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Design of an Automatic Handwashing Tool Using Infrared Sensor Based on Arduino Nano in Physics Department of Sriwijaya University

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Abstract

The implementation of the New Normal forces people in Indonesia to be able to return to their activities outside the home, alongside the risk of the COVID19 outbreak. One of the health protocols that must be applied is hand washing, so that the use of automatic hand washing devices is very effective in use. The way this automatic hand washing tool works is simply pointing your hand near the sensor, the sensor will detect it. The Automatic Hand Washing Tool is designed using a sensor Infrared, Arduino nano, a module Relay, a water pump and a solenoid faucet. Where is the working principle when thesensor infrared detects an obstacle, it will send an input signal to arduino nano as a microcontroller center which is regulated through a program in the Arduino Ide software, then sends it to themodule relay as answitch on / off, When on it is, themodule relay will activate the solenoid faucet, if it is in thecondition off , the relay will deactivate the solenoid valve, while the pump is used for washing soapy water, where the automatic hand washing tool on water with soapy water is differentiated according to the respective distance that has been set on the arduino nano microcontroller.

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Introduction

Coronaviruses are a group of viruses that can cause diseases in both animals and humans. They can lead to respiratory infections in humans, varying from common colds to more severe conditions like Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS) [1]. The COVID-19 pandemic is caused by a novel coronavirus that was

previously unknown in humans. This virus primarily spreads to other individuals through the air when an infected person coughs or talks [2]. During penyebaran virus korena yang semakin parah maka dilakukan new normal,The "new normal" refers to a change in behavior aimed at continuing regular activities while also adhering to health protocols to prevent the transmission of COVID-19. In simple terms, it means maintaining the habits developed during regional quarantine or Large-Scale Social Restrictions (PSBB). With the new normal, we start engaging in activities outside the home while still following government-regulated health protocols, such as wearing masks when leaving the house, frequently washing hands with soap, maintaining physical distance, and avoiding crowded places to prevent the spread of the coronavirus [3]. One of the important health protocols that must still be followed is handwashing. However, the virus can survive on surfaces for some time. Therefore, using ordinary handwashing tools can be risky. That's why the use of an automatic handwashing device is highly effective because there is no need to touch it [4]. Hand washing is crucial for maintaining health, especially in preventing infectious diseases[5]. Previous research conducted by Muthakin et al. requires a wider place while our automatic hand washing device does not really require a large space, besides that we place the pipe for soap exit above the pipe exit for water so that it is more efficient. In this study, an automatic handwashing machine was created to make hand washing activities easier and to conserve water.

Theory

In order to design and make an automatic hand washing equipment, several parameters must be taken into consideration, including A sensor is equipment used to convert a physical quantity into an electrical quantity so that it can be analyzed with a specific electrical circuit. These sensor output signals can be voltage, current, or charge, which can be further described between amplitude, frequency, phase, or digital code, this set of characteristics is called the output signal format, therefore, sensors have input properties (of any kind) and electrical output properties [6-7]. Infrared sensor is a distance sensor that can measure in the range of 10-80 cm using the reflection of infrared light. By using the triangulation method to calculate the measured distance, this sensor can provide consistent data readings and reduce interference caused by surface reflections, length of work, or ambient temperature [8]. Arduino nano is a microcontroller board based on AT Mega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16MHz crystalline oscillator, USB connection and reset button [9]. To program an Arduino board, we need the built-in Arduino IDE (Integrated Development Environment) application. The Arduino IDE software utilizes the C/C++ programming language[10]. Relays are needed in electronic circuits as executors as well as interfaces between loads and electronic control systems that have different power supply systems [11]. Solenoid valve is one of the faucets designed using a solenoid as its control, this faucet is active when given a minimum voltage of 12 volts with a current of 1.2 Amperes for each faucet. This faucet is only able to be on and off because the solenoid in principle works in two conditions, namely only on and off. Solenoid valve has 2 channels, namely the inlet (inlet port) and the outlet (outlet port) [12-13]. A pump is a tool to move energy from a player or activator to a higher pressure vessel. Besides being able to move liquids, pumps also function to increase the speed, pressure, and height of the liquid [14] pump has a power capability of 10 ft - 20 ft [15].

Experimental Method

There are 3 stages in this research, as follows:

1. System Design Stage

In the system design for automatic hand washing tools using 1 infrared sensor, 1 Arduino nano, 2 channel relay, 2 adapters, 1 selenoid valve, 1 water pump, female to female jumper and male to male jumper as shown in figure 1.

