Design And Implementation Of Autonomous Fire Fighting Robot.

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Abstract: This paper reports the design and development of an Autonomous Fire Fighting Robot. The project mainly focuses on developing a robot that can go to places where a fireman has to risk his life and go put off the fire. Fire disasters can occur anytime at any place and result in high losses. Due to the damage of buildings and explosive materials, it becomes a major task to save people and to stop a disaster. With such constraints in the handling of fire, a technological breakthrough that can help to fight the fire utilizing a fire fighting robot from which people and properties can be saved from the fire accidents. With the advancement of technology, humans are replaced with robots in life-risking situations. In the proposed system, we develop a robot that automatically detects, navigates, and suppress the fire before it rages out of control. The system automatically detects the fire using the flame sensors attached to the firefighting robot, which will continuously monitor the intensity of the fire. If the value of temperature increases above the predefined value it will send the warning message to the corresponding authority using the GSM module and at the same time robot automatically navigate towards the detected fire. Consequently, the robot moves in the direction to which the temperature recorded to be relatively very high among three flame sensors using an L293 motor driver. Once the robot reaches near the fire, Arduino actuates the relay and the pump will automatically on for the water to be sprinkled through the sprinkler. By implementing the proposed system, any fire disasters can be avoided with a minimal amount of damage to property and risk of human life.

Keywords: Fire Fighting Robot, Arduino, Flame Sensors, Temperature Sensor, Motor Driver, Sprinkler, Disaster, Minimal Damage to property and Human Life.

1. Introduction

In today's life, robotics and embedded systems have become important in assisting human beings. The use of robotic systems in firefighting is being increasingly studied due to firefighters routinely being exposed to dangerous conditions to save the lives of victims during fire accidents. By the use of embedded systems, a mechanical device that performs a task using sensors to perceive its environment, computer programs to control the robot based on its environment. According to statistics in India, there are about 70 deaths per year for the last seven years. The main motto of this project is to design and develop a robot that can be used to extinguish fire remotely in an environment of any major fire hazard, particularly in large-scale industries. Major fire accidents do occur in industries like petroleum refineries, nuclear power plants, chemical factories, gas tanks and other large-scale industries resulting in quite serious consequences. Many of people have lost their lives in such mishaps. In the presence of a fire fighting robot, there is no big risk of life for firefighters as they need not have to fight against fire from the regions.

2. Literature survey

1. "Lynette Miller Daniel Rodriguez (2003) was all discussing the development of each component of the robot that is designed to find a small fire represented by a light emitting diode in a model home and extinguish it. This paper will talk about each component of the robot from the start signal to the robot platform to the line following and room finding and finishing with the fire detection."

2. "Sahil S Shah (2013) was all discussed about design a FIRE FIGHTING ROBOT using embedded system. A robot capable of fighting a simulated household fire will be designed and built. It must be able to autonomously navigate through a modeled floor plan while actively scanning for a flame. The robot can even act as a path guider in normal case and as a fire extinguisher in emergency. Robots designed to find a fire, before it rages out of control, can one day work with fire-fighters greatly reducing the risk of injury to victims. The result shows that higher efficiency is indeed achieved using the embedded system."

3. "Swati A. Deshmukh (2015) was all discussed about the fire detection system using sensors in the system, and program the fire detection and fighting procedure using sensor-based method."

4. "Kristi Kosasih et al. Has developed the intelligent firefighting tank robot. Materials like acrylic, plastic, aluminium and iron are used to make the robot. The tank robot is consisting of components like two servo motors, thermal array sensor, two DC motors, flame detector, ultrasonic sensor, IR and photo transistors, sound activation circuit and micro switch sensor. The goal of paper is search the prescribed area find the fire and extinguish it. The robot is activated by using DTMF transmitter and receiver."

