DESIGN OF AUTOMATIC WATER FAUCET FOR A READY FOOD RESTAURANT SINK USING MICROCONTROLLER BASED ULTRASONIC SENSOR

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Abstract

Technological developments in the field of control are increasingly advanced, especially in the world of electronics. Electronic water faucets are one example that we can find in fast food restaurants which are quite expensive for some groups and water is often wasted when the hand washing process is in progress. Therefore this research was carried out by designing and building an automatic faucet in a sink so that there is no wastage of water. The problems faced are the use of manual faucets that are not sterile and the process in the field when washing hands is not efficient and hygienic. The method used is to design and build mechanical and electronic components based on microcontrollers. By utilizing Arduino UNO, HC-SR04, L298N, Relay and DC pump, hand washing sink will facilitate the hand washing process. The design of an automatic water faucet for a fast food restaurant sink based on a microcontroller was successfully realized and implemented with the realization that water managed to come out of a 12V DC pump capable of dispensing water according to the reach of the hand between 2.5cm to 27.5cm which was carried out by the HC-SR04 sensor. The process carried out is that the automatic water faucet at the sink in a fast food restaurant can simplify the hand washing process and reduce water wastage with a water saving of 5.3 liters for adults and 8.66 liters for small children. The average water used by adults for automatic sinks is 0.49 liter/person and young children is 0.45 liter/person, with a water velocity of 0.163 l /s for adults and 0.150 l /s for small children.

Keywords: ***Arduino UNO; Micocontroller; Sink; HC-SR04; 12V DC pump***

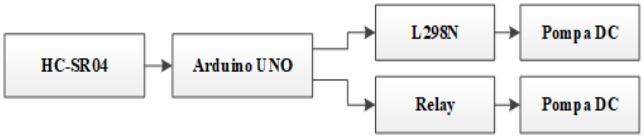
1. INTRODUCTION

The development of science and technology (IPTEK) such as in the era of the fourth world industrial revolution (4.0) has become the basis of human life. With the development of science and technology, of course, the ease of life will be realized because all the equipment used works automatically and is practical. In line with the development of science and technology, control or instrumentation systems are increasingly playing an important role in human life, one of which is the industrial sector(Desfriyati & Anggraeni Dewi, 2022). The application of this control is not only in the field of large industry but also occurs in several small-scale industries. One example that is often encountered is an electronic water faucet(Firman et al., 2022).

Electronic water faucets are common in bathrooms, offices and fast food restaurants in big cities in Indonesia. This water faucet opens automatically when the sensor detects movement from the hand approaching the faucet. However, the obstacle that is often faced is the price that is not affordable by certain circles, causing the use of faucets to be reversed by using manual faucets by turning or pressing on the faucet.(Firmansyah et al., 2020). This can make the faucet not sterile and the process in the field when washing hands is not efficient(Febrina et al., 2022). Therefore, an automatic hand washing tool was made in a sink controlled by Arduino UNO and using the HC-SR04 sensor as a detector. So that you can open the water faucet and remove soap without having to make direct contact. This built system can also be applied in food stalls, schools, hospitals and other places.

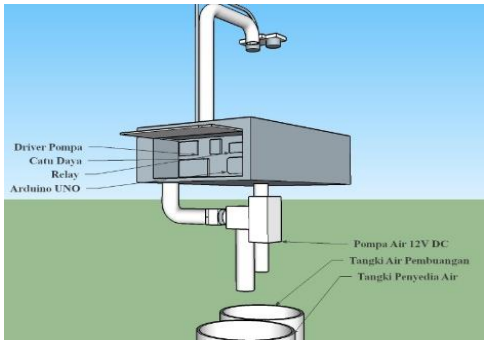
2. IMPLEMENTATION METHOD

The research method used in this research is to design and build a fast food restaurant sink using a microcontroller-based ultrasonic sensor. The block diagram of the system used in this study consists of the HC-SR04, Arduino UNO, L298N, Relay and DC Pump as shown in Figure 1 below.



