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PROTOTYPE MINI FIRE ENGINE WITH ULTRASONIC AND FLAME SENSOR USING ARDIUNO UNO

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Abstract

Prototype Mini Fire Engine with Ultrasonic and Flame Sensor Using Arduino Uno has several components, namely: 3 ultrasonic sensors to read objects using the wall avoider method, fire sensors to detect hotspots, Arduino uno as the brain, l293D motor as IC, DC motor for driving fire engine, delay to activate the pump until it can spray to the point of fire, and the battery as a source of robot voltage. All strung together to become a fire fighting robot. How it works Prototype Mini Fire Engine with Ultrasonic and Flame Sensors Using Arduino Uno is a robot that runs on a predetermined lane that has the shape of the letter U. The robot detects objects to the point of fire until the fire sensor lights up and the robot will stop. If the fire sensor detects a hotspot, the delay will start to activate the pump so that it can spray water to the fire source.

Keywords: *Prototype, Mini Fire car, Ultrasonic Sensor, Flame Sensor, Arduino Uno*

INTRODUCTION

Technology in the current era is developing very rapidly, technology is able to bring people into processes that are easier and more sophisticated. One of the technological developments is the type of robot car. The ability of this robot car varies according to the level and type of needs. For example, the ability to put out a fire in a room or in a building. Fire trucks to detect rooms that have or haven't burned in a burning room, the ability to pass through narrow lanes. Fire fighting robot car is very helpful for human work. Referring to the above, in this thesis I designed a fire fighting car robot, this robot has the ability to move independently without being controlled by humans to search for hotspots by applying multi-ultrasonic sensors (front, left, and right) to facilitate the speed of the robot and one flame sensor as a flame detector. From all processes from object input to process to the output, all the application of the Mini Fire Extinguisher Prototype is needed to accelerate the process of extinguishing the fire at the source of the fire and as the next learning medium.

RESEARCH METHODS

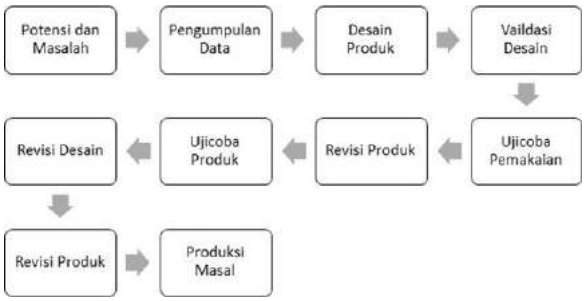
Time and Place of Research

The time of the study was conducted in March 2019 until August 2019. The place of this research was conducted at the Robotic Lab of Computer Systems at Balitar Islamic University, Blitar.

Data collection

This research uses the R & D (Research and Development) method where this research can produce products made by researchers.

The needs analysis is followed by the development of certain products and the effectiveness of these products is tested. In this study the authors will make products using the Prof. method. Sugiyono



Picture1Metode R&D

Robot Design

The design of the fire extinguisher robot uses the main components of ultrasonic sensors and fire sensors. The ultrasonic sensor is used by the fire extinguisher prototype to determine the route of the road in search of fire hotspots.

Picture 2 Full BodyFire Fighting Robot

The following is a list of Robot fire engine components:

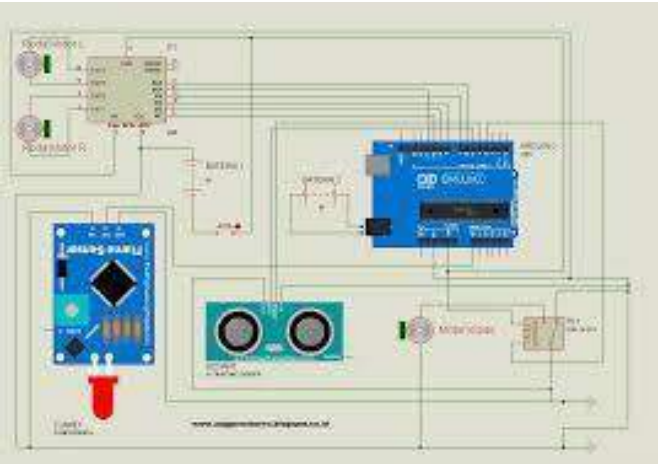
No	Name Components	Amount
1	Arduino Uno	1
2	Motor Driver L293D	1
3	Motor DC	2
4	Sensor Ultrasonik HC-SR04	3
5	Sensor Flame	1
6	Water Spray	1
7	Breadboard	1

