

Design of Automatic Sliding Door Based on Arduino Using Ultrasonic Sensors as a Preventative the Spread of Covid-19

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ABSTRACT

Covid-19 is an infectious disease caused by acute respiratory syndrome coronavirus 2 (Sars-CoV-2), therefore a study is conducted to break the chain the spread of the coronavirus is a touchless automatic door. In this study, an automatic door is made, and this door uses an Arduino-based ultrasonic sensor. This research aims to be able to design and build sliding doors for automatic doors and can create an Arduino system that is suitable for automatic doors and can use ultrasonic sensors as a touchless medium. This research uses tools and materials, namely Arduino Uno, ultrasonic sensor, dc motor, l298n motor driver, and for the driving mechanism is a dc motor connected to the pinion sprocket and a chain connected to the door surface. This research designs doors in SolidWorks 2018 software and builds doors with specifications (Material: PVC, Height: 1900 mm, Width: 610 mm, Thickness: 40 mm, Mass: 7.5 kg, Weight: 73.5 N) in a street workshop in Leuweung Sawo Cilegon-Banten, as well as making an Arduino system for doors that can move automatically by making a coding program in the Arduino IDE software, for opening and closing the door with an ultrasonic sensor that is set at a distance of about 5 cm..

Keyword: Covid-19, Arduino, Ultrasonic sensor, Automatic door

ABSTRAK

Covid-19 adalah penyakit menular yang disebabkan oleh sindrom pernapasan akut coronavirus 2 (Sars-CoV-2), oleh sebab itu dibuatlah penelitian yang dapat memutuskan rantai penyebaran corona virus ialah pintu otomatis tanpa sentuh. Pada penelitian ini membuat pintu otomatis, dimana pintu ini menggunakan sensor ultrasonik yang berbasis arduino. Penelitian ini bertujuan untuk dapat merancang dan membangun pintu geser untuk pintu otomatis dan dapat membuat sistem arduino yang sesuai untuk pintu otomatis serta dapat menggunakan sensor ultrasonik sebagai media tanpa sentuh. Penelitian ini menggunakan alat dan bahan ialah arduino uno, sensor ultrasonik, motor dc, driver motor l298n, serta untuk mekanisme penggerak ialah motor dc yang dihubungkan dengan pinion sprocket dan rantai yang terhubung di permukaan pintu. Penelitian ini merancang pintu di software solidworks 2018 dan membangun pintu dengan spesifikasi (Material: PVC, Tinggi: 1900 mm, lebar: 610 mm, Tebal: 40 mm, Massa: 7,5 kg, Berat: 73,5 N) di workshop jalan leuweung sawo cilegon-banten, serta membuat sistem arduino untuk pintu dapat bergerak otomatis dengan membuat coding program di software ARDUINO IDE, untuk pembuka maupun penutup pintunya dengan sensor ultrasonik yang jaraknya sudah diatur sekitar 5 cm.

Keyword: Covid-19, Arduino, Sensor ultrasonik, Pintu otomatis



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1. Introduction

Corona virus disease 2019 (Covid-19) is an infectious disease caused by acute respiratory syndrome coronavirus 2 (Sars-CoV-2) [1]. This disease was first discovered in December 2019 in Wuhan, the capital of China's Hubei Province, and then spread globally causing a coronavirus pandemic. This Corona Virus causes shortness of breath, high fever, cough, runny nose, sore throat, body aches, and diarrhea. This virus also easily spreads from the air, comes into contact with wild animals, comes into contact with humans and also touches objects around it, for example, such as doors [2].

Arduino is a microcontroller system specifically designed to make it easier to create objects or develop electronic devices that can interact with various sensors and controllers. The sensor used in this study is ultrasonic sensor, which is useful as a touchless door opener [3]. The working principle of the sensor is a sensor that works to reflect sound waves to an object and receive back the results of the reflected sound waves [4]. The object of this study is the palm of the hand, where the palm is brought closer to the ultrasonic sensor.

In this study using a dc motor connected to the pinion sprocket and chain [5]. Where the dc motor rotates the sprocket pinion and the sprocket pinion drives the chain connected to the door so that the door moves shifting and translation [6].

Therefore this research was conducted in order to reduce or break the chain of spread of the coronavirus. This research is to design a door that opens and closes automatically without touching using Arduino Uno, ultrasonic distance sensors, DC motors and pinion sprockets and chains which act as the drive media for the door. In addition to prevent transmission of the corona virus, this research is also minimize the manufacturing costs which use PVC doors that are light and durable. Because the cost of automatic doors found in the market needs very high cost. In this research, it can be developed in public toilets that use PVC doors. Public toilets are often touched or opened and closed by many people so there are lots of germs, therefore this research can be developed for public facilities in the environment to reduce the spread of the corona virus (covid-19).

