

## DEVELOPMENT OF HEALTHCARE ROBOT MEDICINE DELIVERY FOR COVID-19 PATIENT

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### ABSTRACT

The advance of robotic technology will bring ease to human life not only in the industrial sector, but also the education and entertainment sector. In this research, an idea of a line following robot assistant on delivering the medicine that can classify the medicine and the room according to their color is proposed. The classification process depends on several sensors such as infrared sensor for detecting the line of black, the color sensor and ultrasonic sensor. In this thesis, the researchers identify where technologies that to a large degree are existing today can be utilized to support the social systems in the near future. This show that several of challenges related to the demographic change can be addressed with technology that is already available and can be reached mass market.

**Keywords:** Healthcare service robot, Covid-19 pandemic

### 1. INTRODUCTION

The Covid-19 pandemic that is caused by the spreading and infection of the virus has impacted the communities all over the world. The Covid-19 is a dangerous virus as it is known for its “stealth-like” infection as it can contact and survive in humans without showing any symptoms in the period of two days up to two weeks. Hence, the healthcare medicine delivery robot is a robot that is the most suitable position to take place in midst of this Covid-19 pandemic [1]. The area of robotics can be utilized as a means of prospective means to overcome this concern, enabling most of the task carried out by humans to be exported to robots in the future. However, improvement concerns difficulties such as sensor and actuator advancement, and also some substantial changes in hardware implementation from artificial intelligence to human communication. This paper describes the demands of healthcare facilities with a focus on the concept that robots could play help in contributing and assisting medical source assistance.

The purpose of the study is to produce an efficient and faster services robot in order to assist the doctors and nurses of delivering the medicine. The aim of this study is to propose the significant technical achievements and capabilities of medical and healthcare robotics to improve human welfare. Advances in robotic technology stimulates the growth of the new process system by improving the performance of workers and lowering the medical costs and consume less time while providing alternative care facilities.

## 2. LITERATURE REVIEW

In the initial stage of this initiative, a number of literatures have been analyzed to get a better understanding of the project and the fundamental of microcontroller that is appropriate for our research objective. This chapter discusses the finding on the topics from various source such as journals, articles and websites which are related to this project. This chapter mainly discusses about the healthcare services in Malaysia.

Coronavirus Disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus. Many other symptoms associated with the COVID-19 virus will encounter mild to conservative lung infections and heal without mandating preferential treatment. Elderly adults and those with implicit medical problems such as cardiovascular disease, diabetes, chronic respiratory disease and cancer are often more prone to developing chronic diseases. Based on research and studies, Asita Elengoe (2020) has reported that a continuous incidence of unexplained acute respiratory tract infections has been recorded in Wuhan City, Hubei Province, China since 12 December 2019, stemming in the Hunan South China Seafood Market (Mil Med Res et al, 2019). Chinese scientists extracted an undisclosed infectious sample from an infected person on 7 January 2020 and synthesized the genetic information using the next genetic analysis method. (Elengoe, 2020) The World Health Organization (WHO) stated on 12 January 2020 that a novel coronavirus, discovered in 2019, was the cause of this epidemic and named coronavirus disease 2019, which is COVID-19 [1]. However, the alternative to the SARS-CoV-2 sources needs to be clarified. The virus can be transmitted by asymptomatic infected individuals and diagnosable individuals through the use of oral fluid droplets, mainly airborne via coughing or sneezing. Hospital admissions in the Malaysia fell dramatically due to the coronavirus disease 2019 pandemic. In this study of John D (2020), it is reported that most of the hospital admissions fell precipitously with the declaration of the coronavirus disease 2019 pandemic, with several reports of hospitals operating at less than 50% capacity. Volumes have fell in part because of hospitals purposefully restricted elective surgery and other non-critical medical services. There are also reported that hospitals decline in admissions for acute medical illness, including stroke and acute myocardial. Fallen hospitalization rates could be substantial harm to public health if the patients defer care for life-threatening conditions. The decline of admissions in all patient groups are defined by age, race and ethnicity, medical and self-pay status, and income. The most reasonable reason for the widespread decline in medical admissions is that patients avoided in seeking for medical treatment, perhaps in response to fear of pandemic from media reports, or as a result of state stay-at-home orders. The results from the studies provide empirical support for concerns about the broad public health impact of the pandemic on non-Covid-19 populations. Some medical conditions facilitate better hospital treatment to avoid adverse effects, therefore, fewer hospitalizations for such medical conditions are almost certainly associated with harm to the patient.