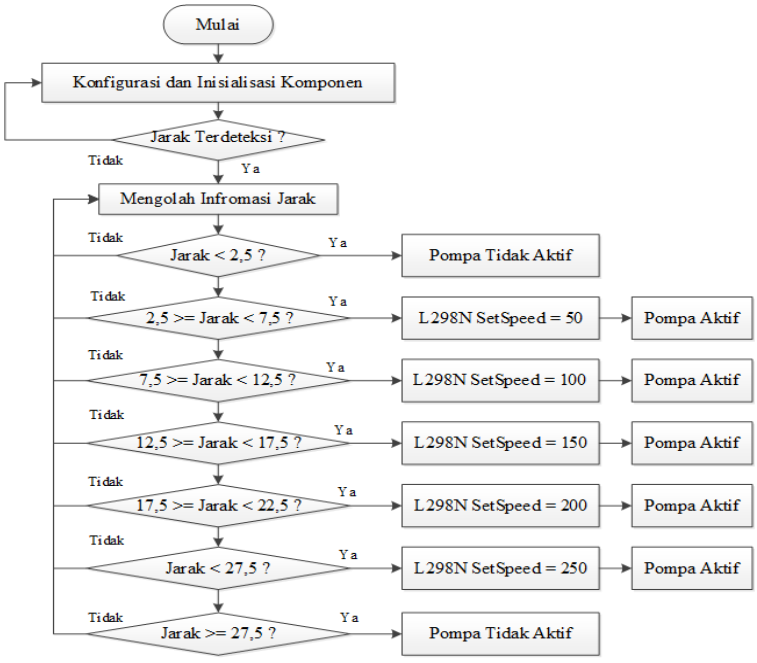
Picture 1. System Block Diagram

The design carried out on the mechanics is a control panel equipped with a sink and automatic water faucet as shown in Figure 2 below.



Picture 2. Control Panel Design

The design carried out on electronics consists of an Arduino UNO circuit with HC-SR04 sensors, Relays, and L298N. Meanwhile, the program implemented in this study can be seen in Figure 3 below.



Picture 3. Application Program Flowchart

3. RESULTS AND DISCUSSION

Results of System Design

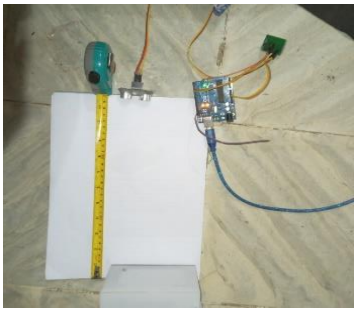
The system design that has been produced in this study consists of mechanical, electronic, and program design results as shown in Figure 4 below:

(a) (b) (c)

Picture 4. Watafel Design Results (a) Realization (b) Mechanical (c) Electronic

Distance Test Results on the HC-SR04 Sensor

The results of the distance reading test carried out on the HC-SR04 sensor have been obtained. Testing is done by first assembling a series of tests and preparing other tools for value comparisons. The measuring tools used in this test are a tape measure and a ruler. The first test is carried out by comparing the reading value of the HC-SR04 sensor with the meter as shown in Figure 5 below.



Picture 5. Results of the HC-SR04 Sensor Testing Series

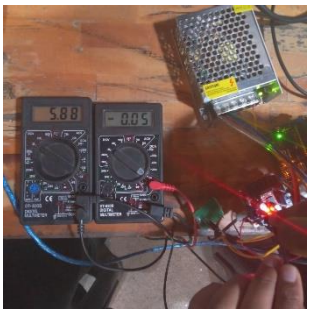
Table 1. HC-SR04 Distance Sensor Reading Test Results

No	Length Reading(cm)			Error
	Measure Value	Ruler	HC-SR04 Sensors	
1	10	10	10.38	0.38
2	150	150	149.76	0.16
3	300	300	301,21	0.4
4	450	450	449.81	0.04
5	600	600	554,1	7.65

Based on Table 1, from the results of distance readings carried out by the sensor with a ruler comparison, the largest error value was obtained during the 5th test with an error value of 7.65. While the smallest error is obtained with a value of 0.04 at the 4th test. The difference in the values contained in this test is due to the measuring instrument which is analog in nature so that there is an indication of human error when using the ruler and of course due to the maximum distance that can be detected by the sensor such as the 5th test.

Pump Speed Control Test Results

The results of the 12V DC pump speed regulation test have been successfully carried out. This test was carried out on the Arduino UNO circuit with L298N and a 12V DC pump that had been prepared as shown in Figure 6 below.



Picture 6. Results of the Pump Speed Control Series Test

Table 2. Pump Speed Test Results with L298N

No	Pump Speed	Pump Power		Information
		Voltage(V)	Current(A)	
1	0	0	0	Pump Off
2	50	0	0	Pump Off
3	100	0	0	Pump Off
4	150	5.88	0.05	Pump On
5	200	9,26	0.9	Pump On
6	250	10.44	0.9	Pump On

Based on Table 2, it was found that the increase in power at the pump increased as seen during the 4th test to the 6th test. In the table above it can also be seen that the L298N is unable to turn on the pump when it is set at a speed of 0 to 100. This is because the power supplied by the driver to the pump does not match the power required by the pump.

Relay Test Results

The results of the 5V DC pump test were carried out to determine the functional level of the relay assembled with Arduino UNO and the pump. Testing is carried out by uploading the test program to the Arduino UNO via the Arduino IDE. After being uploaded, the test is continued by paying attention to the response of the pump and the relay. After there is a response from the relay, documentation will be carried out so that the test results are obtained which can be seen in Table 3 below.