2. Method

2.1 Arduino

Arduino Uno R3 Atmega 328P is an electronic board that has a microcontroller chip called Atmega 328P, where Atmega 328P is the product of Atmel which can use C language programs. This C language can make programmers easier with their PCs, because it's easy to download [7]. C language can be used in Arduino Ide software.

Table 1. Datasheet of Arduino Uno

Name	Information
Microcontroller	ATmega328P
Voltage Operation	5 Volt
Input Voltage	7-12 Volt Recommended
Input Limit Voltage	6 - 20 Volt
Pin I/O Digital	14 (6 can be used for PWM)
Flash memory	32 KB (ATmega328P) & 0,5 KB used by bootloaders

2.2 Ultrasonic Sensor

ultrasonic sensor is a sensor that works to reflect sound waves to an object and receive back the results of the reflected sound waves. The frequency of sound waves is from 40 KHz to 400 KHz [8]. In this research, the HC-SR04 ultrasonic sensor has 4 pins, namely:

- VCC: As the current pin enters the HC-SR 04 (positive).
- Trigger: As a signal from the microcontroller that will be taken out or reflected.
- Echo: As a result signal from trigger reflection.
- Gnd: As the output current pin (negative)

There are letters T and R on the HC-SR04 ultrasonic sensor. The meaning of the letters T and R is T = Transmitter and R = Receiver, the transmitter is the signal transfer and reflects the signal to the object while the receiver is the receiver of the signal reflection from the transmitter

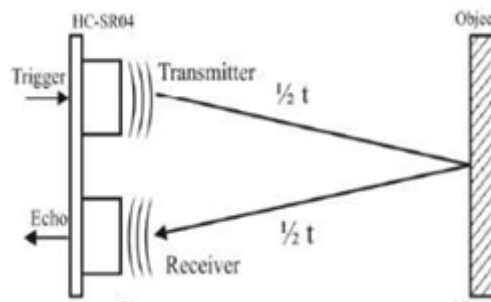


Figure 1. Ultrasonic Sensor Working Principle (HC- SR04).

2.3 Door Actuators

Aktuator merupakan sebuah peralatan mekanis untuk menggerakkan atau mengontrol sebuah mekanisme atau sistem ialah actuator [9]. Aktuator diaktifkan oleh lengan mekanik yang biasanya digerakkan oleh motor listrik yang dikendalikan oleh pengontrol otomatis yang diprogram mikrokontroler. Motor DC merupakan piranti elektronik yang dapat mengubah energi listrik menjadi energi mekanik berupa putaran [10]. Energi listrik arus searah atau yang juga biasa dikenal dengan nama listrik DC digunakan sebagai energi masukan motor DC. Umumnya sebuah motor DC memerlukan tegangan masukan antara 1,5 volt sampai 24 volt. Pada penelitian ini menggunakan actuator berjenis motor DC.

The actuator is a mechanical device to drive or control a mechanism or system[9]. The actuators are activated by a mechanical arm which is usually driven by an electric motor controlled by a microcontroller programmed automatic controller. DC motor is an electronic device that can convert electrical energy into mechanical energy in the form of rotation [10]. Direct current electrical energy or also commonly known as DC electricity is used as the input energy for DC motors. Generally a DC motor requires an input voltage of between 1.5 volts to 24 volts. In this study using a DC motor type actuator.

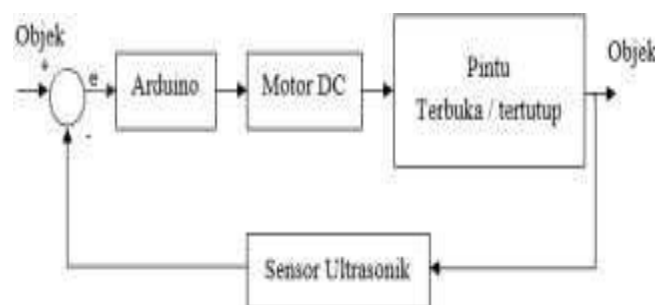


Figure 2. Automatic Door Block Diagram.

3. Result and Discussion

The results of the analysis of product specifications are continued by describing the structure of the component functions so that it can be concluded that there are several variants of product concept problem solving solutions. Starting from the function of the entire system, accompanied by the flow of how the product works, signals and energy that occur in the control system.

