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BUILDING SYSTEM OF SAVING WATER FIRE EXTINGUISHER BASED ON MICROCONTROLER ARDUINO MEGA 2560

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ABSTRACT

Fire hazards could be happened anywhere, it could be on a land (houses, buildings, forests, etc.) or on the sea (ships). This incident was occurred at KM Artamina Jaya. Fire prevention action performed by eliminate three elements of oxidation reaction, these are: fuel, oxygen, and heat. A method to break the three elements is spray water to the fire source. Existing or common fix fire distinguish usually use water spray or sprinkle. It takes a large amount of water to extinguish the fire and it conduce wets areas where not affected by fire. So that this research was invent to design a water-saving fire extinguish system based on Arduino Mega microcontroller. This study use 5-channel infrared flame sensors to detect the location of a fire and a DC motor sensor to spray water. By using 5-channel infrared flame sensors, the Arduino Mega microcontroller can determine which DC motor to spray water. The focus of this research is how to activate the fire extinguish pump or water sprayer according to the channel on the infrared flame sensor, which detects the source of the fire, and the system can activate more than one pump.

Keywords: Arduino Mega 2560, Infrrared Flame Sensor 5 Channel, Motor DC

1. Introduction

A fixed fire extinguishing system using water will spray all the water through the existing sprinklers, not only in the area where there is a fire. This work system causes the use of water that is quite large when carrying out fire fighting and also wets areas that are not affected by fire, so that in this study a water-efficient fire extinguishing system design was created based on the Arduino Mega 2560 microcontroller.

Fire is one of the disasters that can cause huge losses. To minimize losses caused by fire, there are many studies that lead to fire suppression systems. Research related to fire extinguishing systems is as follows:

1. Nola Sari Rahayu and Wildian (Rahayu and Wildian, 2017) in their research discussed the prototype design of an automatic and dynamic fire extinguishing system based on the Arduino Uno microcontroller module. The results of the research are that the system is able to sprinkle water up to the point of the fire source which is up to 18 cm above the floor of the simulation room.
2. Rika Sri Rizki, Ira Devi Sara and Mansyur Gapy (Rizki et al. 2017) in their research discussed systems that could minimize fires so they would not spread further. This study aims to produce a prototype fire hazard detection system in buildings. The results of this study are prototypes that are used as fire detectors to turn on alarms and spray water automatically to minimize fires.
3. Rahmat Naharu Yanuar, Mochammad Hannats Hanafi Ichsan, and Gembong Edhy Setyawan (Yanuar et al. 2019) in their research discussed systems capable of detecting fires and taking preventive action, namely blackouts. The test results from this study are that the system can determine various room conditions with an accuracy of up to 100%.
4. Mega Apriyaningsih, Abdul Muid, and Nurhasanah (Mega Apriyaningsih, 2017) in their research discusses

Prototype of ATmega328P microcontroller-based automatic fire extinguishing system that can provide early warning in the form of SMS (Short Message Service) via cellular telephone network. The results of this study indicate that the system can display the temperature on the LCD and send information in the event of a fire to the designated

telephone number and the system can turn on the water pump to extinguish the fire.

From existing studies, there is no research that discusses the efficiency of using water to extinguish fires.

2. Research Methods

System design is to build a system model based on the problem formulation and problem boundaries so that the research objectives can be achieved. The system model to be built is as shown in the following figure.

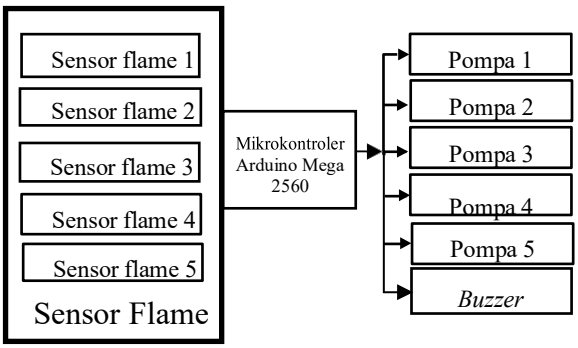

Figure 1. System Design Block Diagram

The system built is using 1 type of sensor is a flame sensor which functions to detect the presence of a fire point. In 1 module there are 5 flame sensors so it is called a 5 channel infrared flame sensor. The flame sensor detects the hotspots, then the hotspot data is sent to the Arduino Mega 2560 microcontroller for processing. After being processed, it produces output in the form of activating a pump close to the fire point. If the fire point is only detected by the flame sensor 1 then the microcontroller only activates pump 1, but if the fire point is detected by flame 1, flame 2 and flame 3 then the microcontroller activates pump 1, pump 2 and pump 3. This system works like that up to flame 5.