Table 3. Relay Test Results

No.	Condition		Information
	Relays	**5V DC pump**	
1	Active	Life	Succeed
2	Not active	Dead	Succeed

Based on Table 3 above, it can be concluded that the tests carried out on the relay have been successfully carried out. This can be seen during the first and second tests, where the condition of the pump will be affected by the relay indicator.

Overall System Performance Test Results

Performance testing or overall testing is the final stage of testing carried out on automatic hand washing sinks. Testing is done by assembling and installing all the design results into one system. This test was also carried out 7 times and this was in accordance with the range conditions of the HC-SR04. In Figure 7 below, it can be seen that during the test there were several measuring instruments used which consisted of a ruler and a multimeter. Ruler is used as an indicator that will read the range of the obstacle with the conditions that have been adjusted. At that time the multi

meter will also function as an indicator that will read the power value of the 12V DC pump. Then do the documentation on the test table that has been provided so that the test results are obtained as shown in Table 4 below

Picture 7. Results of the Overall System Testing Series

Table 4. Overall System Performance Test Results

No	Measure value(cm)	Condition		Information
		12V DC pump	5V DC pump	
1	<2.5	Dead	Dead	Succeed
2	≥2.5 and <7.5	Active	Active	Succeed
3	≥7.5 and <12.5	Active	Active	Succeed
4	≥12.5 and <17.5	Active	Active	Succeed
5	≥17.5 and <22.5	Active	Active	Succeed
6	≥22.5 and <27.5	Active	Active	Succeed
7	≥27.5	Dead	Dead	Succeed

In Table 4 above it can be seen that the tests carried out on the entire system have been carried out and succeeded without any problems. In the table it can also be seen that the condition of the pump will turn on if it is between 2.5cm to 27.5cm. Conversely, the pump will turn off or stop with a hand reach distance of below 2.5cm and above 27.5cm. Conditions when the distance is between 12.5cm to 17.5cm, the 12V DC pump will push water in the tank with a speed of 150rpm and with a power of W. To find out the speed used by the 12V DC pump, it is done by connecting the Arduino UNO and displaying the serial monitor. when the condition of the pump is off, it is seen that there is no water coming out of the sink.

Overall Performance Test Results

The realization that was carried out at the hand washing sink was continued by testing arbitrary by comparing the results of the water obtained in the final reservoir. In this realization, it was carried out using 10 sample tests with different individuals and recording data so that the results were obtained. This realization also collects data on the duration or process of hand washing carried out with automatic and non-automatic sinks. Then the data obtained will of course be recapitulated to see the effective level of automatic hand washing sinks so that the results can be seen in Table 5 below.

Table 5. Result of Realization of Automatic Hand Washing Sink System

No.	Sink (l)		Error (%)
	Automatic	Conventional	
1	0.17	0.99	0.82
2	0.24	0.91	0.67
3	0.23	1.03	0.8
4	0.27	0.94	0.67
5	0.21	0.98	0.77
6	0.29	0.97	0.68
7	0.51	1.25	0.74
8	0.26	0.94	0.68
9	0.22	0.93	0.71
10	0.24	0.95	0.71
Total Water (l)	2.64	9.89	7,25

Based on Table 5 above, it can be seen the difference in water located in the final reservoir. Based on the table above, it can be seen the comparison of the volume of water obtained in automatic and conventional hand washing sinks. The results obtained were a smaller volume of water when using an automatic hand washing sink with a volume of 2.64 liters of water obtained. Whereas for a conventional sink, a water volume of 9.89 liters is obtained.

4. CONCLUSION

The conclusions that can be drawn in this study are as follows

a. The design of an automatic water faucet for a microcontroller-based fast food restaurant sink has been successfully realized and implemented. In the realization that was carried out, the 12V DC pump was able to dispense water according to the distance of the hand between 2.5cm to 27.5cm which was carried out by the HC-SR04 sensor.
b. The process that is carried out by an automatic water faucet in a fast food restaurant sink can facilitate the hand washing process and reduce water wastage with a savings of 5.3 liters for adults and 8.66 liters for small children. The average water used by adults for automatic sinks is 0.49 l/person and young children are 0.45 l/person. Meanwhile, the average water used in a conventional sink is 1.02 l/person for adults and 1.32 l/person for small children, with a water velocity of 0.163 l/s for adults and 0.150 l/s for small children.
c. Testing of sensor readings and 12V DC pump speed was carried out after the design and testing stages with an average error value on the HC-SR04 sensor of 1.7%. Meanwhile, the speed setting of the 12V DC pump was carried out without any failure during the test and the 5V DC pump that was assembled with the relay was successfully carried out without any failure during the test.

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