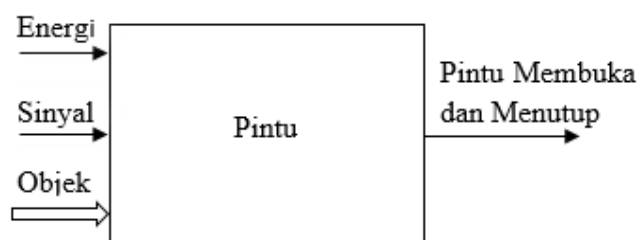


Figure 3. Automatic Door Block Diagram

The overall function of the tool design is the process of opening and closing doors without touching so that doors can be opened or closed without touching. To get a solution, it is necessary to describe several functions

and sub-functions and determine functions and supporting functions. Following are some functional structure variants for automatic opening and closing door designs.

This study is using PVC doors, due to the light load of 7.5 kg. The image below is of the design of an automatic sliding door that has been built.



Figure 4. Design of Automatic Sliding Doors with Actuation Mechanics, Ultrasonic Sensors and Arduino Systems.

The results of testing the ultrasonic sensor reading function on automatic sliding doors are as follows:

Table 2. Ultrasonic Sensor Detection

Sensor Distance (cm)	Information
3	Responsive
4	Responsive
5	Responsive
6	Not Responsive
7	Not Responsive

The time required for the process of the door to be fully opened or closed at the shifting speed of the door leaf.

Table 4. Door Open Time.

Time (second)	Information
2	Not completely opened
2.05	Not completely opened
2.1	Not completely opened
2.15	Not completely opened
2.2	Completely Opened

Table 5. Closed Door Time.

Waktu (detik)	Keterangan
2.3	Not completely closed
2.30	Not completely closed
2.31	Not completely closed
2.315	Not completely closed
2.32	Completely closed

The data above was taken for one sliding door open-close cycle. This shows that the sliding door can operate when there is a wave of a hand or an object approaching the ultrasonic sensor is no more than 5 cm and then the door opens and closes when the individual has passed through the door.

4. Conclusion

Based on the research that has been conducted that using sliding doors made of PVC (Polyvinyl Chloride) material, the minimum distance of the ultrasonic sensor can read hand waves from 2 cm to 5 cm. The working steps of operating the door are bringing your palm or other object closer to the ultrasonic sensor, the motor operates so that the door opens, and the ultrasonic sensor detects an object passing through the door, then moves the motor back so the door closes.

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References

- [1] Syakurah, Rizma Adlia, and Jesica Moudy. "Pengetahuan terkait usaha pencegahan Coronavirus Disease (COVID-19) di Indonesia." *HIGEIA (Journal of Public Health Research and Development)* 4.3 (2020): 333-346.
- [2] Susilo, Sidik, et al. "Door Handle Opener Controller Based on Arduino to Prevent Transmission of the Covid-19 Virus in Public Spaces." *Conference on Broad Exposure to Science and Technology 2021 (BEST 2021)*. Atlantis Press, 2022.
- [3] Listijorini, Erny, et al. "Preliminary Study of Door Opener Design in Automatic as a Prevention Means Spread of Coronavirus Diseases." *Conference on Broad Exposure to Science and Technology 2021 (BEST 2021)*. Atlantis Press, 2022.
- [4] Yudha, Putra Stevano Frima, and Ridwan Abdullah Sani. "Implementasi Sensor Ultrasonik Hc-Sr04 Sebagai Sensor Parkir Mobil Berbasis Arduino." *EINSTEIN (e-Journal)* 5.3 (2019).
- [5] Prabowo, Brilliant Adhi. "Pemodelan Sistem Kontrol Motor DC dengan Temperatur Udara sebagai Pemicu." *INKOM Journal* 2.1 (2010): 39-43.
- [6] Efrizal, Efrizal, and Mohammad Sabar. "Analisa Perancangan Transmisi Sprocket And Chain Pada Kendaraan Prototype Bensin Kontes Mobil Hemat Energi (KMHE) MENRISTEKDIKTI UMT." *Motor Bakar: Jurnal Teknik Mesin* 3.1 (2020).
- [7] Badamasi, Yusuf Abdullahi. "The working principle of an Arduino." *2014 11th international conference on electronics, computer and computation (ICECCO)*. IEEE, 2014.
- [8] Venkatesh, Shashank. "Obsatacle Avoidance Robotic Vehicle Using Hc-Sr04 Ultrasonic Sensor." *Turkish Journal of Computer and Mathematics Education (TURCOMAT)* 12.12 (2021): 2358-2362.
- [9] Surindra, Mochammad Denny. "Analisis Respon Output Dari Pemodelan Kontrol Proporsional Pada Aktuator Motor DC." *Eksergi* 9.2 (2016).
- [10] Yuski, Moh Nur, Widyono Hadi, and Azmi Saleh. "Rancang Bangun Jangkar Motor DC." *Berkala Sainstek* 5.2 (2017): 98-103.