (30.39s)

In the study I conducted, there were three forms of situation in which a smart medrobot would go to travel to each room. Among the data collected is the Smart Medrobot journey, which begins and ends in patient rooms A and B. Next, I did an analysis of the one-cycle journey taken by the smart medrobot to both patient rooms.

FIGURE 2: VELOCITY VS TIME

Time Taken After(Min)	Room A	Room B	Room A&B
5	13.97	15.71	50.39
10	14.56	15.30	51.00
15	12.99	16.00	55.52
20	13.55	15.62	58.69
25	14.03	14.59	50.00

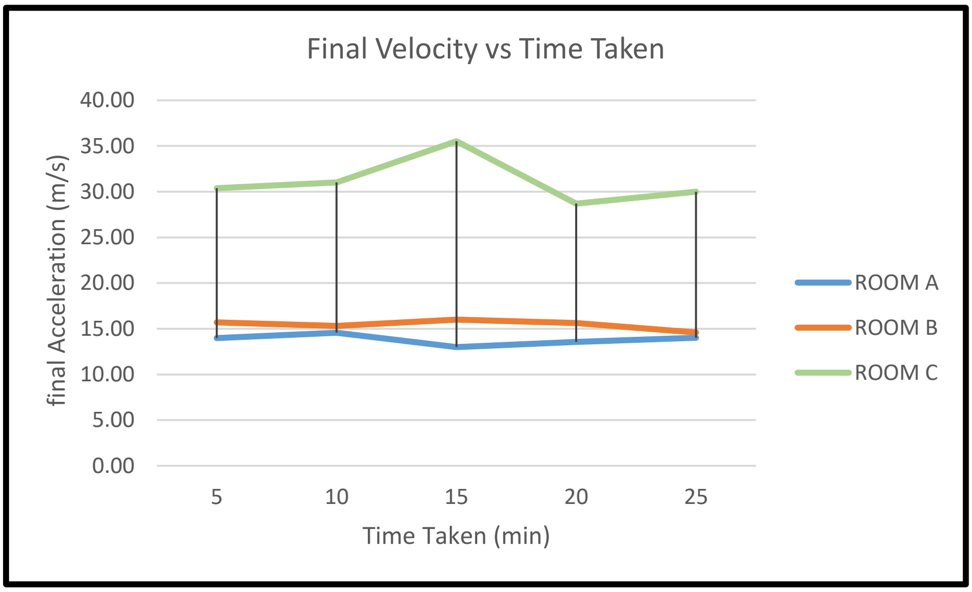


Figure 2 depicts a graph of velocity vs. time required for three patients room (A, B, and A&B). In general, it was discovered that the end velocity is not proportional to the time taken. That is, the longer the time required, the lower the end velocity. The ultimate velocity was found to be between 13.96ms and 14.03ms for room A, 15.71ms and 14.59ms for room B, and 50.39ms and 50ms for room A&B. Furthermore, the time required ranges from 100% to 15 minutes. It should also be noted that the rooms A&B have the maximum final velocity of 55.52ms at 15min and the room A has the lowest final velocity of 12.99ms. This is due to the fact that smart medrobot batteries deplete quickly while they are in operation.

FIGURE 3: TIME TAKEN (s) VS DISTANCE (INCH)

