Touchless Electronic Device Control Design

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Abstract— Transmission of COVID-19 occurs between humans through droplets or splashes of body fluids containing SARS-CoV-2 particles. If a COVID-19 patient does not cover his mouth and nose when coughing or sneezing, the patient will emit droplets containing the virus. Droplets can stick to the patient's hands and surrounding items. Anyone can get the virus when shaking hands or touching items that have the virus and contracting the virus if they touch their eyes, nose, or mouth without washing their hands first. In public places such as schools, offices, and hospitals, many pieces of equipment are controlled using the help/touch of a hand. The use of equipment in public places by many vulnerable people is the cause of the rapid spread of infectious diseases. The research that will be carried out is to design and manufacture tools to control equipment without touching hands to prevent the spread of infectious diseases. The controlled equipment consists of water faucets, lights, fans, and curtains. The lights, fans, and water faucets are controlled using palm movements with the max distance from the Smart IR Switch being 11 cm. If there is palm movement within the working range of the Smart Switch IR, the solenoid valve, lights and fans will change from their previous conditions. If the initial condition is 'off' it will change to 'on' or vice versa. The curtain is controlled using palm movements with the max distance to the GP2Y0A21YK0F IR sensor being 10 cm. If there is palm movement within the working range of the GP2Y0A21YK0F IR sensor then the curtain will change from its previous condition. If the initial condition of the closed curtain changes to open or vice versa.

Keywords— *Covid-19, palm movement, sensor*

1. Background

Infectious diseases are diseases caused by microorganisms, such as viruses, bacteria, parasites, or fungi, and can be transferred to other healthy people. Several common infectious diseases in Indonesia can be prevented through vaccination and a clean and healthy lifestyle.

Infectious diseases can be transmitted directly or indirectly. Direct transmission occurs when germs in sick people are transferred through physical contact, for example through touching and kissing, through the air when sneezing and coughing, or through contact with body fluids such as urine and blood. Infectious diseases can also be transferred indirectly, through touching objects that have been contaminated with the virus.

The current infectious disease is Covid-19. Transmission is very fast and has spread to almost all countries, including Indonesia, in just a few months. This virus can cause disorders of the respiratory system, severe lung infections, and even death.

The main way of transmission of the SARS-CoV-2 virus (the cause of COVID-19), is through respiratory fluids that come out when an infected person coughs or sneezes. This respiratory fluid can stick to objects and surrounding surfaces. The coronavirus is then transmitted by touch when someone else touches this object or surface, then touches their eyes, nose, or mouth.

In public places such as schools, offices, or hospitals, much equipment is turned on and off using the help/touch of the hand. The use of equipment in public places by many vulnerable people is the cause of the rapid spread of infectious diseases.

Several studies of hands-free control of equipment have been carried out. Controlling the lamp with the light sensor, the bright light of the lamp is on, when the light is dark the lamp is off[2]. Controlling window blinds and lights using a light sensor that detects the intensity of light outside the house. When the light outside is bright, the curtains are open, the lights are off and when it is dark the curtains are closed, the lights are on [1]. Research [1],[2], the equipment cannot be turned on and off according to the user's wishes. Based on these problems, the researchers designed and made equipment control devices consisting of water faucets, lights, fans, and curtains using palm movements without touching objects at all. This research was conducted to prevent the spread of infectious diseases.

2. Device Design

In general, the following research design will be carried out. The Zelio Smart Relay is used as a Curtain controller. The input consists of an IR sensor and 2 limit switches. The IR sensor is used to open/close the curtain, Limit switch1 as a barrier to the movement of the curtain opening and limit switch2 as a barrier to the movement of the curtain closing. The output consists of a curtain-opening motor driver and a curtain-closing motor driver. The motor driver used is a relay. Lights, fans, solenoid valves (electric faucets) are controlled using the IR smart sensor switch through the movement of the palm.

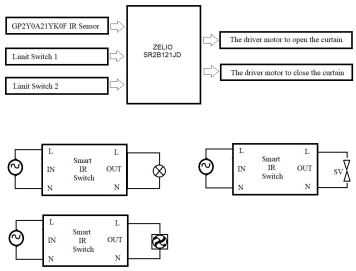

Fig 1. Block Diagram of Touchless Electronic Device Control Design

2.1. Work Description

Curtain: The initial condition of the curtain is closing, limit switch1 (lower limit switch) is depressed or 'on'.When the palm is moved near the IR sensor, the IR sensor will be 'on' and the smart relay activates the motor driver to open the curtain. The motor stops opening the curtain when limit switch 2 (upper limit switch) is depressed or 'on'. When the curtain is fully open, if the palm is moved again near the IR sensor, the smart relay will activate the diver motor to close the curtain. The motor stops closing the curtain when limit switch 1 (lower limit switch) is depressed or 'on'.

Lights, fans, and solenoid valves: The light is controlled by the smart IR switch 1 with palm gesture input.

The fan is controlled by the IR 2 smart switch with palm gesture input. The solenoid valve is controlled by a smart IR 3 switch with palm movement input. The initial condition of the light is off if the palm is moved near the smart IR 1 switch, then the light will turn on. If the palm is moved again near the smart IR switch 1, then the light will turn off again.