Based on research and studies by Arshia Khan (2020), in 50 years ago, the first developed in contrast to the industrial robots to automate dirty, dull and risk tasks. Nowadays, the design of the medical and healthcare robots is changing entirely with the situations and responsibilities that involve with direct communications with user interaction. In the last decade, there has been a substantial growth in the industrial robots which interested the commercial and researchers. Robots that already affect the use of engineering and innovation to prevent and treat diseases and injuries and the accessibility of disease prevention and treatment. The robotic systems are useful to the community. It can perform and follow human procedures by demonstrating an experiment with no or little guidance by mental health professionals. It is also possible to continue long-term therapy at home after hospital admission. In this research and studies of Arshia Khan (n.d), states that robots are being used in industry since the 1960s and have been fully implemented due to the benefits and

support services they provide in max up the manufacturing process, providing help where human reach is limited, providing accurately precision and assistance in sectors where safety is at stake or in hazardous situations. Robots in health care are much less acknowledged and tested not just by patients, but also by healthcare professionals [6]. Healthcare robots experience difficulties that are not as prominent in the manufacturing sector [6]. Difficulties such as working in an environment populated by disadvantaged people in regarding physical, mental and other vulnerabilities further lessen the acquiescence of healthcare robots. The functionality of the robot in terms of convenience and the education and training requisite to use it can significantly reduce its functionality. According to Laurel R (2017), there is infrequently a societal problem surrounding through use of a robot in addition to the cognition capabilities that pose problems.

Infrared sensors are tiny microchips with a photocell that are programmed to respond to infrared radiation. They are mostly used to identify remote controls signals. Each TV and DVD player has one of them in the front to react to the IR signal from the clicker. Within the remote control is a corresponding IR LED, which generates an IR pulse to instruct the TV to turn on, off or switch channels. Photodiode is used for the robot to detect the line. For this setup, a set of IRs LEDs (TX) and photodiode sensors (RX) is facing to the surface of the floor is used which are stick with black line. The output is generated depending on the amount of light that reflected by the analogue signal. The Arduino comparator will receive the signal with the amount of light emitted to produce an output of 0s and 1s. It is considered assumption that the sensors will reads 0 when it detects the line and it will read 1 when it is off the line. With the corresponding of Arduino, the algorithm of the system decides the movement and trying to position the robot such as that all the sensors read 0. The robots can respond and react to changes the direction of ways with sensors appear the intelligent or life-hike. Comparator is a device, which it is a comparison digital signal of two input current or voltages and produces an output of high or low. It represented by a triangle diagram which is the inverting input, non- Inverting input, Vcc, Ground, and Output. The properties of comparator are that if positive voltage is greater than negative voltage, then the output voltage is the same ass the Vcc (Digital High Output is 1) in the circuit diagram. IR LED combine with the Photodiode will make it as the reflective optical sensor. When the IR beam is break to the photodiode, it will generate and interrupt to the signal. The low value resistor of IR led is used as it produce a very bright shines to be able to create the IR break-beam. The IR LED's light is detected by the photodiode which act as the receiver to 'on'. (Sujeet Kumar, 2016).

In Roberto Rojas (2016) research studies, it is reported that the color sensor is used to identify colors other than the light information that comes from it to differentiate the incoming light into green, blue and red components. Thus, the chromatic coordinates of the reflected radiation can be measured and compared to the reference colors stored in advanced. Color models are used to evaluate the colors are being captured to allow numeric representation of colors, which seems to be the case with the RGB model (representing red, green and blue colors) and the HSV (hue, saturation and value). The RGB color sensor model is defined as three model and an incremental composition, reflecting three RGB color planes. The coordinate-based model will represent colors in space at ranges corresponding to the visual variations between them and industrial measurements of object colors are suggested. (Castro et al, 2013). The color sensors consist of RGB led to develop white light source, a Plastic Optical Fiber (POF) that is use to direct the wave and the photodetector transduce. These extrinsic sensors comprise of a wave guide that conveys the radiation generated by the light source to the sample (Moh. Yasin et al, 2012), and (Olsen Eugene, 2003), which is then embodied in the sample itself, and then sent the information through the Plastic Optical Fiber (POF) to the transducer with a square array of up to 64 randomly spaced photodiodes separated into three categories for primary colors red, green and blue. The sensors translate the sensed light into a frequency, which is corresponds to the color. A square signal with a working time of 50% and a

frequency that is directly corresponding to the intensity.