The design of the fire detection sensor used in this study is a 5 channel infrared flame sensor circuit connected to a microcontroller. Infrared flame sensor 5 channel is a fire sensor that is used to detect the presence of a fire point by utilizing 5 Infrared (IR) receivers. This sensor has 5 LED indicators (Light Emitting Diode) which are useful as detection indicators. The connection of the 5 channel infrared flame sensor can be seen in Table 1.

Table 1. 5 Channel Infrared Flame Sensor Connection With Microcontroller

Infrared Flame Sensor5 Channel	Mikrokontroller
Sensor flame 1	Pin A0
Sensor flame 2	Pin A1
Sensor flame 3	Pin A2
Sensor flame 4	Pin A3
Sensor flame 5	Pin A4

The relay module design in this study functions to activate pump 1, pump 2, pump 3, pump 4, and pump 5 when the microcontroller has a command to activate it. The microcontroller connection with the relay module is shown in Table 2

Table 2. Relay Module Connection with Microcontroller

Modul Relay	Mikrokontroller
Relay 1	Pin 2
Relay 2	Pin 3
Relay 3	Pin 4
Relay 4	Pin 5
Relay 5	Pin 6

Pumps are also called machines or mechanical equipment that are used to raise liquids from lowlands to highlands or to drain liquids from areas of low pressure to areas of high pressure and also as a flow rate booster in a piping network system. Pump installation in this study is shown in Table 3

Table 3. Pump Connection with Relay Module

Pompa	Modul Relay
Pompa 1	Relay 1
Pompa 2	Relay 2
Pompa 3	Relay 3
Pompa 4	Relay 4
Pompa 5	Relay 5

The buzzer design in this study serves to provide a warning signal in the event of a fire. The buzzer installation in this study is shown in Table 4.

Table 4. Buzzer Connection with Microcontroller

Buzzer	Mikrokontroler
Buzzer 1	Pin 7

The design of the test in this study is to detect hotspots using matches. The hotspot will be moved - moving its position to see the response from the microcontroller to activate the pump and activate

the buzzer as a warning sign. The response that is expected in the research of the system is that the active pump is only a pump that is close to the fire.

3. Results and Discussion

Prior to analysis and conclusions, in this study hardware testing was carried out separately to ensure that each piece of hardware was functioning properly so that when tested as a whole, the correct results were obtained. With the correct results will produce the correct analysis and conclusions as well.

A. Separate Hardware Tests Separate hardware tests are performed

to ensure that all the hardware used can work properly so that the results obtained in the research are appropriate. Hardware testing includes testing on the 5 channel infrared flame sensor, relay module, pump, and buzzer.

1. 5 Channel Infrared Flame Sensor Testing
   Testing the 5 channel infrared flame sensor which functions to detect the source of fire is carried out by providing a 5V voltage source then in front of the sensor is given a source of fire from a match. 5 Channel Infrared Flame Sensor Test Results From the test results shown in Figure 4.1, the 5 channel infrared flame sensor can function properly which is indicated by the LED as an indicator light on the sensor lights up when there is fire source. When the fire source is on the left, the leftmost LED lights up, then when the fire source is shifted to the middle, 2 LEDs from the left light up.
2. Relay Module Testing
   The relay module used is a single relay module consisting of 1 Com pin, 1 NO pin and 1 NC pin. Testing the relay module is carried out by providing a 5V voltage to the voltage source. The relay module has an LED indicator light that indicates the relay module is active or inactive. When the relay module is not active, the LED indicator light is off and the Com pin is connected to the NC pin, while when the relay module is active, the LED indicator light is on and the Com pin is connected to NO.
   The test results show that the relay module is in good condition because when a 5V voltage source is given, the relay becomes active which is indicated by the light on the LED indicator light and a clicking sound indicating the transfer of the Com short circuit from NC to NO.
3. Pump Testing
   The pump functions to move the position of the liquid from one position to another. Pump testing is carried out by providing a 12V voltage to the pump voltage source so that it can move the position of the liquid.
   From the test results stated that the pump is in good condition because it can move the position of the liquid after being given a 12V voltage source.
4. Buzzer Testing
   Buzzer is hardware that functions to give a warning by making a sound when it is active. Testing on the buzzer is carried out by providing a 5V voltage source.
   After testing, namely by providing a 5V voltage source, the buzzer can make a sound so it can be concluded that the buzzer used for research is in good condition.
5. Testing the Arduino Mega Microcontroller
   Testing the Arduino Mega microcontroller is done by entering a simple program to turn on the LED light. This test is carried out to test or ensure that the microcontroller still works