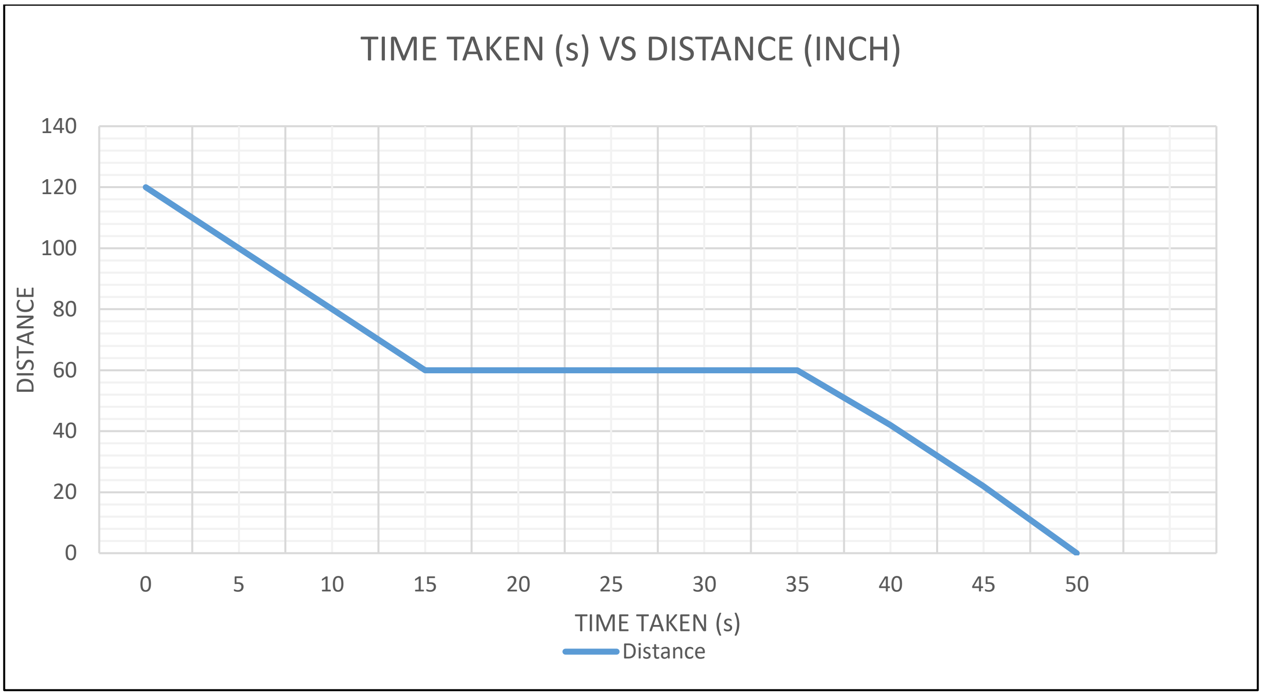


Figure 3 shows that the x axis represents the time taken in seconds and the y axis represents the distance travelled by the smart medrobot to reach the patient's room. The clever medrobot took roughly 15 seconds to reach patient room A, reducing the distance from 120 to 60. Following that, it becomes horizontal at 60 (inch) in the entire 20 seconds since it took time to move from room A to room B. Finally, he lowers abruptly for 15 seconds while walking to room B.

FIGURE 4: ERROR VS TIME TAKEN (HOURS)

ERROR	1 HOURS	5 HOURS	10 HOURS	15 HOURS
1	/	X	/	/
2	/	/	/	/
3	/	/	/	/
4	/	X	/	/
5	/	/	X	X
6	X	/	/	/
7	/	X	/	/
8	X	/	/	/
9	/	/	/	/
10	/	/	/	/

Based on the diagram shown, the tests which have been carried out in 10 consecutive days - also at certain time there are some problems encountered which cause the state of the robot not working so well according to the set objectives. The problem with the battery that provides power is that because the smart medrobot moves a lot, he has absorbed a lot of energy in performing activities. In addition, the sensor is an easy cause that causes the smart medrobot to move in a bad condition because the sensor has a sensitive nature. Finally, the erratic route prevents the sensor from functioning properly.

There were also cases in good condition on some trials. This is the outcome of the proof that smart medrobot smart rate can be used effectively.

4.3 Discussion

As is clear, robots do not require masks, can operate for extended periods of time without reducing output, are readily disinfectable, and do not grow ill. As a consequence, Smart MedRobot and other similar robots may be used on every hospital level or ward to prevent undesired interaction with isolated patients. This would reduce the number of instances of covid19 among doctors and medical professionals, who need the most protection in order to save lives. As a result, medical robots like these have the potential to save and protect people's lives. The robot can serve up to 12 hours every day and has a 2-hour recharge period when using rechargeable batteries.

But sometimes this uneven terrain caused enough jarring of the robot to tip the food and medicine. A dedicated food and medication holder might assist to reduce this issue by keeping the food and medicine from tipping when the robot travels difficult terrain. The medication station failed not effectively distribute food and medicine to the docked robot during one of the experiments because the smart medrobot was stuck in the line tracking. We intend to improve the mechanical design of the smart medrobot in order to address these issues and raise the system's overall resilience.

The drawback and flaw of this type of setup is that it assumes that the ward layout is static and that the dynamic map of the ward will not change. As a result, while looking for a patient, the robot is precisely given information about their position using markers. To put it another way, it is believed that wards will not be updated until our robot delivers the medicine. If the time of evacuation has to be decreased, dynamic updating of drug delivery status would make the situation more difficult. Additionally, it is presumable that no other robots are moving in the arena in this situation. If another robot enters the arena in the other direction or begins to depart at the same time that our robot is attempting to enter a place, our technique does not take this into account. As a result, even if the arena design and the restrictions placed on the topic had problems, the open-ended nature of the problem would lead to intriguing research that are crucial in the competition for the challenging field of Smart Medrobot.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

Various health organizations throughout the world, according to Microsoft, have produced many artificial intelligence (AI) chatbots and self-assessment bots, reaching out to over 18 millionpeople and sending over 160 million messages. Similarly, robots like Smart Medrobot may be able to save patients as well as medical personnel from this fatal sickness.

Sales of these robots and AI-assisted bots have exploded, and analysts predict that this trend will continue in the future. Finally, technology like this will continue to benefit humanity, including the usage of robots, which can give external support to the covid19soldiers. Smart Medrobot and similar robots can reduce the infection rate among doctors and healthcare workers by a significant amount.