The initial condition of the fan is off if the palm is moved near the smart IR 2 switch, then the fan will turn on. If the palm is moved again near the smart IR 2 switch, the fan will turn off again. The initial condition of the solenoid valve is off, if the palm is moved near the smart IR 3 switch, the solenoid valve will drain water. If the palm is moved again near the smart IR 3 switch, the solenoid valve will turn off again.

2.2. I/O Table

The PLC addressing and I/O equipment of the Curtain Control device are shown in Table 1.

Table 1.
I/O Zelio SR1BD121JD

Input Address	Input Device
A1	GP2Y0A21YK0F IR sensor
I1	Limit Switch 1
I2	Limit Switch 2
Output Address	**Output Device**
Q1	the drive motor to open the curtain
Q2	the drive motor to close the curtain

2.3. Ladder Diagram

The Curtain Control Ladder Diagram program is shown in Figure 2.

Fig 2. Curtain Control Ladder Diagram

3. Result

3.1. GP2Y0A21YK0F IR Sensor

The sensor used to detect palms on the curtain controller is the GP2Y0A21YK0F IR sensor which is a product of Sharp. This sensor works based on the principle of infrared reflection from the transmitter (transmitter) and is received at the receiver side. The range of distances that can be measured is between 10 cm to 80 cm. Beyond that distance will result in invalid data.

Fig 3. GP2Y0A21YK0F IR sensor

Other specifications are as follows:

a. Voltage: 4.5 – 5.5 Vdc
b. output type: analog
c. current consumption: 30 mA
d. dimensions: 29.5 x 13 x 13.5 cm

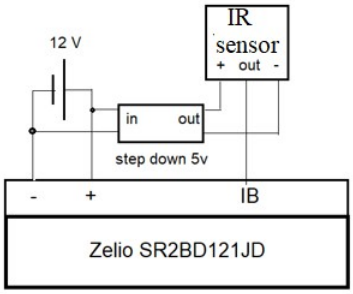

Fig 4. IR Sensor Wiring with Zelio SR2BD121JD

Table 2.
IR Sensor Experiment Test

No	the distance between the palm and the IR sensor (cm)	output voltage of sensor (Volt)
1	1	2.15
2	2	2.15
3	3	2.50
4.	4	2.60
5.	5	2.60
6.	6	2.10
7.	7	2.05
8.	8	2.05
9.	9	2.00
10.	10	2.00
11.	11	2.00
12	12	1.90

The IR sensor transmitter barrier with a distance of <= 11 cm emits a voltage of >= 2.00 volts. If the palm is moved near the sensor with a distance of <=11 cm, the Zelio smart relay's IB input will be 'on'. IB input 'on' is used to activate the motor to open/close the curtain.

3.2. Smart Sensor IR Switch

The palm movement detector on the lamp, fan, and solenoid valve controls is the Smart IR Switch.

Fig 5. Smart IR Switch

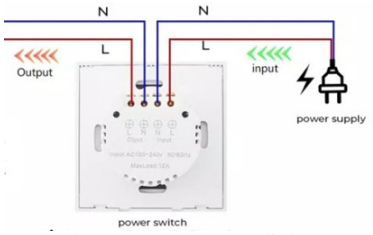

Fig 6. Input-Output Installation

Table 3.
Working Range Testing of the IR Sensor on the Smart Switch

No	the distance between the IR sensor and the palm (cm)	output (AC Voltage)
1	1	220
2	2	220
3	3	220
4.	4	220
5.	5	220
6.	6	220
7.	7	220
8.	8	220
9.	9	220
10.	10	220
11.	11	0

3.3. Solenoid Valve

The regulator of the water flow in the sink is a solenoid valve (electric faucet). The solenoid used is a 220 Vac solenoid.

Fig 7. Physical Form of the Solenoid Valve

Figure 7 is the physical form of the solenoid valve, the solenoid valve has a coil as its driver which functions to move the piston which can be driven by AC or DC current, the input hole serves as a terminal/place for liquid to enter or supply, the output hole serves as a terminal or a place for liquid to exit. which is connected to the load, and the exhaust hole serves as a channel to remove the trapped liquid when the piston moves or changes position when the solenoid valve is working. The source of the electric drive for the solenoid valve itself is AC power (220 V, 110 V) and DC power (12 V, 24 V). The working principle of the solenoid valve is shown in Figure 8.

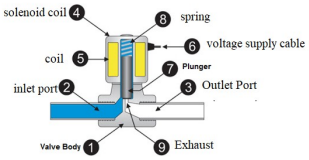

Fig 8. Function Structure of Solenoid Valve

The working principle of the solenoid valve used is an electric valve that has a coil as the driver, where the coil gets a supply voltage of 220 Vac, the coil will turn into a magnetic field so that it moves the piston on the inside. When the piston changes position, the liquid from the input hole will flow into the exhaust hole and will exit through the output hole. The valve will open if the current is flowing and the valve will close if no current flows.

Table 4.
Solenoid Valve (SV) Experiment

SV input voltage (AC Volatage)	Current (A)	Condition
220	1.8	Valve open

4. Conclusion

1. Curtains, Lights, Fans, and Electric Faucets can work without hand touch.
2. The curtain is controlled using palm movements with a distance of the GP2Y0A21YK0F IR sensor max 10 cm.
3. Lights, Fans, and Electric Faucets are controlled using palm movements with a distance of the IR Smart Switch max 11 cm.

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