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Article

Development and Analysis of Automatic Controls of Washer and Hand Dryer Equipment

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Abstract: The results of making and testing hand washing and drying equipment are technological changes and improvements that are useful in everyday life and can even reduce the spread or transmission of viruses. When using hand washing and hand drying equipment, you no longer need to hold/press/squeeze the equipment, you only need to bring your hand closer to the equipment, you can clean your hands in a short time and it is also more practical.

Keywords: Automatic hand wash; automatic hand dryer; antiseptic; microcontroller

1. Introduction

Specifically for handwashing related to simple dining places and other public places, handwashing is very necessary and it is recommended to use soap or antiseptic liquid. However, public handwashing stations still require hand contact to turn the faucet on and off. As a result, there is a possibility of viruses spreading through touch[2]. Handwashing devices that use sensors and mechanisms should be created so that they do not need to be touched to solve this problem[3]. Therefore, the purpose of our thesis proposal is the creation and analysis of an automatic control system for handwashing and hand-drying equipment that does not require touch during use [4].

The method used involves assembling electronic components and other equipment used to create automatic control for handwashing and hand-drying devices[5]. The data to be measured includes: (a) the speed of the liquid flow, (b) the duration of the liquid flow, (c) whether any components heat up during assembly, (d) similarly for the hand dryer, the temperature during hand drying, (e) the time taken for the automatic control of the hand washing and hand drying equipment to activate when hands are brought close [6]. So the expected outcome is that the development and analysis of the automatic control of handwashing and hand-drying equipment can be beneficial, thus, Insha Allah, it can help in the implementation of health protocols recommended by the government[7].

By washing hands, it can reduce the infection of pathogens from feces and other infectious materials, thereby reducing the risk of respiratory infections[8]. One of the first ways to prevent COVID-19 infection is by washing hands with soap or water as often as possible, for at least twenty seconds[9]. In addition to using soap, using antiseptic liquid is a chemical that has the ability to prevent the growth of microorganisms on the surface of the body and can eliminate or inhibit the growth and activity of these microorganisms, as well as affect their metabolism. [10].

Water and soap are an important combination for removing bacteria. Bacteria that adhere to the skin are mostly in the form of a thin oily layer. This oily layer can be removed

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through washing. Meanwhile, antiseptic liquids contain alcohol as their main component[11]. Alcohol has a rapid and effective bactericidal effect against various types of bacteria, including gram-positive and gram-negative vegetative bacteria, MRSA, M.tuberculosis, several types of fungi, and non-enveloped viruses[12]. Alcohol works by altering the protein structure and destroying the bacterial cytoplasmic membrane[13]. In the creation of automatic hand wash and hand dryer control equipment, the designs are combined, which means a combination of hand wash and hand dryer that can be used automatically without us touching/pressing the equipment. so far there has been none, and it is equipped with quite a unique feature, namely when the fingers are brought close to the handwashing equipment, the antiseptic liquid will automatically come out, and when the fingers are brought close to the dryer on the device, it will emit air that functions to dry the hands[16].

The creation of automatic handwashing and hand-drying equipment functions to wash and dry hands automatically, thereby making it easier for users to wash and dry their hands without the hassle of using manual media that require touching. Additionally, the automatic handwashing and hand-drying equipment aims to break the transmission chain of COVID-19, which can spread through touch.

2. Materials and Methods

The variables used are electronic components and other equipment used in the manufacture of handwashing and hand-drying devices. The variables of the handwashing and hand dryer equipment circuits are combined so that both function well. The flowchart is shown below:



Figure 1. Flow Chart Research

Determining the specifications of the materials used before assembly aims to ensure that the tool made aligns with the plan and that the tool operates effectively and efficiently.

The specifications are as follows:

¬ The Arduino Nano used Arduino Nano V3.0 ATmega328P
¬ The power supply used Power Supply 5 Volt 3 Ampere
¬ The water pump used DC Water Pump 5 Volt 4 Watt
¬ Relay Module used Relay Module 4 Channel 250 VAC 30 VDC 10 Ampere
¬ The sensor used HC-SR04 Ultrasonic Sensor

In the process of designing this handwashing and hand-drying device, it is divided into two processes: software design and hardware design.