- Recommendations for the medicine delivery :

Smart Medrobot differ from other types of robots and deserve special regulatory attention. Legal frameworks should acknowledge the high-risk nature of robotic systems for healthcare purposes. Clarity on the medical device for Smart Medrobot types, including surgical, physically and socially assistive, and healthcare service robotsis needed at risk that they will be repurposed without the appropriate safeguards .

Universal standards for progressive autonomy levels for Smart Medrobot should be defined to increase legal certainty with respect to responsibility allocation in highly complex human-robot interaction contexts, also in the medical field. 5.

The parameters in which the need for Smart Medrobot is assessed cannot be resource efficiency and increased productivity as with industrial robots only, other aspects as the implications for society need to be considered. To address safety comprehensively, Smart Medrobot demand a broader understanding of safety, extending beyond physical interaction, but covering aspects such as cybersecurity, temporal aspects, societal dimensions and mental health. Embodied Smart Medrobot can also exacerbate existing biases against certain groups and, therefore, their design, implementation, and use should account for diversity and inclusion.

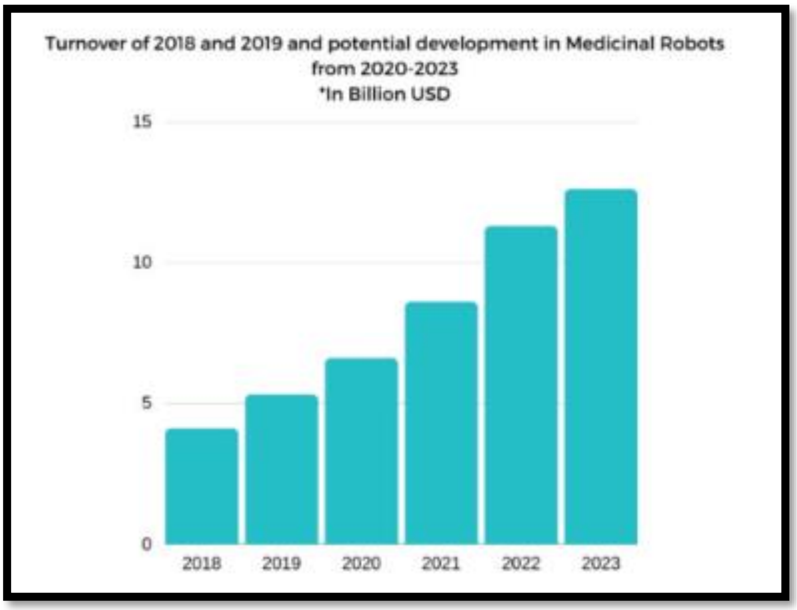
5.2 Conclusion

This study discusses a multi-robot system that provides automatic medicine and food delivery to a user in a hospital room by room. A tiny mobile robot and an automated medicine station comprise the system. When it comes, it orders the station to administer food and medication (Tic Tacs in these experiments). The robot detaches and moves to the place specified by the patient room. The robot then turns slowly in a circle, attempting to locate the patient's room by detecting his or her raised hand. Once spotted, the robot moves closer to the user. I conducted experimental trials with the user in the patient's room.. The results of the trials were promising, but also revealed areas that need improvement in the design and robustness of the system. Future work will focus on improving the robustness of the system both through enhanced software and improvements in mechanical design. Some of the obvious limitations of the multi-robot system include the fact that it can only operate in one level living environments (it cannot go up or down stairs). Also, its navigation and localization may be better in smaller environments (less than 1500 sq ft) as opposed to larger environment.

However, the target demographic typically lives in hospital-style living arrangements, which are ideal for our approach. We also anticipate that new system capabilities will be beneficial. At the moment, the gesture must be timed to occur when the robot is looking in order to be detected by the robot, which requires a slow, careful look around. We believe that future iterations of the system will include both faster scanning of the area by the robot and autonomous ways for detecting people. When a human is recognized, the robot may request that the person make a gesture as confirmation. Furthermore, if the user chooses not to immediately take the medicine and food upon delivery, the robot could wait as a physical reminder, or potentially follow the user, until the user either takes the medicine or sends the robot away to return later. The robot might also integrate awareness of the user’s activities or adapt over time to find more effective times for delivery. For instance, a pill may need to be taken with food, and an older adult may eat a different time of the day. More generally, this type of multi-robot system could deliver other items that would benefit older adults. For example, a blood pressure cuff or thermometer might be delivered to improve health monitoring.

The experiments I conducted in this paper with my multirobot system are a necessary precursor to more elaborate human-robot interaction. The motivation of our work is to develop a system that can improve the medication adherence and hydration of older adults with a low-cost multi-robot system that does not use an on-board general-purpose manipulator. A low-cost system of this nature can potentially accelerate the use of robots in home healthcare settings.

