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Training on the Design of an Automatic Faucet Water System Using Arduino for Youth in Giri Mekar Village

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ABSTRACT

Nowadays, water faucets play an important role in controlling water flow. Besides that, faucets are generally moved manually by every human activity by turning or moving the faucet up or down. This manual faucet system has weaknesses, namely water wastage and easily damaged faucets. The use of automatic faucets in public facilities can minimize waste their use because generally people often forget to close the faucet again. Besides, using Arduino-based automatic water faucets can reduce the transmission of Covid 19 for the community, especially during the current pandemic. This activity aims to design Arduino-based automatic water faucets at public facilities to reduce the spread and transmission of COVID-19, especially in the Girimekar Village area, Bandung Regency. The target of this activity is youth and cadets in the area. The implementation of the Arduino-Based Automatic Water Faucet design in training resulted in a prototype unit of Arduino-based automatic water faucet using the ultrasonic sensor HC-SR04 as detection and use of an electric solenoid valve as a form of direct water control.

Keywords: *Automated faucet Arduino, Girimekar Village, Youth*

INTRODUCTION

Currently, there is a Covid-19 pandemic. The Covid-19 pandemic can occur because of the high-speed transmission of Covid-19. Covid-19 was first discovered in Wuhan, China, on December 31, 2019 (Yuliana, 2020). Transmission of Covid-19 through droplets or splashes of coughing/sneezing (Susilo et al., 2020). In addition, the spread of the coronavirus can be indirect. The spread is through objects that are contaminated with the virus due to splashes or touching hands that are contaminated with the virus. At the end of January 2020, WHO declared a Global Emergency status for this Coronavirus case, and on February 11, 2020, WHO named it COVID-19 (Handayani, Hadi, Isbaniah, Burhan, & Agustin, 2020). Therefore, the Indonesian government has ordered all provincial governments to analyze the number of citizens affected by Covid-19.

One of the provinces in Indonesia that are actively reporting the results of tracing the

spread of Covid-19 is the West Java Provincial Government. The West Java Provincial Government has the largest population in Indonesia, so the Provincial Government recommends that each region create a website for tracking the spread of Covid-19. Based on the release of the Covid-19 zoning map issued by the West Java Provincial Government as of October 7, 2020, Bandung Regency is included in the orange zone. In the October 2020 period, the daily positive cases of covid 19 in Bandung regency were still around 50 people. The highest period of daily positives occurred in June 2021, with almost 600 people.

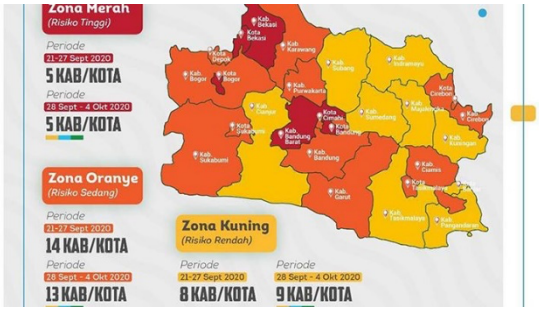


Figure 1. West Java Provincial Government Covid-19 Zoning Map

In preventing the spread of COVID-19, there are also several methods, one of which has been recommended by the government by washing hands after touching. But the method of hand washing in crowds has been carried out in many ways, which is one way of spreading the virus because individuals still touch the faucet and soap using their hands alternately. Prevention like this is wrong prevention.

From this, the research team through the Community Service Program aims to reduce mistakes in handwashing places where people still carry out activities, one of which is traditional markets. The Community Service will be carried out to make an Arduino-Based Automatic Water Faucet. Thus, human hands no longer touch the faucet alternately. Hopefully, with th, ion of various parties can improve the prevention of the spread of Covid-19.

Several studies have been done before related to system design, such as Automatically filling water in the bath with this infrared sensor that works according to the volume of water in the bath, then research on water filtering machines that can change poor quality water into decent water. Consumed directly without having to cook it first. Gangan uses a sensor that is connected to a microcontroller. This sensor has two functions, the first function is to detect water reservoirs, while the second function is to detect full water (Malluka & Surjati, 2015).

Furthermore, there is a water temperature measuring device and automatic filling of water tanks via a microcontroller-based short message service. The water sensor used is a resistive sensor which is placed at the lower limit and water limit. The output from the sensor is in the form of voltage and is processed by the microcontroller to produce output logic for the system (Hasan, Hasbullah, & Ardianysah, 2021; Pramudita & Ardiansyah, 2021; Syamsuddin, 2007).

In this study, several approaches were carried out in researching to produce an Arduino-based automatic water faucet that could be given training to the community in reducing the transmission of covid 19.