3. Results

The operation of the automatic hand wash and hand dryer control system based on Arduino involves using an ultrasonic sensor connected to an Arduino Nano as the central controller of the system. The Arduino is then connected to a pump to draw antiseptic liquid out of the container, and the Arduino is also connected to the drying equipment. Once all the devices are connected, users can simply place their hands near the ultrasonic sensor. When the ultrasonic sensor detects hands at a certain distance as input, it sends a signal to the Arduino Uno microcontroller, which processes the signal to control the pump and drying equipment. The pump dispenses the antiseptic liquid, allowing users to use the equipment without touching it. For the system operation of the automatic hand wash and hand dryer control equipment, it can be seen in the image below:

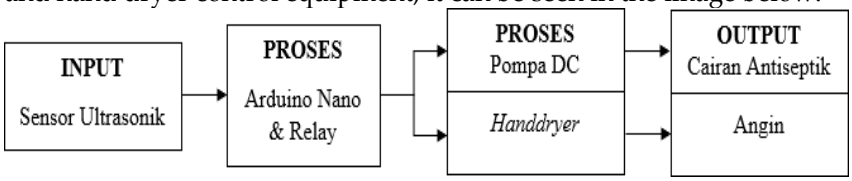


Figure 2. System Block Diagram

In the block diagram shown in Figure 4.1, it consists of 3 parts: input, process, and output:

1. The Ultrasonic Sensor is a device that functions as a motion detector.
2. The Arduino Nano functions as the system controller that transfers data from the sensor to the pump for the antiseptic liquid and the hand dryer.
3. The antiseptic liquid pump functions to dispense antiseptic liquid into the container.
4. The antiseptic liquid and air emitted by the hand dryer are the final outputs that serve to wash and dry hands.

3.2 Method of Preparation

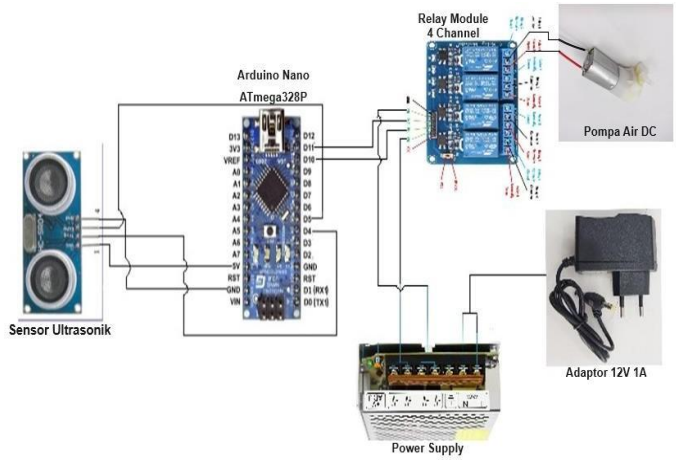


Figure 3. Handwashing Equipment Circuit

In the image above is a depiction of the circuit in the handwashing equipment, here is the explanation of the circuit according to the image above:

1. The Trig pin on the ultrasonic sensor is connected to pin D4 on the Arduino.
2. The Echo pin on the ultrasonic sensor is connected to pin D5 on the Arduino.
3. then the VCC of the Ultrasonic Sensor Connected to the 5V Arduino
4. The GND (Ground) of the Ultrasonic Sensor is connected to the GND (ground) of the Arduino for processing.
5. then the D10 pin on the Arduino is connected to the IN2 jumper input pin on the Relay Module
6. Pin D11 on the Arduino is connected to the input jumper pin IN3 on the Relay Module as the output of the system.

7. Then the + current of the DC water pump is connected to Normally Open relay 1.
8. The negative current of the DC water pump is connected to the common of relay 1.
9. For the electrical current, the + current from the power supply is connected to Input Jumper IN4 on the relay module.
10. For the negative current on the power supply, it is connected to the Input jumper IN1 on the relay module.
11. Then the AC IN on the power supply is connected to the 12V 1A adapter to be connected to the power source.