5.3 Suggestion for Future Work



According to International Federation of Robotics, the medicinal robotics market is going to increase exponentially in the coming years. There is a steep rise in the production and development of mobile medicinal as well as service robots and one of the major reasons is the coronavirus outbreak. Robots like Smart MedRobot can be supported with Artificial Intelligence and computer vision so that they can cater to the patients in a more sensitive way. Voice recognition system including text to speech and speech to text could be implemented and the ability to talk to patients, make phone calls to their knowns over the internet could be made possible by making them smart by connecting it to the internet and cloud. These robots can not only be used in hospitals but also other public places like markets, libraries, malls, shops, parks, and halls. The possibilities and scope of this work is limitless.

5.4 Chapter Summary

In view of the safety and medical concerns of patients and the persons delivering medicines on a timely fashion, robotic delivery of medicines in wards of hospitals using artificial intelligence techniques is investigated in this work. The robot traverses the wards where the medicine needs to be delivered using intelligence-based algorithm based on sensors and indicator marked in the wards, in the best possible shortest path and exits the ward. The program would ensure that the robot does not collide with other robots and humans in the path and also would search for the indicator where the medicine would have to be delivered on a timely fashion. This way, we would ensure that contagious diseases are not transferred when medicine delivery is done and also compared to the same with laborious process being done manually. This proposed method functionality and algorithm is tested on a prototype arena and was proven to be successful using a Smart MedRobot in the laboratory for the algorithm. The proposed method saves time and also human resources and is easy to operate with external monitoring from the hospital reception.