Motor is a device that converts any form of energy into mechanical energy or imparts motion. In constructing a robot, motor usually plays an important role by giving movement to the robot. In general, motor operating with the effect of conductor with current and the permanent magnetic field. The conductor with current usually producing magnetic field that will react with the magnetic field produces by the permanent magnet to make the motor rotate. There are generally three basic types of motor, DC motor, even servo motor and stepper motor, which are always being used in building a robot. DC motors are most easy for controlling. One DC motor has two signals for its operation. Reversing the polarity of the power supply across it can change the direction required. Speed can be varied by varying the voltage across motor.

### 3. METHODOLOGY.

Before the robots start, the robot is place at the medicine room. The first thing that the nurses or doctors need to do is put the medicine on the robot with assigned color plastic for each room after request is accept. Then, they need to press start button to actuate and the robot will move along with line trace control on the floor. The robot will detect the different color that assign to each room. Ultrasonic sensor is used for safety purpose. This will allow the robot to stop the movement and produce a sound to alert anything that blocks the pathway of the robot. The robot will continue moving after it detects no object or obstacle in front of it. The first color that the robot will detect with color detection is color blue, which indicate for room 1. In this process, the robot will stop and servo motor 1 and color detection will turn on. The servo motor 1 is use to rotate the tray and color detection on the side of the tray will detect the color of the medicine according to the color of the room. If the color sensor detects the medicine for the its room, servo motor 2 is on and servo motor will stop rotate. Servo motor 2 is use to open the lid for the medicine to drop. The lid will close with the use of timer, and the robot move to next location. The process is repeat continuously until the robot detect color black, which indicate its initial place at medicine room.

As the design of the prototype, there is three parts of compartment for each individually medicine which are red, green and blue. The tray is another part for the user to retrieve the medicine from the robot. Figure 1 and Figure 2 below shows the parts and components that are linked to the Arduino microcontroller are the IR sensor, color recognition sensor, motor driver shield and servo motor. All of the components are connected to the digital output of Arduino microcontroller pins. The architecture circuit for this project uses the Arduino IDE software system.

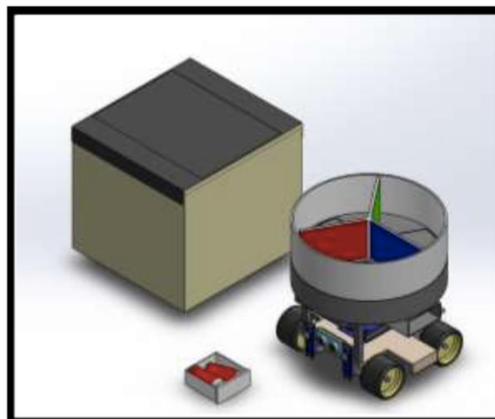


Figure 1: The prototype

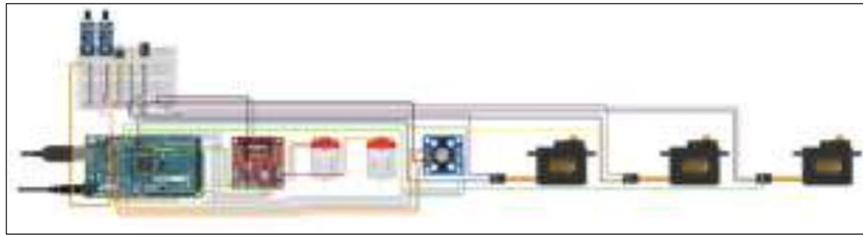


Figure 2: Circuit diagram for the prototype

For detecting color of an object, a color sensor module like GY-31 TCS3200 and Arduino Mega is used for this project. TCS3200 chip is designed to detect the color of light incident on it. It has an array of photodiode (a matrix of  $8 \times 8$ , so a total 64 sensors). These photodiodes are covered with three types of filters. 16 sensors have red filter over them thus can measure only the component of red in the incident light. Likewise, other 16 have GREEN filter and sixteen have BLUE filter.