THEORETICAL FOUNDATION

1. Arduino

Arduino is an open-source physical computing platform where Arduino has simple

input/output (I/O) that can be controlled using a programming language. Arduino can be connected to devices such as computers. The programming language used on Arduino is the C programming language which has been simplified with features in the library so that it is quite helpful in making programs (Pramudita & Ardiansyah, 2021; Shaputra, 2019).

(a)

(b)

(c)

Figure 1. (a) Arduino Uno (b) Relay (c) Sensor Ultrasonic HC-SR04

Arduino IDE is software used to create, write, modify, and upload Arduino program code. While the hardware is in the form of a board. There are many variations of Arduino hardware, including Arduino Uno R3, Arduino Mega, Arduino nano, Arduino Bluetooth, Arduino Lilypad, and so on (Pramudita & Ardiansyah, 2021; Shaputra, 2019).

2. Relay

Relay is a switch (switch) that is operated electrically and is an electromechanical component consisting of 2 main parts, namely electromagnet (coil) and mechanical (a set of switch contacts or switches). Relays use electromagnetic principles to move the switch contacts to conduct higher voltage electricity with a small electric current (low power). Relays that use 5V and 50 mA electromagnets can move the armature relay (which functions as a switch) to conduct 220V 2A electricity (Arifin, 2015; Astari, Pramana, & Nusyirwan, 2013).

3. Sensor Ultrasonic HC-SR04

The ultrasonic sensor HC-SR04 is a sensor that works based on the principle of sound wave reflection and is used to detect the presence of a certain object in front of it. Its working frequency is above sound waves from 40 kHz to 400 kHz. The ultrasonic sensor HC-SR04 consists of two units, namely a transmitting unit and a receiving unit. The structure of the transmitter and receiver unit is a piezoelectric crystal connected by a mechanical anchor and connected by a vibrating diaphragm. An alternating voltage having a working frequency of 40 kHz – 400 kHz is applied to a metal plate. The atomic structure of the piezoelectric crystal will contract (bind), expand, or shrink against the polarity of the applied voltage, which is called the piezoelectric effect. The contractions that occur are transmitted to the vibrating diaphragm

so that ultrasonic waves are emitted into the air (the surrounding area). The reflection of ultrasonic waves will occur when there is a certain object and the reflection of ultrasonic waves will be received back by the receiving sensor unit. Furthermore, the receiving sensor unit will cause the vibrating diaphragm, and the piezoelectric effect produces an alternating voltage with the same frequency (Rosyidi, 2021; Suhardi, 2019).

The ultrasonic wave reflection can be used to measure the distance between the sensor and the object which can ideally be calculated by the following formula:

$$\frac{d[F_1]}{d\omega_2} = SAm_2 \cos\omega, \ \frac{d[F_1]}{d\omega_3} = SAm_2 \cos\omega \quad 1)$$

$$\frac{d[F_1]}{d\omega_2} = SAm_2 \cos\omega, \ \frac{d[F_1]}{d\omega_3} = SAm_2 \cos\omega \quad 2)$$

Where :

s = distance of the object with sensor (m)

t = travel time or pulse width (seconds)

v = speed of sound in air which is 340 m/secon (1 cm every 29,034 µS)

To determine the distance on the microcontroller, the microcontroller measures the pulse width or travel time and converts it in the form of distance with the following equation:

$$\frac{d[F_1]}{d\omega_2} = SAm_2 \cos\omega, \ \frac{d[F_1]}{d\omega_3} = SAm_2 \cos\omega \quad 3)$$

Where :

Distance: the distance between the object and the sensor

Pulse width: travel time (seconds)

29,034: 1 cm every 29,034 µS

4. Power Supply

The power supply is electronic hardware that supplies electric current by changing the voltage from AC to DC. So the PLN electric current, which is Alternating Current (AC), enters the power supply, is converted into Direct Current (DC), and then flows to other components that need it.

The power Supply has four main parts to produce a stable DC. The four main sections include:

a. The transformer used for power supply is a step-down type transformer that functions to lower the voltage according to the needs of the electronic components contained in the circuit. The transformer works based on the principle of electromagnetic induction, which consists of 2 main parts in the form of a winding, namely the primary winding and the secondary winding. The primary winding is the transformer's input, while the output is the secondary winding.
b. Rectifier or wave rectifier is an electronic circuit in the power supply that converts AC waves into DC waves after a step-down transformer lowers the voltage.
c. Filter In the power supply circuit, the filter is used to even out the current signal coming out of the rectifier. This filter usually consists of a capacitor component.
d. Voltage regulator To produce a steady and stable DC voltage and current, a voltage regulator is needed to regulate the voltage so that the output voltage is not affected by temperature, load current, and also the input voltage from the output filter. Voltage regulators generally consist of a

Zener diode, transistor, or IC (integrated circuit) [13], [14].

