Sunan Kalijaga of Journal Physics
Vol. 4, No. 1, 2022, pp. 37-43
ISSN: 2715-0402, DOI:

Design of a Covid-19 Sterilization Room in a Package Using a Spray Nozzle Based on an Atmega328p Microcontroller

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ARTICLE INFO

Article history:

Received July 28, 2021
Revised August 28, 2021
Accepted September 28, 2021

Keywords:

nozzle spray;
mikrokontroller ATmega328P;
sensor ultrasonic;
motor stepper;
relay

ABSTRACT

Many efforts have been made to prevent the spread of COVID-19, one of which is the use of disinfectant liquids. The use of disinfectant liquid is widely used on objects, one of which is for spraying disinfectants on shipping packages in the form of goods which are still mostly done manually. In this study, a disinfectant spray device for shipping goods has been developed with a sprayer that moves automatically in the form of a COVID-19 sterilization room on packages using a spray nozzle based on the ATmega328P microcontroller. This research is limited to the size of the item 20 x 20 x 5 cm and the object detection distance is 1-20 cm. The tests include testing the proximity sensor, programming stepper motors and pumps, testing the mass of goods, and the system as a whole. The results of the distance sensor test for a detection distance of 1 – 20 cm obtained errors at a distance of 1 and > 15 cm, while for a detection distance of 10 - 440 cm an error was obtained from 0 – 3.41%. Test results of stepper motor programming for distance readers 1-20 cm motor on condition. Pump programming testing for object detection distance of 1-20 cm when the motor is on. Testing the maximum mass of goods is 2100 grams. Overall test results obtained 6 out of 10 successful tests where the indicator of success is when all surfaces of the goods are completely wetted with disinfectant liquid and are limited to items measuring 20 x 20 x 5 cm.

Cite Article:

Okta Canda Pritiwi, Ahmad Aminudin, Dadi Rusdiana, "Design of a Covid-19 Sterilization Room in a Package Using a Spray Nozzle Based on an Atmega328p Microcontroller," *Sunan Kalijaga of Journal Physics*, vol. 1, no. 1, pp. xx-xx, 2022, doi: .

1. INTRODUCTION

On March 12 2020 WHO upgraded the status of COVID-19 to a pandemic. In Indonesia, COVID-19 was first published on March 2 2020 with 2 cases, and continued to increase until December 2 2021, the number of cases was 4.2 million people. Since the official announcement regarding handling and preventing the spread of the COVID 19 virus, various government policies have emerged such as health protocols.

Many efforts have been made to prevent the spread of COVID-19, one of which is by using disinfectant liquid. The effectiveness of using disinfectant liquids is widely used on inanimate objects. According to research, it is said that the use of disinfectant fluids will be effective if the selection and use are in accordance with needs. Disinfectant booths are widely used to prevent the spread of COVID-19. Then spraying disinfectant for shipping packages in the form of goods is still done manually, and some shipping expeditions have not even sprayed the goods.

Previous researchers have studied disinfectants. The Effect of Disinfectants on the Detection of SARS-CoV-2 RNA on Swabs from Various Surfaces was studied by Krasnikova [1]. Sustainable Coproduction of

Two Disinfectants via Balanced Modular Electrochemical Synthesis of Hydroxides Using a Redox Reservoir was researched by Wang [2]. Optimization of disinfectant doses for simultaneous control of lead and disinfection by-products in water distribution networks was researched by Maheshwari [3].

A new class of quaternary ammonium compounds as effective and environmentally friendly disinfectants was researched by Wang [4]. The efficacy of essential oil disinfectants against SARS-CoV-2 microbes was studied by Bailey [5]. Assessment of the ecological hazard and environmental fate of disinfectant quaternary ammonium compounds was investigated by DeLeo [6].