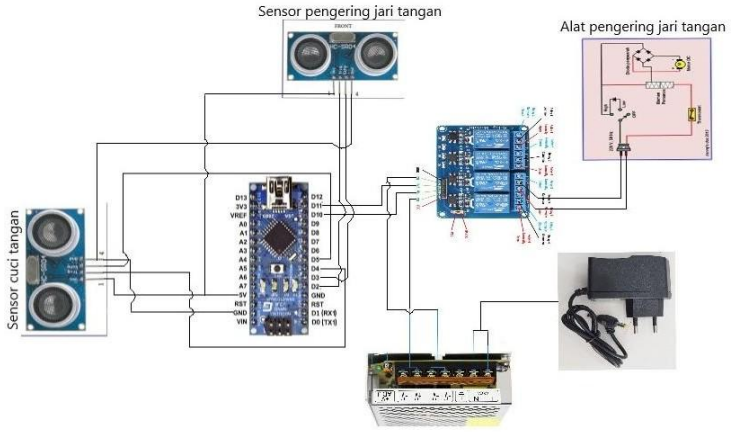


Figure 5. Hand Dryer Equipment Circuit

The following is an explanation of the hand dryer circuit according to the diagram above the hand dryer circuit:

1. The VCC pin of the hand dryer sensor is jumpered to the VCC pin of the hand wash sensor.
2. For the ground pin on the hand dryer sensor, jumper it to the ground pin on the hand wash sensor.
3. Then, the trig pin of the hand dryer sensor is connected to pin D2 of the Arduino.
4. Then, the echo pin of the hand dryer sensor is connected to pin D3 of the Arduino.
5. Then, the + on the hair dryer is connected to terminal channel 3 on the Relay Module.
6. The – on the hair dryer is connected to terminal channel 4 on the Relay Module.

3.3 How the Equipment Works

Explanation of how the automatic hand wash and hand dryer control equipment works is as follows:

1. The automatic control equipment that has been powered on then activates and starts initializing the ultrasonic sensor.
2. When our hand approaches the sensor, the ultrasonic sensor will measure the distance to the detected object and then send a signal to the Arduino. If there are no objects approaching the automatic control equipment sensor, then the sensor will not send a signal to the Arduino.
3. When an object, such as our hand, is detected, the ultrasonic sensor sends a signal to the Arduino, which then sends a command to the relay module to activate.
4. If the relay module is not active or not working, you can check the Arduino Nano coding process by adjusting the distance between the hand and the ultrasonic sensor.
5. The activated relay module then drives the pump, allowing the pump to dispense antiseptic liquid through the hose, and the hair dryer can operate to blow air.

3.4 Analysis of handwashing equipment results

After the assembly process of the handwashing and hand-drying equipment, the components function normally and do not generate heat or show signs of short-circuiting. For the testing data of the handwashing equipment on the speed of antiseptic fluid output, and the distance between the hand and the sensor until the antiseptic fluid comes out, see Table 1.

Table 1. Handwashing Equipment Data

Bentuk Cairan	Waktu Keluar (detik)	Jarak antara Jari-jari dengan Alat (cm)
Cair	3,0	7,5
	2,5	6,7
	2,0	5,0
Rata-rata	2,5	6,4
Gel	5,8	7,5
	4,0	
	3,4	6,5
Rata-rata	4,4	6,3

The data in Table 1 shows that the time for handwashing equipment to dispense liquid antiseptic is faster than that for gel antiseptic. For liquid antiseptic, it takes an average of 2.5 seconds to dispense, while for gel antiseptic, it takes a bit longer, averaging 4.4 seconds to dispense. This happens because the density of liquid is lighter than that of gel, so when the sensor on the handwashing equipment detects hand movement, the lighter density, which is the liquid antiseptic, will come out faster.

3.5 Analysis of hand dryer equipment results

On the hand dryer equipment, the components function normally and do not generate heat or show signs of a short circuit. For the testing data on the speed test when the hand is brought close to the hand dryer sensor, and the temperature of the hand dryer equipment, it is displayed in Table 2.

Table 2. Data on Hand Dryer Equipment

Saat Tangan Didekatkan ke Peralatan Pengering	Waktu Udara Keluar (detik)	Jarak (cm)	Temperatur (°C)
	2,4	7,4	39,8
	2,1	6,0	38,0
	1,9	5,1	37,1
Rata-rata	2,13	6,1	38,3

The data shown in Table 2 indicates the average air temperature that comes out when hands are brought close to the hand dryer for 2.13 seconds, with an average distance of 6.1 cm and a heat temperature of 38.3°C. The speed of the hot air output indicates that the hand dryer system using an ultrasonic sensor and fan rotation is functioning well.