5. Solenoid Valve

A solenoid or electric valve is a valve controlled by an electric current, either AC or DC through a coil or solenoid. Solenoid valves are often used to control fluid systems such as pneumatic systems, hydraulic systems, or in machine control systems that require automatic control elements. For example, in a pneumatic system, a solenoid valve controls the pressurized air line to the pneumatic actuator (cylinder). In a water reservoir, a solenoid valve is used as a water-filling regulator so the reservoir does not become empty. In this design, the solenoid valve is used to open and close the water faucet. When the ultrasonic sensor detects an object, the solenoid valve will open. And if the ultrasonic sensor does not detect the object, the solenoid valve will be closed (Hantrakul, Pramokchon, Khoenkaw, Tantitharanukul, & Osathanunkul, 2017).

6. Module MP1584

The MP1584 is a DC-DC step-down module that uses the MP1584EN chip as its main component. MP1584 is able to drive loads with currents up to 3 A, besides that, it can change the input voltage of 4.5 – 28 V to a lower voltage that can be regulated as desired between 0.8 - 20 V. So it is very efficient in applications that require a power converter (Anggraini, Aisah, & Rasyid, 2021).

(a)

(b)

Figure 2. (a) Selenoid Valve (b) Module MP1584

METHODS

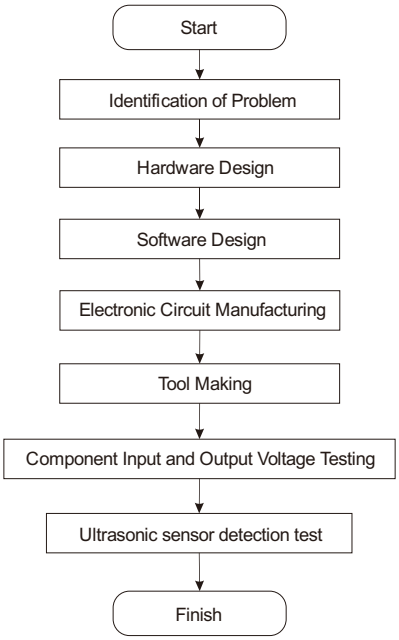
In carrying out the system design, several stages are carried out in order to facilitate the process of designing an Arduino-based Automatic Water Faucet. In contrast, the system design is shown in Figure 2.

The design begins by identifying the problems contained in several reference sources. Then in the design of the system, the hardware that will be used is determined so that there is compatibility between the components used. At the design stage, the software uses Arduino IDE application software to create, write, modify, and upload the Arduino program code.

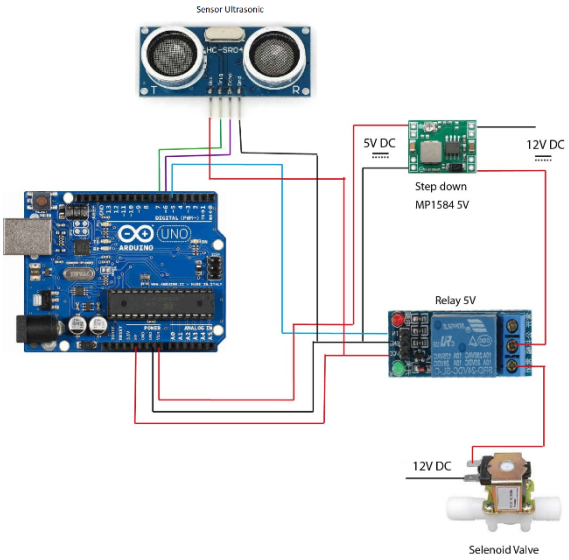
At the design stage of the tool, a mechanical design made of iron is created and designed to place each component of the automatic water faucet in the design framework.

At the tool testing stage, input and output voltage tests are carried out on each component. This is to ensure that each connected component is in accordance with each terminal that must be connected to other components.

In the next stage, testing is carried out on the sensor to see the results of ultrasonic sensor detection against real conditions that must detect the presence of the detection object.



(a)



(b)

Figure 2. (a) Flow Chart (b) Arduino-Based Automatic Water Faucet Wiring Diagram.

RESULT AND DISCUSSION

The application of Arduino-based automatic water faucets has significant benefits in reducing the transmission of covid 19, where the results of tests carried out on Arduino-based automatic faucets can perform optimally, as seen from the results of sensor detection carried out on test objects with distances ranging from 5-20 cm can detect objects. In a scenario where the detection distance is vulnerable, the water faucet will automatically work for 120 minutes.