Reprogrammed and the pins are still working fine. After testing based on the previous explanation, that the Arduino Mega microcontroller can work well because the microcontroller can turn on the LED according to the program made.

B. Overall System Testing

Testing the system as a whole is by installing a 5 channel infrared flame sensor to detect the source of fire. Fire source data with 5 points is input by the Arduino Mega microcontroller. Arduino Mega processes data from these sensors to control the activation and inactivity of pump 1, pump 2, pump 3, pump 4 and pump 5. The expected work system is that each channel on the infrared flame sensor detects a fire source that can trigger and activate 1 pump where infrared flame sensor 1 trigger activates pump 1, infrared flame sensor 2 triggers activates pump 2, infrared flame sensor 3 triggers activates pump 3, infrared flame sensor 4 triggers activates pump 4, and infrared flame sensor 5 triggers activates pump 5. And if two channel from the infrared flame sensor detects the source of the fire then triggers two active pumps according to the previous determination. The overall test results of the system can be seen in Table 5.

Table 5. Overall Test Results

NO	Sensor 5 Way Flame	Motor
1.	Infrared flame sensor 1 nyala	Pompa 1 menyemprotkan air
2.	Infrared flame sensor 1 nyala	Pompa 1 menyemprotkan air
3.	Infrared flame sensor 2 nyala	Pompa 2 menyemprotkan air
4.	Infrared flame sensor 2 nyala	Pompa 2 menyemprotkan air
5.	Infrared flame sensor 3 nyala	Pompa 3 menyemprotkan air
6.	Infrared flame sensor 3 nyala	Pompa 3 menyemprotkan air
7.	Infrared flame sensor 4 nyala	Pompa 4 menyemprotkan air
8.	Infrared flame sensor 4 nyala	Pompa 4 menyemprotkan air
9.	Infrared flame sensor 5 nyala	Pompa 5 menyemprotkan air
10.	Infrared flame sensor 5 nyala	Pompa 5 menyemprotkan air
11.	Infrared flame sensor 1 dan2 nyala	Pompa 1 dan 2 menyemprotkan air
12.	Infrared flame sensor 1 dan2 nyala	Pompa 1 dan 2 menyemprotkan air
13.	Infrared flame sensor 2 dan3 nyala	Pompa 2 dan 3 menyemprotkan air
14.	Infrared flame sensor 2 dan3 nyala	Pompa 2 dan 3 menyemprotkan air
15.	Infrared flame sensor 3 dan4 nyala	Pompa 3 dan 4 menyemprotkan air
16.	Infrared flame sensor 3 dan4 nyala	Pompa 3 dan 4 menyemprotkan air
17.	Infrared flame sensor 4 dan5 nyala	Pompa 4 dan 5 menyemprotkan air
18.	Infrared flame sensor 4 dan5 nyala	Pompa 4 dan 5 menyemprotkan air
19.	Infrared flame sensor 1, 2 dan 3 nyala	Pompa 1, 2 dan 3 menyemprotkan air
20.	Infrared flame sensor 1, 2 dan 3 nyala	Pompa 1, 2 dan 3 menyemprotkan air
21.	Infrared flame sensor 2, 3 dan 4 nyala	Pompa 1, 2 dan 3 menyemprotkan air
22.	Infrared flame sensor 2, 3 dan 4 nyala	Pompa 1, 2 dan 3 menyemprotkan air
23.	Infrared flame sensor 3, 4 dan 5 nyala	Pompa 3, 4 dan 5 menyemprotkan air
24.	Infrared flame sensor 3, 4 dan 5 nyala	Pompa 3, 4 dan 5 menyemprotkan air

4. Conclusion

Based on the results of previous tests, the following conclusions can be drawn:

1. The system can only spray water at the location of the fire source, as evidenced by an active pump, only the pump facing the fire source.

2. The system can activate more than one pump so that if a wider fire occurs, more pumps will work

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