8	Jumper Cable	25
9	Battery	6
10	Testing Board	1
11	PCB/Fiber	3
12	Buffer Bolt	16
13	Water tank	1
14	Body Casis	1
15	Relay	1
16	Water Hose	1

Table 1 RobotFire Engine Components

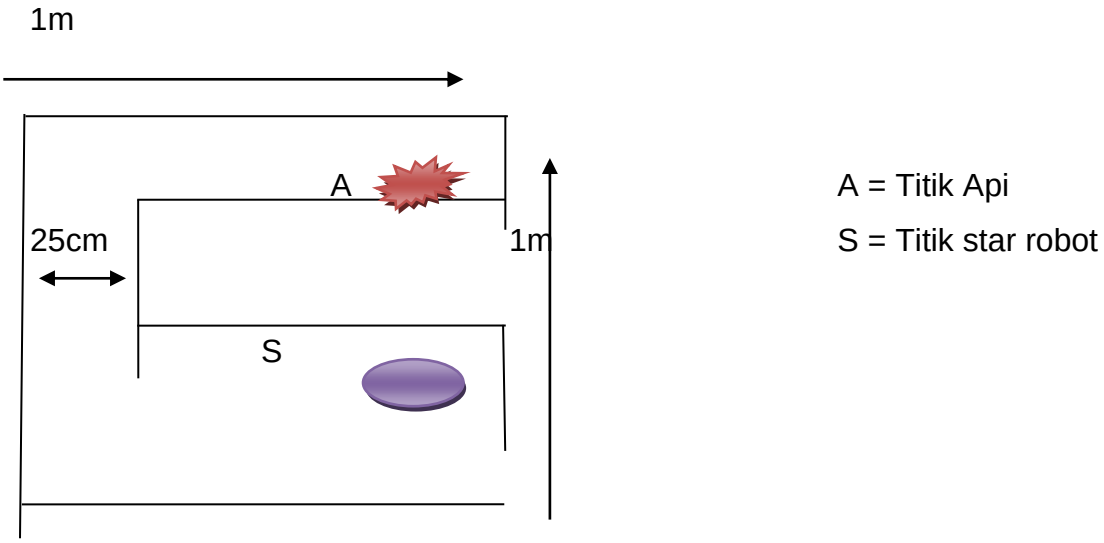
Robot Electronics Design and Testing Board

The following is a prototype electronic system design of a fire detection car fire truck using an artificial neural network method consisting of input, processor and output circuits. The robot uses Arduino UNO type and there are three ultrasonic sensors aiming to make it easier for the robot to read objects compared to just one sensor. There is one fire sensor (Flame) to detect the presence of fire. If the fire sensor detects the presence of a motor fire, the water pump will start to extinguish the fire.



Picture 3 Robot Electronics Design

Following is the design of the fire fighting robot testing board that will be tested in the robotics lab.



Picture 4 Testing Board

Fire extinguisher prototype testing board is made of cardboard with a square board size of 1 m x 1 m. This board is shaped like the letter U to facilitate the speed of the robot and ultrasonic sensors will make many decisions to the right because the path to most of these directions. Robot testing begins at the Start point with the left and right sensor conditions detecting a 10cm wall, so the robot will advance forward. The robot advances until it finds a turn with the front and left sensors detecting a wall of less than 10cm, then the robot will turn right and then advance to find a hot spot. The width of the road to the point of fire for the robot is 25 cm and the robot has a width of 11 cm. So that it has flexibility on the left and right sides of 7cm, respectively, because the position of the left and right sensors facing 45 ° is slightly tilted forward then the distance of the left and right walls to the ultrasonic sensor becomes 9cm. So, if left and right ultrasonic sensors detect <10cm and front sensors> 10cm, the robot will move forward.