The working condition of the circuit is that the power used in the automatic water faucet device is a voltage of 220 VAC and then converted to a voltage value of 12 VDC. Then used this DC/DC step-down voltage converter based on the MP1584, which converts the 12V input voltage into a smaller voltage between 5V, capable of driving 3A loads with excellent line and load regulation. Then the Ultrasonic Sensor will detect the movement of the hand

approaching the sensor, with a predetermined setpoint of 5-20 cm. Data from the sensor will be processed using Arduino Uno, with power from the 12V adapter lowered to 5V. If the motion is detected, the Arduino will send a signal to turn on the relay so that the water on the solenoid valve will flow.

Tests carried out on the ultrasonic sensor are set at 5 cm with a High state to open the water faucet and > 5 produces a LOW state to close the water faucet (Suhardi, 2019). In the results of testing the distance to the ultrasonic sensor with a vulnerable distance of 3-30 cm, an error value of 0% is obtained with the conclusion of good results (Arsada, 2017).

In the programming that limits the sensor detection to the detection object, this is done to prevent the solenoid from opening automatically if there are objects that just pass by without having the plan to turn on the automatic water faucet.

```
const int TRIG_PIN  = 7; // Arduino pin connected to Ultrasonic Sensor's TRIG pin
const int ECHO_PIN  = 6; // Arduino pin connected to Ultrasonic Sensor's ECHO pin
const int RELAY_PIN = 3; // Arduino pin connected to Relay's pin
const int DISTANCE_THRESHOLD = 50; // centimeters

// variables will change:
float duration_us, distance_cm;

void setup() {
  Serial.begin (9600);       // initialize serial port
  pinMode(TRIG_PIN, OUTPUT);  // set arduino pin to output mode
  pinMode(ECHO_PIN, INPUT);   // set arduino pin to input mode
  pinMode(RELAY_PIN, OUTPUT); // set arduino pin to output mode
}

void loop() {
  // generate 10-microsecond pulse to TRIG pin
  digitalWrite(TRIG_PIN, HIGH);
  delayMicroseconds(10);
  digitalWrite(TRIG_PIN, LOW);

  // measure duration of pulse from ECHO pin
  duration_us = pulseIn(ECHO_PIN, HIGH);
  // calculate the distance
  distance_cm = 0.017 * duration_us;

  if(distance_cm < DISTANCE_THRESHOLD)
    digitalWrite(RELAY_PIN, HIGH); // turn on Relay
  else
    digitalWrite(RELAY_PIN, LOW);  // turn off Relay
```

Figure 3. Arduino Programming

Figure 3 shows the programming done on Arduino with the Arduino IDE application software. The setting variable used is related to the duration of the on-system (t) and the distance from the sensor to the object (cm).

Table 1 shows the results of tests carried out by conducting ten experiments on the tools that have been made and the results of the implementation carried out in Community Service activities. This tool automatically has effectiveness in water use, especially in the absence of direct touch to the tool to be used. Turned on so that this automatic water faucet can prevent the spread of covid 19 without direct human contact with the tool. The use of this tool shows where the difference between the use of conventional water faucets and automatic water faucets is combined with additional Arduino technology as an effort to develop the use of technology in the health sector.

Table 1. Ultrasonic Sensor Testing HC-SR04

Test	System power on time (t)	Sensor distance with the object (cm)
Trial 1	120 Second	5
Trial 2	120 Second	6
Trial 3	120 Second	7
Trial 4	120 Second	8
Trial 5	120 Second	9
Trial 6	120 Second	10
Trial 7	120 Second	11
Trial 8	120 Second	12
Trial 9	120 Second	13
Trial 10	120 Second	14
Trial 11	0	21

In the manufacture of automatic water faucets that can be done based on MQTT, which proposes a setting to perform a faucet shutdown time that is directly applied through a web application with a delay of 0.3 seconds. With a benchmark that refers to water savings and user satisfaction in using automatic water faucets. This is done to save more water and meet user satisfaction (Hantrakul et al., 2017). If no time

delay is applied, usually the user has not finished cleaning his hands and then turns on the water faucet again which results in the hand cleaning process being twice as long as it should be.

CONCLUSIONS AND SUGGESTIONS

Conclusion

The discussion results concluded that using automatic water faucets with the help of Arduino-based technology could reduce efforts in preventing covid 19. In the absence of direct touch on this tool, it can have a significant impact on preventing covid 19.

Judging from the tool design system made, Arduino-based automatic water faucets can perform solenoid open-close performance according to the settings made in the program, with the use of the HC-SR04 ultrasonic sensor as a detection tool capable of performing optimal performance in detecting objects.

Suggestion

With this research, it is expected that in the future, automatic water faucets can be developed which can be added to an integrated IoT-based system to simultaneously measure the volume of use in washing hands from each user's habits so that it can accurately take the time of opening the water faucet needed in hand cleaning activities.

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