5. "S.N. Kini, Rutuja Wadekar, Shweta Khatade, Sayali Dugane and Rutuja Jadkar proposed a firefighting robot which included a project that aims to promote technology innovation to achieve a reliable and efficient outcome. The movement of the robot is controlled by the sensors which are fixed on the mobile platform.is to provide security of home, laboratory, office, factory and building is important to human life. They also developed an intelligent multisensory based security system that contains a fire fighting system in our daily life. It included the design of the fire detection system using sensors in the system, and program the fire detection and fighting procedure using sensor based method."

6. "Pokey the Fire-Fighting Robot (USA) is the firefighting robot, that made its way out of competitions, and became more "serious" than other systems. In there are detailed description of used equipment and basic algorithms of operating. Robots operating environment is a building, so the robot is equipped with necessary sensors, for example, with a line sensor, that could be unuseful in conditions of dense smoke."
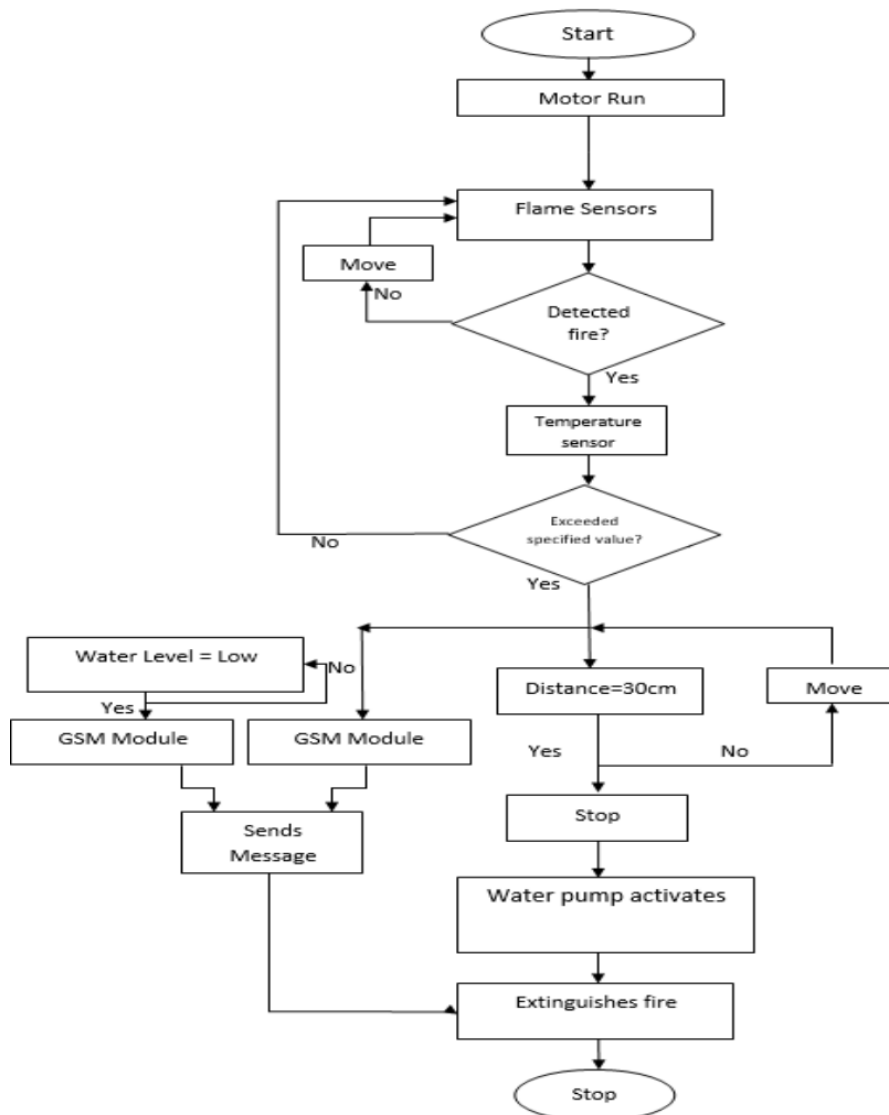
3. Proposed system

Fig.1 Fire Fighting Robot flowchart.