4. Discussion

3.6 Care Instructions

Handwashing and hand-drying equipment do not require high maintenance. Just clean the channel where the antiseptic liquid is dispensed regularly, at least once a month for liquid antiseptic use. If using gel antiseptic, it is recommended to clean it every two weeks because gel antiseptics dry faster, which can quickly clog the hose or valve. Additionally, if the equipment has not been used for a long time or has been idle for a

while, the outlet channel for the antiseptic liquid should be cleaned first. Because the antiseptic liquid will clog in several areas that need to be cleaned quickly, especially in the hose where the antiseptic liquid is dispensed. Although the cleaning of the hose is done manually, the process is quite simple and only takes a few minutes, namely:

1. Clean the tip of the liquid outlet valve by inserting a needle or toothpick into the valve tip to remove or clean any dried antiseptic residue.
2. Fill the antiseptic liquid container inside the device with alcohol, then bring your hands close to the handwashing sensor so that the alcohol can flow through the hose and valve to rinse off the dried antiseptic residue.
3. If the alcohol flows out smoothly, it means there are no more remnants of the antiseptic liquid, so the antiseptic container can be refilled with antiseptic liquid for reuse.

For hand dryer equipment, no special maintenance is actually required as long as it functions normally and no components are damaged, so the equipment can be used continuously. Maintenance might only involve cleaning off the dust on the hand dryer equipment, as it can interfere with the performance of the fan inside the hand dryer.

5. Conclusion

How to make handwashing and hand dryer equipment ¬ The circuit on the hand washer: from the VCC pin on the ultrasonic sensor connected to the +5V pin on the Arduino Nano, then the ground pin of the sensor connected to the ground pin of the Arduino Nano. Next, the trig pin of the sensor is connected to pin D4 (Digital IO pin 4) of the Arduino Nano, and the echo pin of the sensor is connected to pin D5 (Digital IO pin 5) of the Arduino Nano. Then, from pin D10 (Digital IO pin 10) of the Arduino Nano, it is connected to Input Jumper IN2 on the Relay Module, and from pin D11 (Digital IO pin 11) of the Arduino Nano, it is connected to Input Jumper IN3 on the Relay Module. Then, for the electrical current, the + current from the power supply is connected to Input Jumper IN4 on the relay module, the - current from the power supply is connected to Input Jumper IN1 on the relay module, and the AC IN on the power supply is connected to a 12V 1A adapter to be connected to the power source. ¬ For the hand dryer circuit: from the VCC pin of the hand dryer sensor, jumper to the VCC pin of the hand washing sensor, then from the ground pin of the hand dryer sensor, jumper to the ground pin of the hand washing sensor. Next, from the trig pin of the hand dryer sensor, connect to pin D2 (Digital IO pin 2) of the Arduino Nano, and from the echo pin of the hand dryer sensor, connect to pin D3 (Digital IO pin 3) of the Arduino Nano. Then, the + of the hair dryer is connected to terminal channel 3 on the Relay Module, and the – of the hair dryer is connected to terminal channel 4 on the Relay Module.

How the hand washing and hand drying equipment works

The automatic control equipment that has received power supply then activates and starts initializing the ultrasonic sensor.

Automatic control equipment that has been supplied with power then activates and starts initializing the ultrasonic sensor. • When our hand approaches the sensor, the ultrasonic sensor will measure the distance to the detected object and send a signal to the Arduino. When our hand approaches the sensor, the ultrasonic sensor will measure the distance to the detected object and then send a signal to the Arduino. If there are no objects approaching the automatic control equipment sensor, then the sensor will not send a signal to the Arduino.

When an object, namely our hand, is detected, the ultrasonic sensor sends a signal to the Arduino, which then sends a command to the relay module to activate.

If the relay module is not active or not working, you can check the Arduino Nano coding process by adjusting the distance between the hand and the ultrasonic sensor.

The activated relay module then drives the pump, allowing the pump to flow antiseptic liquid through the hose, and the hair dryer can operate to blow air.

How to maintain handwashing and hand dryer equipment

Clean the tip of the liquid outlet valve by inserting a needle or toothpick into the tip of the valve to remove or clean any dried antiseptic residue.

Fill the antiseptic liquid container inside the device with alcohol, then bring your hands close to the handwashing sensor so that the alcohol can flow through the hose and valve to rinse off the dried antiseptic residue.

If the alcohol flows out smoothly, it means there are no more remnants of the antiseptic liquid, so the antiseptic container can be refilled with antiseptic liquid for reuse.

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