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Evaluation of the Fungicide Effect of Several Commercial Disinfectant and Sterilization Agents Formulated in Soluble Liquids on Tomato Plants Infected with Sclerotium rolfsii was studied by Hussien [17]. Listeria monocytogenes Sublethal Injuries and Viable but Non-Culturable Conditions Caused by Acidic Conditions and Disinfectants were studied by Arvaniti [18]. Are Disinfectants for the Prevention and Control of COVID-19 Safe? researched by Samara [19].

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Application of New Organic Acid Compound Disinfectants against Common Foodborne Pathogens studied by Folliero [26]. The effect of water-based disinfectants or air drying on changes in dimensions of thermoplastic orthodontic aligners was studied by Bresolato [27]. Regenerative Endodontic Procedures, Disinfectants and Outcomes: A Systematic Review was researched by Kharchi [28].

A New Synergistic Strategy for Eradicating Viruses and Bacteria: Towards a Universal Disinfectant was researched by Leclercq [29]. Antimicrobial Resistance Phenotypes and Genotypes of Salmonella spp. Isolation from Commercial Duck Meat Production in Thailand and Minimal Disinfectant Concentrations were studied by Sinwat [30].

Based on previous research, it is necessary to develop an automatic disinfectant sprayer which aims to make it easier for people/items to be sprayed with disinfectant liquid. This research focuses on spraying disinfectant on shipping goods packages which is expected to help clean the goods.

Based on the background that has been described, it is necessary to develop research regarding disinfectant sprayers, especially for sending goods with automatic sprayers. The real hope of making disinfectant equipment is to suppress and prevent the spread of the Covid-19 virus in shipping packages. Therefore, it is necessary to carry out research entitled "Design of a COVID-19 Sterilization Room for Packages Using a Spray Nozzle Based on an ATmega328P Microcontroller".

2. METHODS

The research method uses descriptive and experimental methods. The stages in the research begin with the research flow diagram in Figure 1.

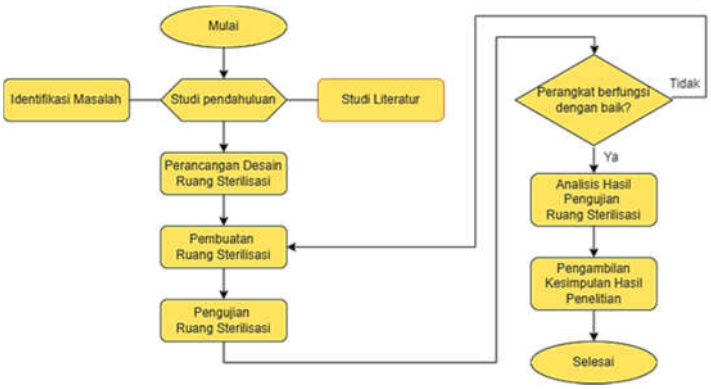

Fig. 1. Research Flowchart

The tools and materials used in this research include distance sensors, power supplies, Arduino Uno, relays, DC pumps, stepper motor drivers, stepper motors, and LEDs.

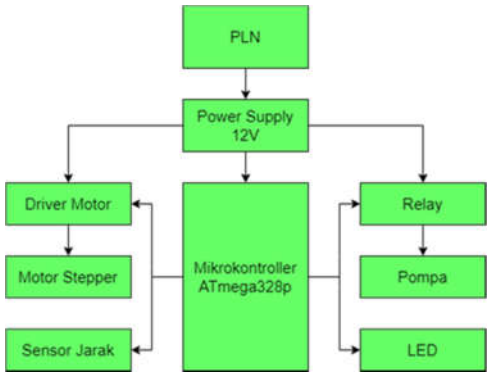

Fig. 2. Sterilization Chamber Block Diagram on Package

Hardware design begins with connecting the power supply to the electricity source. When an object is placed on the device, if the object is detected by ultrasonic waves, the waves are reflected and received by the pin on the sensor. The microcontroller acts as a control center after receiving sensor wave pulses and will regulate the stepper motors, relays and LEDs.