2. Mechanical Design Stage

The mechanical design of this automatic hand washing device is designed by placing the sensor above the water dispenser so that when the hand is placed under the pipe / or water dispensing device, the water and soap can come out. for the sink, a frame with a height of 80 cm,Width 39 cm and Long 49 cm is made, and to protect it using aluminum as shown in Figure 2.

3. Program Design Stage

In this program design begins with making a flowchart first, after that at the next stage, namely starting to write a program listing on the sketch board on the Arduino IDE software. shown in figure 3. Next, the program is compiled and embedded into the microcontroller on the Arduino Nano module.

4. Overall Tool Schematic

The Overall Tool Scheme is a description of all the tools and materials that have been assembled for this project. In this overall tool scheme, the software application Fritzing was utilized to depict all the supporting tools for the Automatic Hand Washing Tool system. These include the Sharp GP2Y0A21YK0F Infrared Sensor, Arduino Nano, 2 Channel Relay, Water Pump, and Solenoid Valve. The circuit scheme of the entire tool is shown in Figure 4.

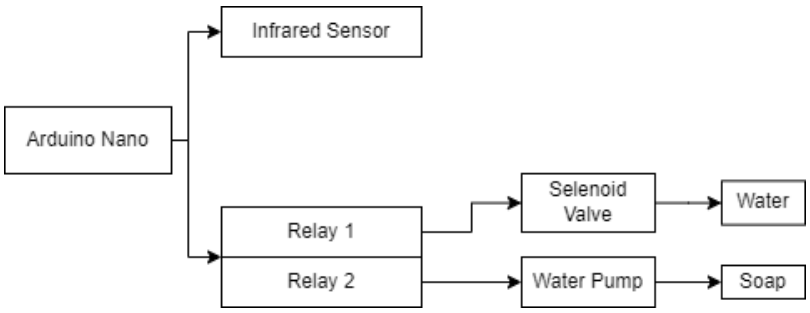

Figure 1. System Design

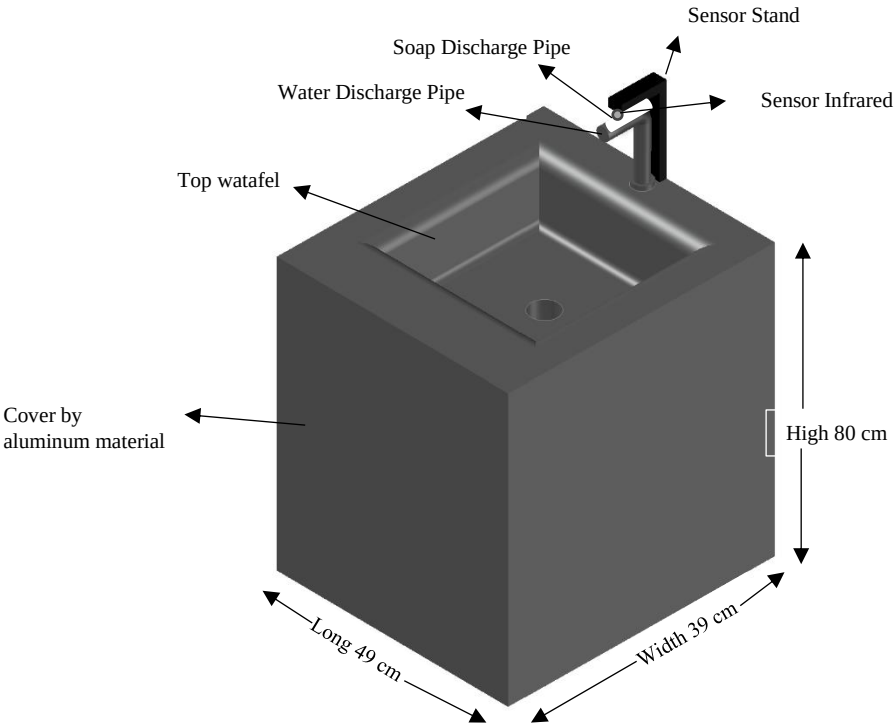

Figure 2. Mechanical Design.