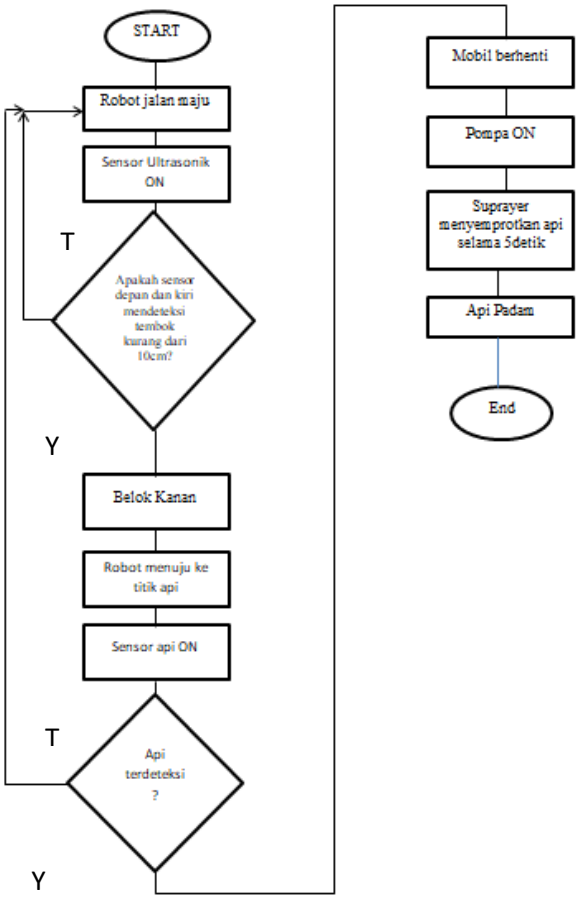
Testing Method

Below there are two possibilities in testing robots, including the following, namely:

1. Testing robots to detect walls using ultrasonic sensors and walking to the point of fire. The ultrasonic sensor testing is based on the travel time to the point of fire for 10 times the test. The testing media uses a U-shaped board which is only 1 row.
2. Testing the fire sensor when it has found the fire and calculating the response time and success of spraying the fire as much as 10x.

Flowchart Prototype Fire Engine

Below this is a flowchart image of a fire brigade robot, among others as follows:



Picture 5 Flowchart Prototype Fire Fighting Robot

Following is the Flowchart Flow explanation of the fire fighting robot:

1. The robot is positioned to start ON

2. The robot starts going forward and the ultrasonic sensor lights up to detect the wall. The robot finds a turn, the front and left sensors detect a wall of less than 10cm then the robot will turn right.

3. The front sensor does not detect a wall, so the robot advances to the point of fire.

4. The robot advances to the point of fire and the fire sensor lights up.

5. If the sensor does not detect fire, the robot will continue to advance, and if the sensor detects fire, the robot will stop and the relay will turn on the water pump.

6. The water pump turns on, the supplier sprays water towards the hot spot for 5 seconds until the fire goes out.

7. Done.

DISCUSSION

The discussion contains the testing and analysis of the system. System testing is the stage to put the system so it is ready to operate properly. Furthermore, the system analysis phase aims to find out how the system can run well.

Testing the Ultrasonic Sensor of a Fire Engine

The test is carried out to determine the performance of a fire fighting robot after a series of robots is made and explained. Tests carried out on boards that have been made with a size of 1m x 1m with a U-shaped path. Testing is done based on travel time to the point of fire for 10 times the test. The testing media uses a U-shaped board which is only 1 row.

Following the testing of the ultrasonic sensor is done 10x oil:

Definition :

S = car starting point

A = hotspot

NO	RATE	DISTANCE(cm)	TIME (s)
1	S - titik A	300	11
2	S - titik A	300	12
3	S - titik A	300	11
4	S - titik A	300	14
5	S - titik A	300	10
6	S - titik A	300	13
7	S - titik A	300	11
8	S - titik A	300	10
9	S - titik A	300	11
10	S - titik A	300	12
		Average	11,5

Table 2 Testing of Ultrasonic Sensors (after taking the average value)

Ultrasonic sensor testing was carried out 10 times and from each experiment has a time difference that is not much. The ultrasonic test calculation is seen from the time taken by the robot to the point of fire. From the tests carried out the average value of robot travel time is 11.5s (second).

$$\text{Average} = \frac{\text{amount of time}}{\text{amount of testing}}$$

The prototype of a mini fire truck was tested 10 times with the test media using a U-shaped board in the form of only 1 lane. From the experimental results the robot experienced 9 times successfully walked and read objects according to the lane board and 1 error because the ultrasonic sensor experienced a delay so that the sensor was slow to read the object.