The design continues with program design by creating a flow diagram in the form of programming steps. The programming flow diagram is shown in Figure 3.

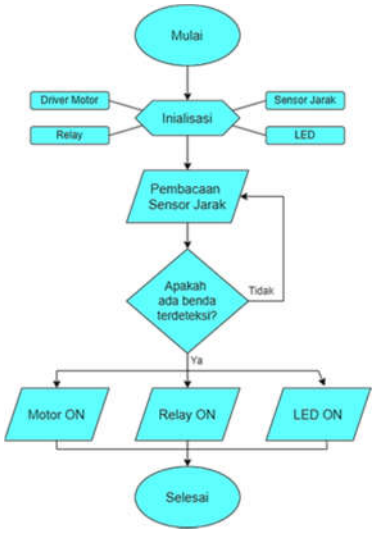

Fig. 3. Program Design Flow Diagram

The program begins with start or begin. Then initialize the motor driver, relay, ultrasonic sensor, and relay. Then the object is read by an ultrasonic sensor. If an object is detected, the motor is on (moves the disc so the box rotates), the relay is on (so the water pump is on so the nozzle sprays water), and the LED is on (as a sign that the process is successful and complete). If no object is detected, the ultrasonic sensor will continue to detect until an object is detected. After designing the circuit and program, the next step is designing the tool design.

3. RESULTS AND DISCUSSION

3.1. Testing Stages

Testing is carried out to find out how it works and the results are in accordance with the plan. Testing is carried out on each part and as a whole. The testing stages in the research include testing the distance sensor and pump, testing the mass of the item and the system as a whole.

3.1.1. Proximity Sensor Testing

Testing via the sensor was carried out three times with a measurement range of between 1 - 20 cm. Testing was carried out using several tools, namely a power supply, HC-SR04 ultrasonic sensor, and Atmega328P microcontroller.

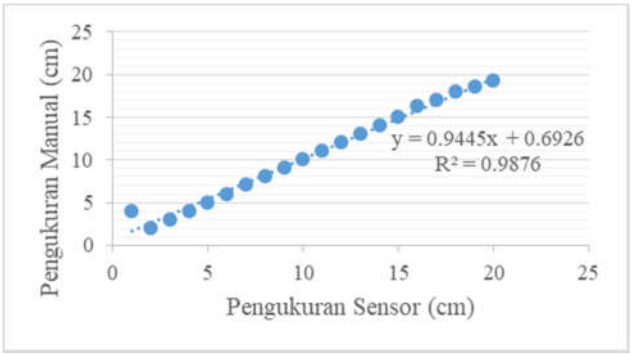

Fig. 4. Comparison of distances measured by ultrasonic sensors in the range 1-20 cm

Based on the graph in Figure 6, the first data for manual measurement is 1 cm, while the measurement using an ultrasonic sensor is 4 cm so that an error of 330% is obtained. This large error is because if the reflective plane is close to the transmitter and receiver there is no room for the ultrasonic sensor to reflects a pulse or signal. This refers to the specifications of the HC-SR04 ultrasonic sensor where the sensor can start detecting properly from a distance of 2 cm. In the second 15th data, the same results were obtained between manual measurements and using an ultrasonic sensor so there were no errors. The 16th data obtained an error

of 1.87%. Data 17 and 18 have no errors. For the 19th data, an error of 1.87% was obtained. And the 20th data error is 3%.

Testing continued with a measurement range of 10 - 440 cm. The following is the test results data in Figure 5.