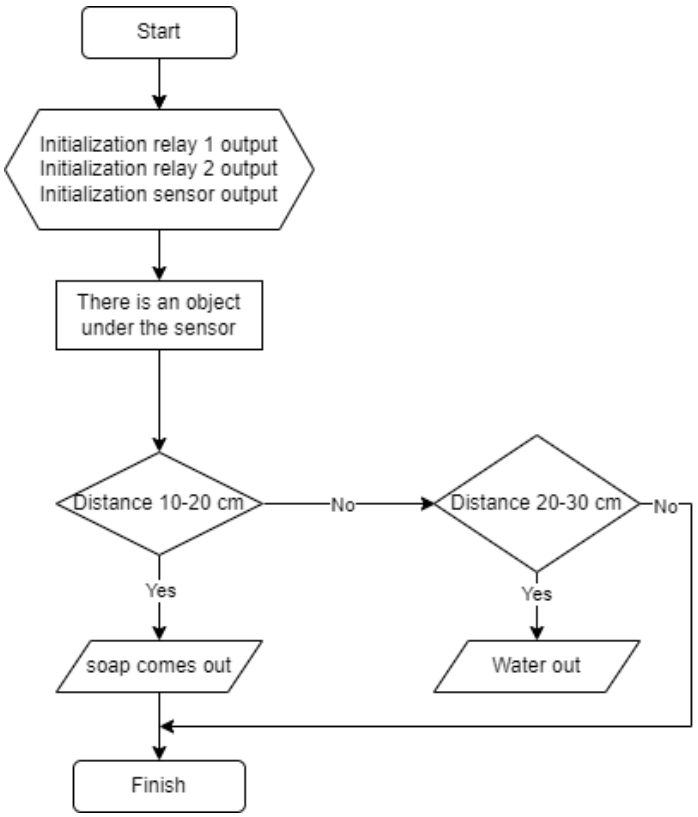

Figure 3. Program Design

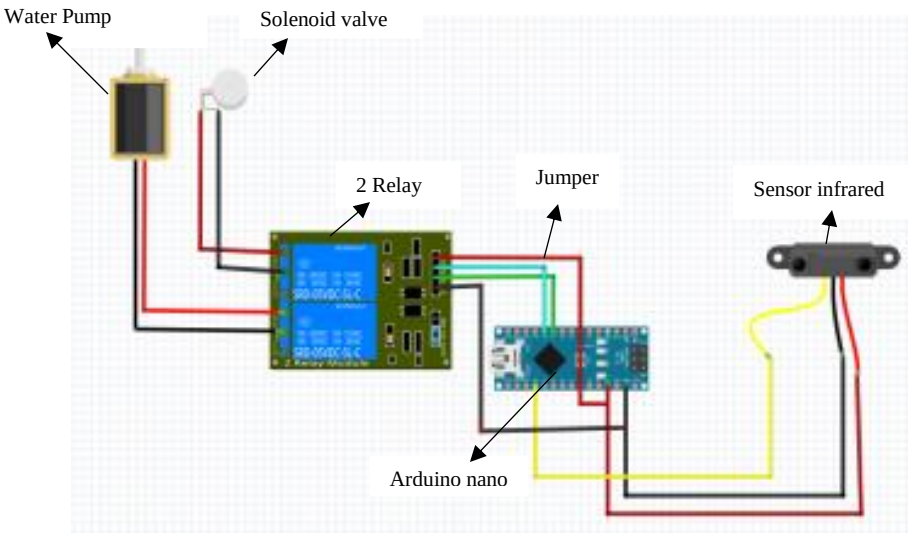

Figure 4. Sketch of the overall tool circuit using fritzing

Result and Discussion

1. Physical form

The physical form of the tool is the appearance of a finished or finished tool in real form. Figure 5 is the physical form of an automatic hand washing tool using an infrared sensor.

Figure 5. Top view and front view physical form results.

2. Sensor Calibration Data

Testing the sensor circuit is done by testing the sensor response, testing is done by bringing an object that has been determined, whether an object can be detected by the sensor properly, or an error occurs. The sensor detects objects with a range of 10 to 80 cm. But in this study only uses a range of 10 to 30 cm only. Sensor testing is done by connecting the sensor to the arduino nano which has compiled the program in the arduino IDE application, after which it is checked

with the serial moditor found in the arduino IDE application. Figure 6 is a picture of the Serial monitor in the arduino IDE program.