CHAPTER 6

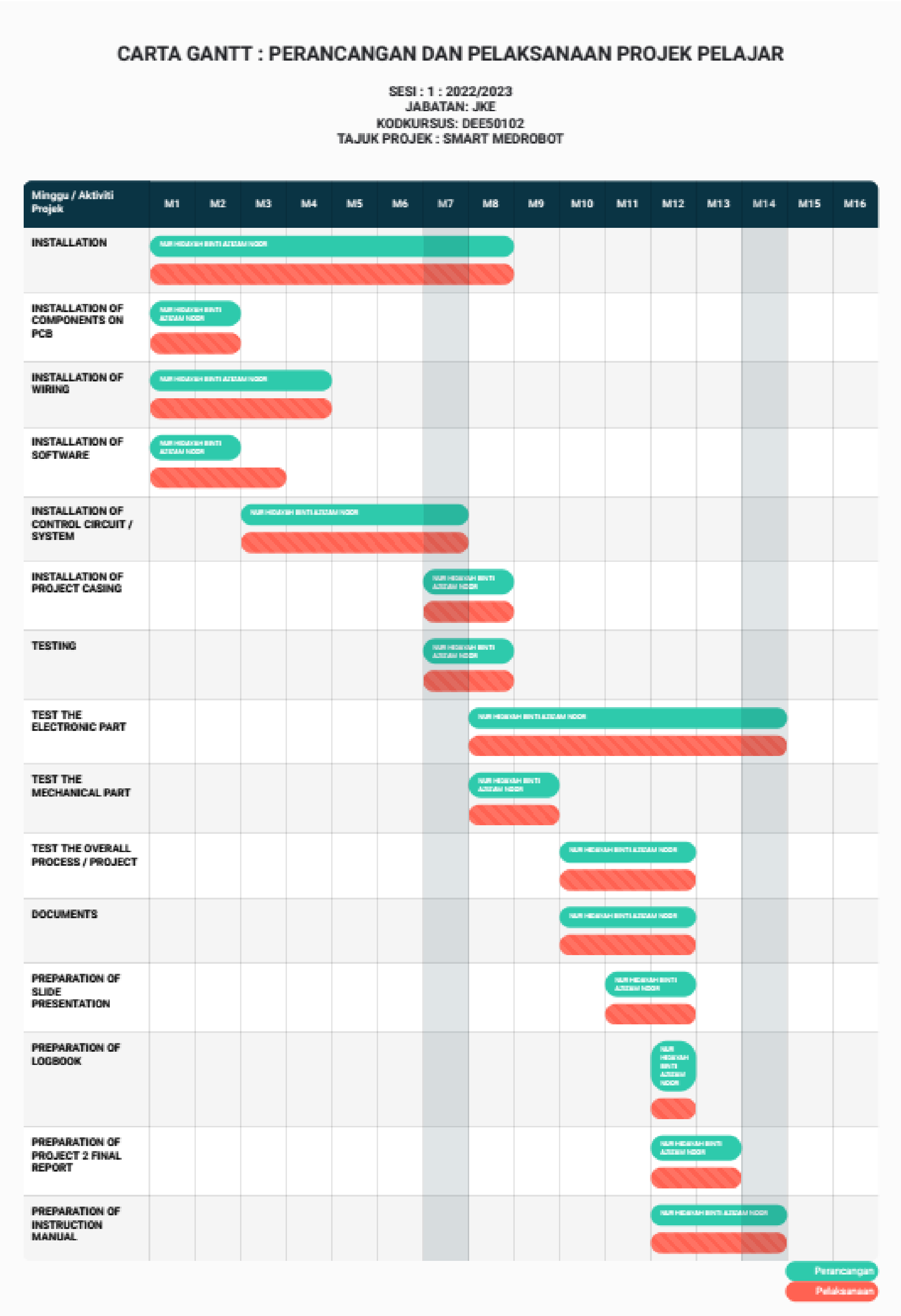
PROJECT MANAGEMENT AND COSTING

6.1 Introduction

This project involves the cost of purchasing components and materials throughout its implementation. components involving cost are hardware Arduino, Expanding board, IR sensor, Hc-sr04 sensor and line Tracking. All of these components are purchased through online purchase methods to make it easier as well as save on costs.

The overall gross budget estimate in the implementation of this project is RM 350.00 and other expenses is at RM 80.00 as shown in Table 1 According to this budget cost, this project is can be considered as a less costly project compared to other projects that can cost over a thousand ringgit. The cost of the project is also in line with one of the key features of a good project developer that is low cost but have a high-quality project.

6.2 Gant Chart and Activities of the Project



6.3 Cost and Budgeting

No.	Component and materials	The unit price	Quantity	Total
1	Arduino UNO R3	RM 50.00	1	RM 50.00
2	Expanding board	RM 2.00	1	RM 2.00
3	IR Sensor	RM 1.50	2	RM 3.00
4	Hc-sr04 sensor	RM 3.30	1	RM 3.30
5	Servo motor SG90	RM6.79	1	RM 6.79
6	Line Tracking	RM 3.90	3	RM 11.70
7	Bo motor & Wheel	RM4.40	4	RM 17.60
8	9V Battery	RM 6.90	8	RM 55.20
9	Others	RM 58.6		RM 58.60
			Total :	**RM 208.19**
	List of other costing			
1	Transportation			
2	Postage	RM 30.00	1	RM 30.00
3	Craft Work	RM 61.81	1	RM61.81
4	Internet	RM 50.00	1	RM 50.00
5	Application			
			Total :	**RM 80.00**
			Overall total	**RM 350.00**

REFERENCES

1. Akshet Patel ,Pranav Sharma ,Princy Randhawa.(2021) .The Medicine Delivery Robot.International Coference on Reliability ,pp,1-4.

2. Kuldeep singh Kaswan ,Santar Pal singh ,Shrddha Sagar(2020). “Role of Arduino In Real World Applications”,International journal of scientific & technology, pp,1-3.

3. L. Louis(2016).”Working principle of Arduino and using it as a tool for study and research”, International Journal of Control,Automation, Communication and Systems, pp,21-29.

4. Ayan Tripathi,Sk Anwar Ali ,Saswata Sundar Laga (2017).”Characteristics of infrared” ,International Journal of Scientific & Engineering ,pp,4-5.

5. F. Blanes, J.E. Simo, P. Perez (2018), “Using infrared sensors for distance measurement in mobile robots,” Journal of Robotics and Autonomous Systems, pp. 255-266.

6. Yasothaa Kalai Chelvama , Norshuhani Zamina , Gail Sylvia Steele ,Rahim et al,(2017), “A Preliminary Investigation of M3DITRACK3R : A MedicineDispensing Mobile Robot for Senior Citizens”, International Conference on Robot PRIDE,pp,240-246.

7. Srikanth Kavirayani, Divya Sree Uddandapu, Aravind Papasani,Marat el at,Emily,Hailong , Piver, Sullen (2018),” Robot for Delivery of

Medicines to Patients UsingArtificial Intelligence in Health Care”,Electrical and Electronics Engineering, pp,1-4.

8. Huiru Cao, Marco,Chong,Xiaofeng Huang, Jianyi Zhuang, Jianqiang Xu, Zening Shao “Cloud and IoT Assisted Indoor Robot for medicine Delivery” International Advanced Engineering and Technology Research Conference, pp,1-5.

9. Rg (2018), Sensor Shield for Arduino UNO,1st edition,[Online],Available: https://rajguruelectronics.com/Product/1353/Sensor%20shield%20for %20Arduino%20Uno.pdf

10.GI Electronic (2019),IR Line Tracking Module,1st edition,[Online],Available: https://www.gie.com.my/download/um/modules/sensor/um_line_tra cking.pdf

11.Guido di Pasquo (2021), “SG90 Servo Characterization”, National University of Technology ,pp,1-6

APPENDICES

APPENDIX A- DATA SHEET

DATASHEET FOR ARDUINO

4 Board Operation

4.1 Getting Started - IDE

If you want to program your Arduino UNO while offline you need to install the Arduino Desktop IDE [1] To connect the Arduino UNO to your computer, you'll need a Micro-B USB cable. This also provides power to the board, as indicated by the LED.