Fire Sensor Car Fire Testing

Tests carried out on boards that have been made with a size of 1m x 1m with a path in the form of the letter U. Flame sensor testing (Flame) is done based on the calculation of the sensor's response time to the fire to be extinguished.

The following is the fire sensor testing (Flame) based on the sensor response time:

TESTING	Lama Respon (ms)
1	0
2	0
3	1000
4	250
5	150
6	0
7	0
8	200
9	150
10	200
AVERAGE	195

Table 3 Testing the Flame Sensor (Flame) After taking the average value

Flame detection sensor testing (Flame) conducted 10 times and from each experiment has a different response time. Calculation of fire detection sensor testing (Flame) seen from the length of the sensor response to the object so that it determines the success of putting out the fire. From the sensor testing, the average length of response of the fire sensor is taken to be 195 ms (0.1 second).

$$\text{Average} = \frac{\text{amount of long time respon}}{\text{amount of testing}}$$

From the experimental results the robot has experienced 6 times succeeded in detecting fire in accordance with the specified fire point and 4 times the failure because the fire sensor is not straight with the object (fire) because the robot goes sideways so it cannot detect fire. And for the success of the robot put out the fire only 1 time out of 10 times the experiment.

Data analysis

Ultrasonic sensor testing was carried out 10 times and from each experiment has a time difference that is not much. The ultrasonic test calculation is seen from the time taken by the robot to the point of fire. From the tests carried out the average value of robot travel time is 11.5s (second). From the experimental results the robot experienced 9 times successfully walked and read objects according to the lane board and 1 error. From the trial results a 90% success rate.

Flame detection sensor testing (Flame) conducted 10 times and from each experiment has a different response time. Calculation of fire detection sensor testing (Flame) seen from the length of the sensor response to the object so that it determines the success of putting out the fire. From the sensor testing, the average length of response of the fire sensor is taken to be 195 ms (0.1 second). From the experimental results the robot has experienced 6 times succeeded in detecting fire in accordance with the specified fire point and 4 times the failure because the fire sensor is not straight with the object (fire) because the robot goes sideways so it cannot detect fire. And for the success of the robot put out the fire only 1 time out of 10 times the experiment. From the fire sensor testing the success rate is 60%.

From the whole robot can go to the point of fire smoothly and can only extinguish the fire once, because the suprayer is only spraying one point, so the robot must be straight with the point of fire in order to extinguish the fire. For the next researcher who needs to be considered, the first is to choose a supplier that can spray water spread so that the fire can be extinguished not just one point. Second, more attention is paid to the design of the robot, because this robot is related to water and electronics are very vulnerable to water. Third note that the chassis of the robot is able to withstand the overall load of the fire fighting robot, if it is overloaded, the robot will not run straight or the robot will stop completely

Conclusions and Suggestions

Conclusion

1. Prototype Mini Fire Engine with Ultrasonic Sensor and Flame Using Arduino Uno has several components, namely: 3 ultrasonic sensors to read objects using the wall avoider method, fire sensors to detect hotspots, Arduino uno as the brain, l293D motor as IC, DC motor for the fire engine drive, delay to activate the pump so that it can spray to the point of fire, and the battery as a source of robot voltage. All strung together to become a fire fighting robot.
2. How the Mini Prototype Fire Car works with Ultrasonic and Flame Sensors Using Arduino Uno, which is a robot running on a predetermined lane that has the shape of the letter U. The robot detects objects to the point of fire until the fire sensor lights up and the robot will stop. If the fire sensor detects a hotspot, the delay will start to activate the pump so that it can spray water to the fire source.

Suggestion

Based on the results of research that has been carried out and drawn conclusions, the researchers will try to provide suggestions for increasing success in Prototype Mini Fire Engines with Ultrasonic and Flame Sensors Using Arduino Uno. After conducting research for 6 months, researchers have suggestions that are expected to improve the obstacles that occur during the study, including the following:

1. If this tool is developed, it is recommended that the suprayer for spraying water to the hotspot be made spread so that the spraying angle can be wide, so that the fire is easy to extinguish. Seen in the analysis of chapter IV data listed suprayer which can only spray sprayed one point, the robot must be straight with the point of fire, and from the results of testing the robot's fire sensor can only extinguish once.
2. From the results of research at the time of testing water often drips onto the sensors underneath such as the robot design in chapter III, then to assemble tools or media should design a robot that is able to protect electronic circuits from water, because electronics are very susceptible to water.

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