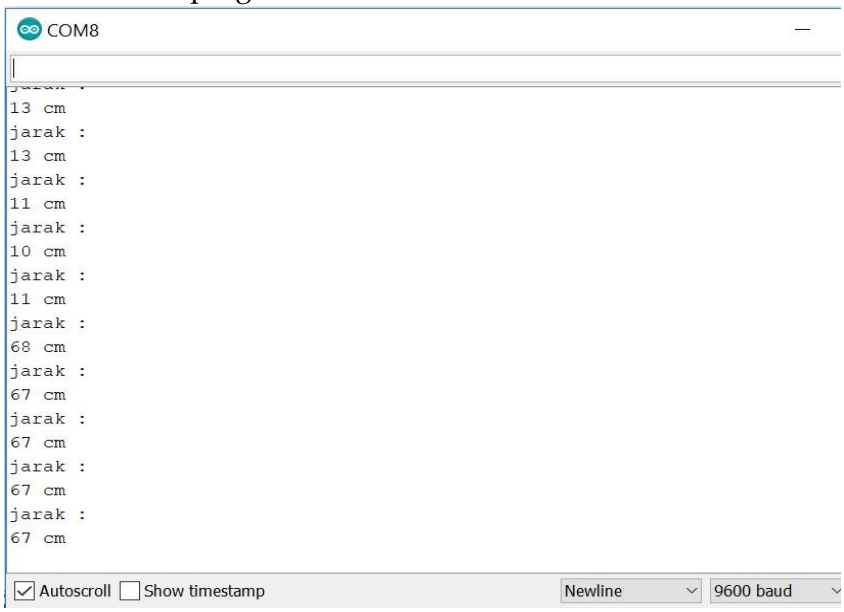

Figure 6. Testing the infrared sensor on the Arduino IDE

3. Water Pump Testing

In automatic hand washing equipment, water pump testing is carried out to determine the ability of the water pump to release soapy water when connected to a water source. Water pump testing is carried out in two stages, carried out without a sensor, to detect whether the water pump is running properly or not, and when the water pump is connected to the sensor testing this condition aims to see whether the water pump and sensor are connected and can run properly or not. As shown in Figure 7

Figure 7. Water pump testing

4. Selenoid Valve Testing

In the automatic hand washing tool, Selenoida Valve testing is carried out to determine the ability of the Selenoida Valve to open and close the water flow automatically, so that the water expenditure is in accordance with the program in the arduino IDE. Selenoid valve testing is carried out in two stages, the first is done without a sensor and the second stage of the Selenoid Valve is connected to the sensor testing this condition aims to see if the Selenoid Valve and sensor are connected and can run properly or not. Figure 8 is a picture of testing the solenoid valve

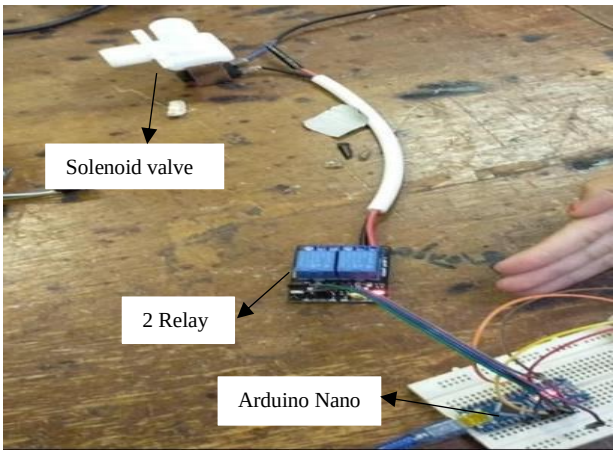

Figure 8. Selenoid Valve Testing

5. Testing the circuit as a whole

After testing each component that is on this automatic handwashing system works well then each component connected and tested, if in accordance with the program on the arduino IDE means the tool automatic hand washing has been successful. When placing your hand under the infrared sensor, it will come out soap at a distance of 10-19 cm and water at 20-25 cm and under 11 and upper 25 no soap and water coming out.

Table 1. Testing Results of Automatic Handwashing Tool.

No	Distance from object to Infrared sensor (cm)	Observation Result (Flowing)
1	0-5	No Water and soap
2	5-10	No Water and soap
3	11-15	Soap
4	15-19	Soap
5	20-25	Water

Conclusion

The individual component tests confirmed the functionality of each part of the automatic handwashing device using an infrared sensor. Integrating and testing the assembled system revealed successful soap dispensing at a distance of 10-19 cm and water dispensing at 20-25 cm from the sensor. This demonstrates the effectiveness of the design in achieving contactless handwashing. In conclusion, this project successfully developed a functional prototype of an automatic handwashing device using an Arduino Nano and infrared sensor. The testing results suggest that the device has potential as a solution to promote hand hygiene and reduce germ transmission through touchless operation. Future advancements could include incorporating a backup power source, an integrated dryer, and higher quality materials to enhance functionality and durability.

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