4. Implementation

We plan to design and develop the fire fighting robot that is utilized to control any disaster caused by fire, instead of risking a fire fighter's life. Our project is mainly composed of Arduino UNO, Flame sensors, Temperature sensors, Motor Driver, Motors, Servo Motor, Water Tank, GPS Module, GSM Module, Relay Module, Water Pump, Water Tank, Alarm, Chassis is used to mount all the components onto it. The power supply is connected to Arduino UNO and the motor driver. Once the fire is detected the robot will approach the fire and extinguish it.
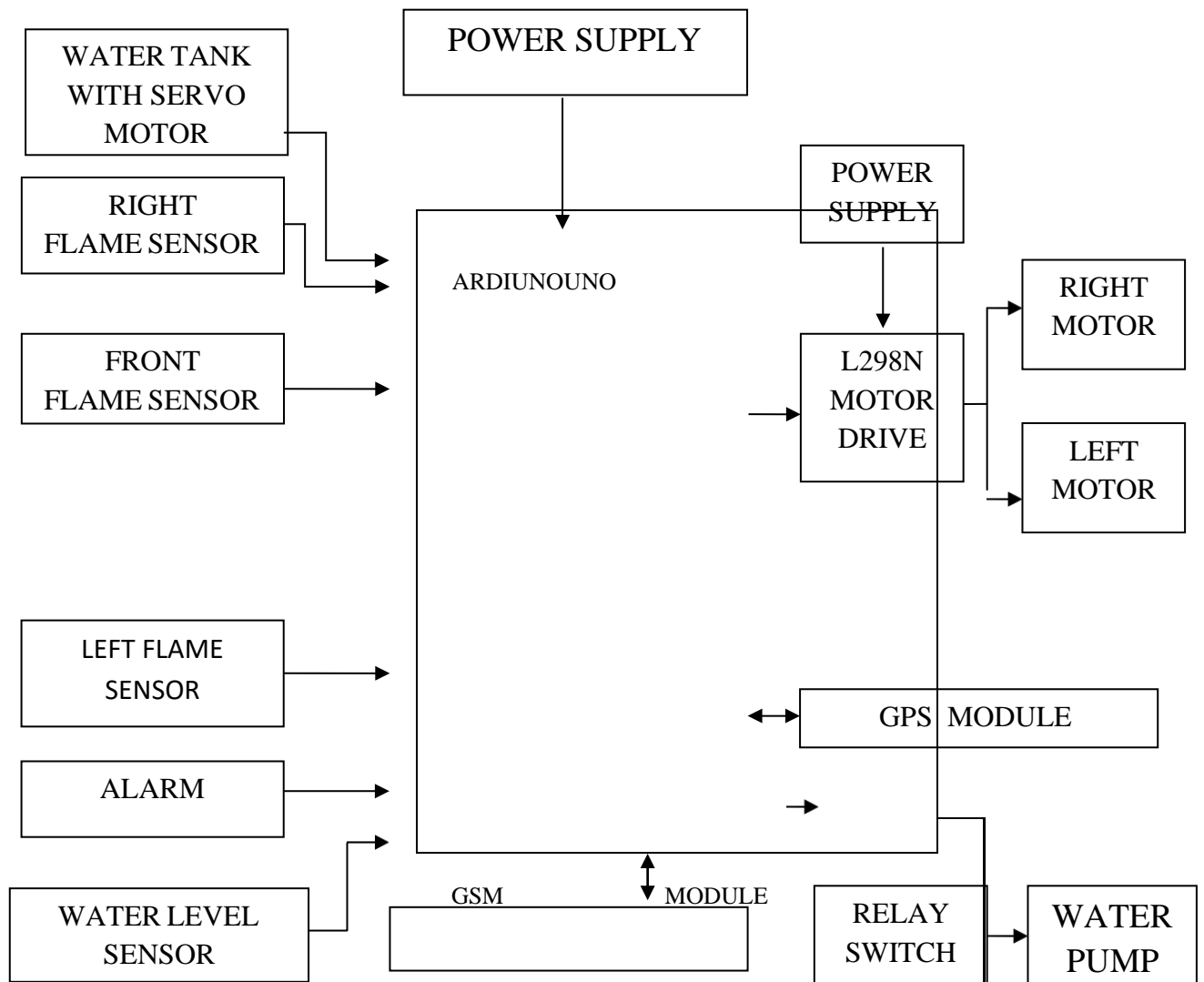
Block Diagram:

Fig2.Fire Fighting Robot Block Diagram.