4.2 Getting Started - Arduino Web Editor

All Arduino boards, including this one, work out-of-the-box on the Arduino Web Editor [2], by just installing a simple plugin.

The Arduino Web Editor is hosted online, therefore it will always be up-to-date with the latest features and support for all boards. Follow [3] to start coding on the browser and upload your sketches onto your board.

4.3 Getting Started - Arduino IoT Cloud

All Arduino IoT enabled products are supported on Arduino IoT Cloud which allows you to Log, graph and analyze sensor data, trigger events, and automate your home or business.

4.4 Sample Sketches

Sample sketches for the Arduino XXX can be found either in the "Examples" menu in the Arduino IDE or in the "Documentation" section of the Arduino Pro website [4]

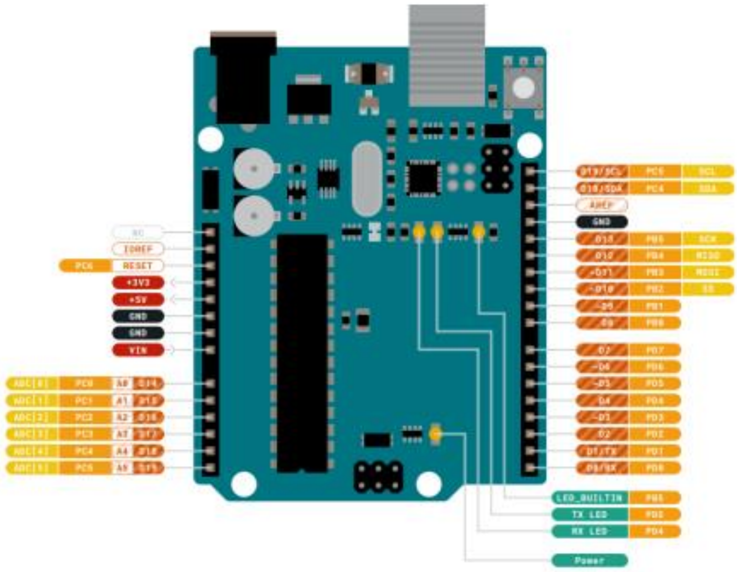
4.5 Online Resources

Now that you have gone through the basics of what you can do with the board you can explore the endless possibilities it provides by checking exciting projects on ProjectHub [5], the Arduino Library Reference [6] and the online store [7] where you will be able to complement your board with sensors, actuators and more

4.6 Board Recovery

All Arduino boards have a built-in bootloader which allows flashing the board via USB. In case a sketch locks up the processor and the board is not reachable anymore via USB it is possible to enter bootloader mode by double-tapping the reset button right after power up.

5 Connector Pinouts



Pinout

5.1 JANALOG

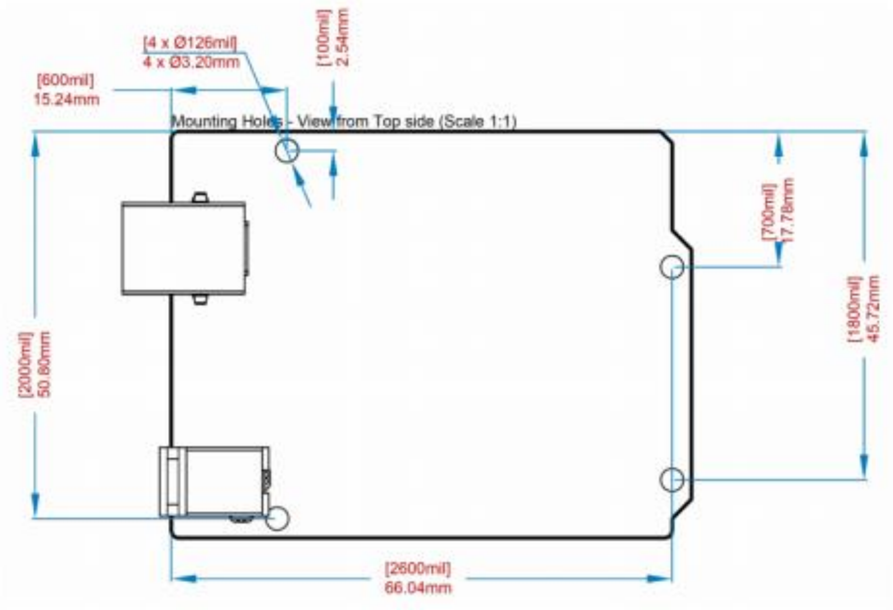
Pin	Function	Type	Description
1	NC	NC	Not connected
2	IOREF	IOREF	Reference for digital logic V - connected to 5V
3	Reset	Reset	Reset
4	+3V3	Power	+3V3 Power Rail
5	+5V	Power	+5V Power Rail
6	GND	Power	Ground
7	GND	Power	Ground
8	VIN	Power	Voltage Input
9	A0	Analog/GPIO	Analog input 0 /GPIO
10	A1	Analog/GPIO	Analog input 1 /GPIO
11	A2	Analog/GPIO	Analog input 2 /GPIO
12	A3	Analog/GPIO	Analog input 3 /GPIO
13	A4/SDA	Analog input/I2C	Analog input 4/I2C Data line
14	A5/SCL	Analog input/I2C	Analog input 5/I2C Clock line