As any visible color can be broken into three primary colors. So, these three types of filtered sensors help measure the weightage of each of primary colors in incident light. The rest 16 sensors have clear filter. TCS3200 converts the intensity of incident radiation into frequency. The output waveform is a 50% duty cycle square wave. The color sensor is connected to the Arduino Mega to show the value of intensity or name of the color that will be showed in the serial plotter. Thus, the color of an object is detected. Working principle of the proposed system was shown in Figure 3.

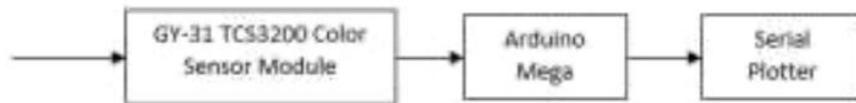


Figure 3: Working principle

#### 4. RESULT AND DISCUSSION

Before obtain the value of each color, a color reader is needed to be done as to get the value of each color using the serial plotter. A code has been program in the Arduino IDE software and upload to the Arduino Mega board. For testing the performance of the sensor, different color papers were used to set the range of data value. A color paper (act as an object) was placed on the GY-31 TCS3220 color sensor module. During the performance test, primary colors such as red, green and blue detected successfully. Figure 4 shows the flowchart for the color sensor to read the signal sensor.

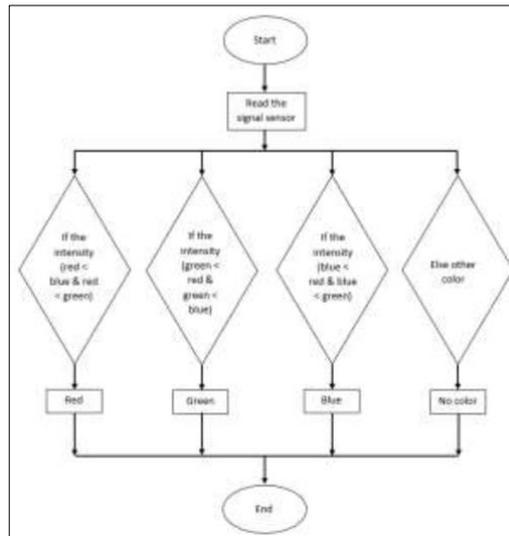


Figure 4: Flowchart for the color sensor to read the signal sensor

The result of the color can be monitor and obtain by using the serial monitor and serial plotter. The graph in Figure 5 shows the result of 3 different values for each of color has been tested which are red, green and blue. The first phase of the graph shows no color that is detected. As for the second phase, the graph value shows for the blue color where the value for blue is low and the other two is high. The third phase shows for red, where the value for the red is low and the others is high which is different with the value for color blue. In the last phase, each of the value is high which represent the green color. The result can be seen on the graph below. After gaining the data result, the color value of each color can be collect and implement the value into the main code for the prototype to be connected and actuate to the assigned servo motor.



Figure 5: Serial monitor and plotter

The microcontroller that is used for the project is Arduino Mega. board is because the prototype has 17 inputs, which are 6 inputs for the color sensor, 3 inputs for servo motor as the prototype needs 3 servo motor, 2 input for infrared sensor and 6 inputs for the motor shield. Arduino has only 14 digital I/O pins. Here is the comparison between the two board. A suitable microcontroller board for this project is Arduino Mega. The software used is the same for all Arduino board which is using Arduino IDE software. In this software, the program of the process flow for the prototype has been made. The software run on the computer and used to write and upload computer coding to transfer to the microcontroller which is the Arduino Mega. The table below shows the difference specifications of 2 microcontroller board. A suitable microcontroller board for this project is Arduino Mega. The software used is the same for all Arduino board which is using Arduino IDE software. In this software, the program of the process flow for the Healthcare Robot Medicine Delivery has been made. The software run on the computer and used to write and upload computer coding to transfer to the microcontroller which is the Arduino Mega. Arduino IDE uses three types of language to code, which are Arduino language, C++ and Java. Arduino IDE is known as one of the robust programming software in electronics projects as it can uses many languages.

## 5.0 CONCLUSION

As for the conclusion, the project where it is designed in order to provide a mechanism for the identification each room by using three different level of color which are; red, green and blue by using the Arduino IDE software can be considered as a functional project based on the working performance of the system. Plus, the objectives of the project of the Healthcare Robot Medicine Delivery using Arduino were achieved and accomplished successfully.

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