5. Result

System Performance testing was done to check whether the fire fighting robot meets its desire or not. Some aspects of the input process, process, and output were analyzed. The performance test included robot actuator test, robot movement test, water pump test, and robot control distance test. The overall results of the testing process can be seen in Table 1.

No	Testing subject	Result
1	Forward movement	Succeed
2	Backward movement	Succeed
3	Turn Left	Succeed
4	Turn Right	Succeed
5	Water Pump	Succeed
6	GSM	Succeed
7	GPS	Succeed

Table 1. Results of Overall Testing

The performance of the robot was tested after the code was dumped in the microcontroller. This test was performed to verify if the movement of the robot was appropriate to the fire conditions. Result of robot movement can be seen in Figure.1, Figure.2 (a) and (b).
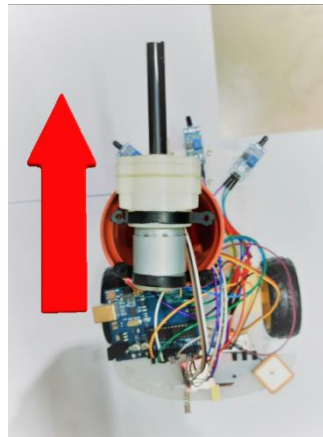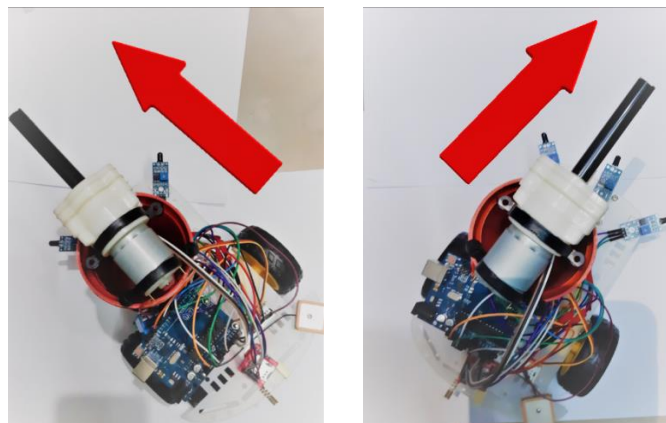

Figure 1. Robot forward movement

(a)   (b)

Figure 2. Robot (a) left turn (b) right turn

6. Conclusion

As technology developing day by day, everything is getting updated in a better way which is very useful for humanity. Hence the Fire Fighting Rover is an updated version of a fire extinguisher that is simple, small, and accurate to use in small places where the humans cannot control the fire or where the place is very congested therefore in these kinds of situations, we can use the rover to put off the fire and to continuously monitor and

control the fire accidents taking place. The rover has features such as the ability to detect the location of fire automatically besides having a compact body and lightweight structure. We can use the rover at a place that hasa small entrance or in small spaces because it has a compact structure. We have also used GSM and GPS to get the exact location of the fire accident taken place and to send the message if the water level in that is less.

The major limitations is the movement of the robot depends on the intensity of the flame hence, a minimum threshold value for intensity has to be mentioned for the robot to stop and put off fire depending on the fire accident.

The application of this project is that we can use it in malls, schools and University, industries, and other places where continuous monitoring of fire is required.

7.Future scope

In the future, increasing the range of specifications of the components used makes it more compact and reliable which can be implemented effectively in the place such as malls, industries, houses, building complexes, schools,colleges, etc...

8.Acknowledgement

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