5.2 JDIGITAL

Pin	Function	Type	Description
1	D0	Digital/GPIO	Digital pin 0/GPIO
2	D1	Digital/GPIO	Digital pin 1/GPIO
3	D2	Digital/GPIO	Digital pin 2/GPIO
4	D3	Digital/GPIO	Digital pin 3/GPIO
5	D4	Digital/GPIO	Digital pin 4/GPIO
6	D5	Digital/GPIO	Digital pin 5/GPIO
7	D6	Digital/GPIO	Digital pin 6/GPIO
8	D7	Digital/GPIO	Digital pin 7/GPIO
9	D8	Digital/GPIO	Digital pin 8/GPIO
10	D9	Digital/GPIO	Digital pin 9/GPIO
11	SS	Digital	SPI Chip Select
12	MOSI	Digital	SPI1 Main Out Secondary In
13	MISO	Digital	SPI Main In Secondary Out
14	SCK	Digital	SPI serial clock output
15	GND	Power	Ground
16	AREF	Digital	Analog reference voltage
17	A4/SD4	Digital	Analog input 4/I2C Data line (duplicated)
18	A5/SD5	Digital	Analog input 5/I2C Clock line (duplicated)

5.3 Mechanical Information

5.4 Board Outline & Mounting Holes



Board outline

DATASHHEET EXPANDING MOTOR

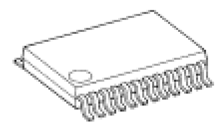
TOSHIBA TB6612FNG

Toshiba Bi-CD Integrated Circuit Silicon Monolithic

TB6612FNG

Driver IC for Dual DC motor

TB6612FNG is a driver IC for DC motor with output transistor in LD MOS structure with low ON-resistor. Two input signals, IN1 and IN2, can choose one of four modes such as CW, CCW, short brake, and stop mode.



SSOP24-P-300-0.65A

質量: 0.14 g (標準)

Features

- Power supply voltage ; VM=15V (Max.)
- Output current ; Iout=1.2A(ave) / 3.2A (peak)
- Output low ON resistor ; 0.5Ω (upper+lower Typ. @VM≧5V)
- Standby (Power save) system
- CW/CCW/short brake/stop function modes
- Built-in thermal shutdown circuit and low voltage detecting circuit
- Small faced package (SSOP24 : 0.65mm Lead pitch)
- Response to Pb free packaging

* This product has a MOS structure and is sensitive to electrostatic discharge. When handling this product, ensure that the environment is protected against electrostatic discharge by using an earth strap, a conductive mat and an ionizer. Ensure also that the ambient temperature and relative humidity are maintained at reasonable levels.

The TB6612FNG is a Pb-free product.
The following conditions apply to solderability:
*Solderability
1. Use of Sn-37Pb solder bath
   *solder bath temperature = 230°C
   *dipping time = 5 seconds
   *number of times = once
   *use of R-type flux
2. Use of Sn-3.0Ag-0.5Cu solder bath
   *solder bath temperature = 245°C
   *dipping time = 5 seconds