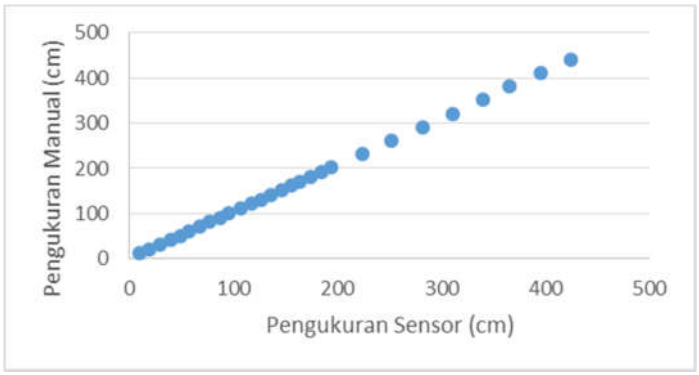

Fig. 5. Comparison of distances measured by ultrasonic sensors and manual measuring instruments with a distance of 10 – 440 cm

3.1.2. Mass Testing of Goods

In this research, the stepper motor is not only an actuator/driver, but also a load holder. Therefore, this test was carried out to determine the maximum load limit on the stepper motor. Based on the results of testing the mass of goods, the minimum mass of goods was obtained as 50 grams and the maximum mass of goods was 2200 grams.

3.1.3. Overall System Testing

Testing of the entire system is carried out to find out the points of error or deficiencies in the system and to find out whether all components are running well or not. The tool made in this research measures 50 x 50 x 50 cm. The objects used in this research were limited to a size of 20 x 20 x 5 cm. The following Figure 6 is the result of the tool created in this research.

(a) Front Look (b) Back View

Fig. 6. Future Results

Based on overall system testing for 10 trials with different object/object sizes, 6 out of 10 tests were successful. The successful/unsuccessful indicator here is based on the package size which is limited to 20 x 20 x 5 cm, corresponding to a detection distance of 1-20 cm from the sensor, and the unsuccessful indicator is where the package size exceeds the size limit. So, for objects whose length exceeds 20 cm, width exceeds 20 cm, and height exceeds 5 cm, the object being tested will not have its entire surface wetted by the disinfectant liquid.

4. CONCLUSION

Based on the research results, it can be concluded: 1) The components used in making the sterilization package are a 220 VAC to 12 VDC 10 ampere power supply, 5V 1 Channel relay, TB6600 stepper motor

driver, 2.5 ampere Sanyo stepper motor, Arduino Uno, HC-SR04 ultrasonic sensor , 4 ampere Sinleader water pump, and LED lights. 2) Based on the measurement results of the HC-SR04 ultrasonic sensor with a distance of 50 cm, the sensor did not experience errors, but when it exceeded a distance of 50 cm, errors began to appear, but the value in the range 61-100 cm had an average error of 2.31%. In testing distances of 100-200 cm, the average error value was 2.50%. In testing distances of 201-300 cm the average error was 2.81%. In testing distances of 301-400 cm the average error was 3.11%. In tests > 400 cm the average error was 3.41%. 3) Based on testing the mass of the goods, the maximum mass of the goods was 2100 grams.

Based on the research that has been carried out, there are several shortcomings that need to be corrected in the development of research that will be carried out by future researchers, including: 1) In this research the stepper motor is used as an actuator/driver and as a load support. Based on item mass test data, the maximum mass is 2100 grams. It is hoped that in future research, the stepper motor will be placed in another part so that the mass of the package can be greater. 2) The size of the sterilization room in this study was 50 x 50 x 50 cm, so the package size was limited to 20 x 20 x 5 cm and the package detection distance was limited to 20 cm. It is hoped that in future research it will be made in a larger size so that the package can be larger.

DECLARATION

Author Contribution

The research method uses descriptive and experimental methods.

Funding

Please add: “This research received no external funding” or “This research was funded by NAME OF FUNDER, grant number XXX” and “The APC was funded by XXX”.

Acknowledgments

In this section, you can acknowledge any support given which is not covered by the author con-tribution or funding sections. This may include administrative and technical support, or donations in kind (e.g., materials used for experiments).

Conflict of Interest

Declare conflicts of interest or state “The authors declare no conflict of interest.”

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