1

2007-06-30

APPENDIX B- PROGRAMMING

```
#include <Servo.h>

volatile int D_mix;
volatile int D_mid;
volatile int D_max;
volatile int Front_Distance;
volatile int Left_Distance;
volatile int Right_Distance;
volatile int Right_IR_Value;
volatile int Left_IR_Value;
volatile int Left_Tra_Value;
volatile int Center_Tra_Value;
volatile int Right_Tra_Value;
volatile int Black;

void Ultrasonic_obstacle_avoidance() {
  if (Front_Distance <= D_mid) {
    digitalWrite(2,LOW);
    analogWrite(5,0);
    digitalWrite(4,HIGH);
    analogWrite(6,0);
    if (Front_Distance <= D_mix) {
```

```
  digitalWrite(2,LOW);
  analogWrite(5,50);
  digitalWrite(4,HIGH);
  analogWrite(6,255);
  delay(100);
  digitalWrite(2,HIGH);
  analogWrite(5,50);
  digitalWrite(4,HIGH);
  analogWrite(6,50);
  delay(150);
  digitalWrite(2,LOW);
  analogWrite(5,0);
  digitalWrite(4,HIGH);
  analogWrite(6,0);
  digitalWrite(2,HIGH);
  analogWrite(5,255);
  digitalWrite(4,LOW);
  analogWrite(6,50);
  delay(150);
  digitalWrite(2,HIGH);
  analogWrite(5,180);
  digitalWrite(4,HIGH);
  analogWrite(6,180);
  delay(280);

}
```

```
  } else if (Front_Distance == D_max) {
    digitalWrite(2,LOW);
    analogWrite(5,50);
    digitalWrite(4,HIGH);
    analogWrite(6,50);
    delay(50);
    digitalWrite(2,LOW);
    analogWrite(5,180);
    digitalWrite(4,LOW);
    analogWrite(6,180);
    delay(500);
  }
}

void Infrared__Tracing() {
  if (Left_Tra_Value != Black && (Center_Tra_Value == Black &&
Right_Tra_Value != Black)) {
    digitalWrite(2,HIGH);
    analogWrite(5,120);
    digitalWrite(4,LOW);
    analogWrite(6,120);

  } else if (Left_Tra_Value == Black && (Center_Tra_Value == Black
&& Right_Tra_Value != Black)) {
    digitalWrite(2,LOW);
    analogWrite(5,80);
    digitalWrite(4,LOW);
    analogWrite(6,80);
```

```
  } else if (Left_Tra_Value == Black && (Center_Tra_Value != Black
&& Right_Tra_Value != Black)) {
    digitalWrite(2,LOW);
    analogWrite(5,120);
    digitalWrite(4,LOW);
    analogWrite(6,120);
  } else if (Left_Tra_Value != Black && (Center_Tra_Value != Black
&& Right_Tra_Value == Black)) {
    digitalWrite(2,HIGH);
    analogWrite(5,120);
    digitalWrite(4,HIGH);
    analogWrite(6,120);
  } else if (Left_Tra_Value != Black && (Center_Tra_Value == Black
&& Right_Tra_Value == Black)) {
    digitalWrite(2,HIGH);
    analogWrite(5,80);
    digitalWrite(4,HIGH);
    analogWrite(6,80);
  } else if (Left_Tra_Value == Black && (Center_Tra_Value == Black
&& Right_Tra_Value == Black)) {
    digitalWrite(2,LOW);
    analogWrite(5,0);
    digitalWrite(4,HIGH);
    analogWrite(6,0);
  }
}


Servo myservo;
float checkdistance() {
```

```
  digitalWrite(12, LOW);
  delayMicroseconds(2);
  digitalWrite(12, HIGH);
  delayMicroseconds(10);
  digitalWrite(12, LOW);
  float distance = pulseIn(13, HIGH) / 58.00;
  delay(10);
  return distance;
}

void Obstacle_Avoidance_Main() {
  Left_IR_Value = digitalRead(A1);
  Right_IR_Value = digitalRead(A2);
  Front_Distance = checkdistance();
  Left_Tra_Value = digitalRead(7);
  Center_Tra_Value = digitalRead(8);
  Right_Tra_Value = digitalRead(9);
  Serial.println(Front_Distance);
  Infrared_Obstacle_Avoidance();
  Ultrasonic_obstacle_avoidance();
  Infrared__Tracing();
}

void Infrared_Obstacle_Avoidance() {
  if (Left_IR_Value == 0 && Right_IR_Value == 1) {
    digitalWrite(2,HIGH);
    analogWrite(5,255);
```

```
    digitalWrite(4,LOW);
    analogWrite(6,12);

  } else if (Left_IR_Value == 1 && Right_IR_Value == 0) {
    digitalWrite(2,HIGH);
    analogWrite(5,12);
    digitalWrite(4,LOW);
    analogWrite(6,255);
  } else {
    digitalWrite(2,HIGH);
    analogWrite(5,(4 * 22.5));
    digitalWrite(4,LOW);
    analogWrite(6,(4 * 22.5));

  }
}

void setup(){
  pinMode(2, OUTPUT);
  pinMode(5, OUTPUT);
  pinMode(4, OUTPUT);
  pinMode(6, OUTPUT);
  D_mix = 3;
  D_mid = 8;
  D_max = 10;
  Front_Distance = 0;
  Left_Distance = 0;
```

```
  Right_Distance = 0;
  Right_IR_Value = 1;
  Left_IR_Value = 1;
  Left_Tra_Value = 1;
  Center_Tra_Value = 1;
  Right_Tra_Value = 1;
  Black = 1;
  Serial.begin(9600);
  myservo.attach(10);
  myservo.write(90);
  pinMode(A1, INPUT);
  pinMode(A2, INPUT);
  pinMode(12, OUTPUT);
  pinMode(13, INPUT);
  pinMode(7, INPUT);
  pinMode(8, INPUT);
  pinMode(9, INPUT);
}

void loop(){
  Obstacle_Avoidance_Main();


}
```

APPENDIX C- PROJECT MANUAL/PRODUCT CATALOGUE

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