

FIRE FIGHTING ROBOT WITH ALERT SMS

G BHANU PRASAD SAI¹, K SUDEEP VARMA², G VEERANAND³, G JAY KRISHNA⁴, Dr N Pallavi Senapati⁵.

^{1,2,3,4}Student of Mechanical Engineering Department, Nadimpalli Satyanarayana Raju Institute of Engineering and Technology (Autonomous), Visakhapatnam – 531173.

⁵Faculty of Mechanical Engineering Department, Nadimpalli Satyanarayana Raju Institute of Engineering and Technology (Autonomous), Visakhapatnam – 531173.

ABSTRACT

The Arduino-based Fire Fighting Robot with SMS Alert System is a robotic system designed to detect and extinguish fires in indoor environments. The robot uses flame sensors to detect the presence of a fire. Once a fire is detected, the robot moves towards the source of the fire and sprays water to extinguish the flames. The robot is equipped with a GSM module that can send SMS messages to alert the user when a fire is detected. This allows for prompt action to be taken to minimize damage and save lives. The components of the robot include an Arduino board, motor drivers, sensors, and a GSM module. The software code is written in the Arduino IDE and controls the motors, reads sensor data, and communicates with the GSM module. The robot is tested and debugged to ensure that it functions correctly and safely in different scenarios. Overall, the Arduino-based Fire Fighting Robot with SMS Alert provides a reliable and efficient solution for fire detection and suppression with the added benefit of remote communication and control.

INTRODUCTION

A robot is a machine designed to execute one or more tasks automatically with speed and precisions. The study of robotic is evolving and developing various technology modifications. Firefighting is a necessary yet risky profession. A firefighter must be able to respond swiftly to a fire and safely put it out, limiting more damage and reducing casualties. The gap between firefighting and machinery has now been crossed, allowing for way more advanced methods of firefighting strategy. Fire safety is a matter of critical concern. Fires, both small and large, can cause devastating harm to lives and property. Fires are unpredictable and can escalate rapidly, engulfing entire structures and endangering lives within moments. In such critical situations, timely communication and immediate action are vital. The conventional methods of combating fires often rely on human intervention, which can sometimes result in delays. Automation, combined with real-time communication, can significantly enhance the ability to respond promptly and effectively to fires.

METHODOLGY

The process of designing the automatic fire-fighting robot will be discussed in detail in this report. This chapter deals with the actual design and construction of the system. The robot aims to detect fires and extinguish them while sending an SMS alert to a specified phone number. To detect fires, the robot uses flame sensors. These sensors are equipped with an Infrared Receiver (Photodiode) designed to identify the presence of a fire. In the occurrence of a fire, the emission of Infrared light from flames is detected by the IR Receiver integrated into the sensor. An operational amplifier (Op-Amp) is utilized to monitor voltage variations across the IR Receiver. Consequently, if the sensor detects a fire, it induces a 0V (LOW) signal at the output pin.

Components and working

Flame Detector Unit

The flame detector (Figure 1) used in this design is the MQ5 gas sensor, they are used in detecting leakage of gas such as LPG, natural gas, town gas, cooking fumes and cigarette in homes and industries.



Figure 1: Flame Sensor

SG-90 Servo Motor

A servo motor (Figure 4) is an electrical device that can push or rotate an object with great precision. If we want to rotate an object at some specific angles or distance, then we use a servo motor. It is made up of a simple motor that runs through a servo mechanism. The position of a servo motor is decided by an electrical pulse and its circuitry is placed beside the motor.



Figure : SG-90 Servo Motor (Wikipedia, 2018)

Arduino UNO

The microcontroller used in this work is the Arduino Mega. It is the brain of the system which interfaces the sensing and actuating devices to perform the required functions, and also controls all the activities of the system. To power the Arduino MEGA microcontroller board, a 9v battery is used, to ensure easy portability of the project. This is done by simply connecting the + end of your battery to Arduino Vin and the - end to Arduino ground. Figure 5 shows the Arduino Mega board

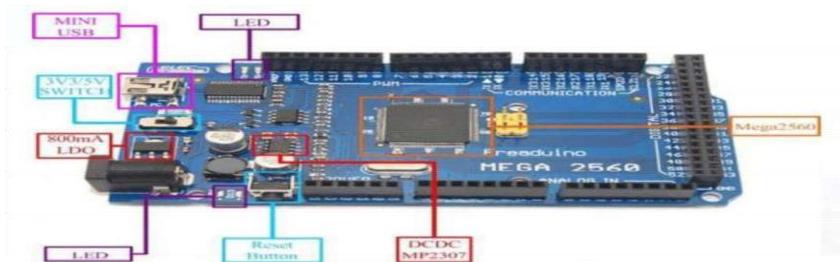


Figure 5: Arduino Mega (Satbhai, 2016)

L298D Motor Driver IC

At the heart of the module is the big, black chip with a chunky heat sink is an L298N. The L298N is a dual channel H-Bridge motor driver capable of driving a pair of DC motors. That means it can individually drive up to two motors making it ideal for building two-wheel robot platforms. The picture of the L298N motor driver is shown in Figure 6.

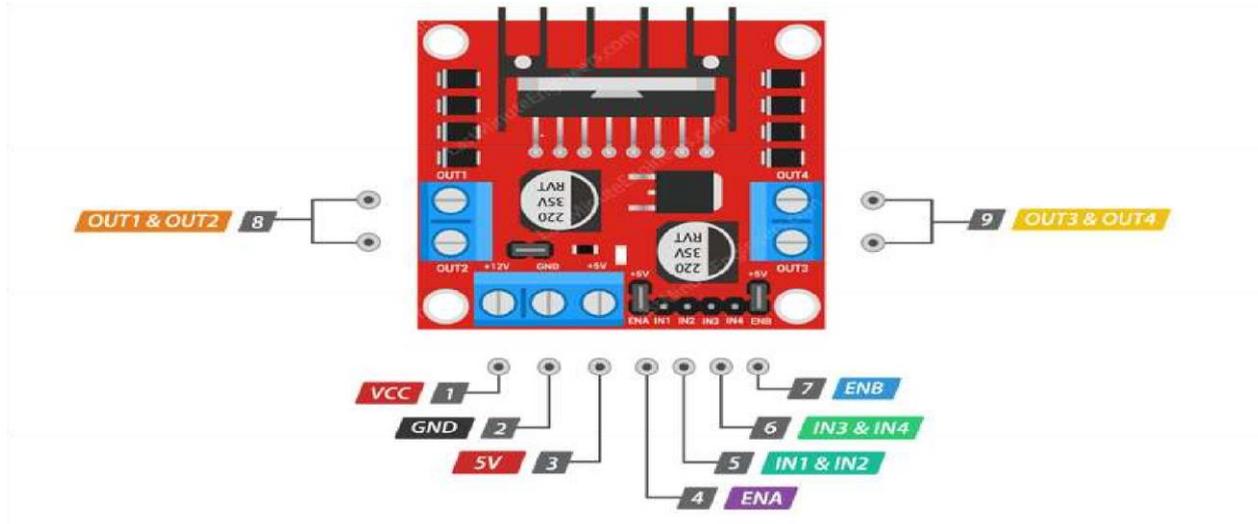


Figure 6: L2983D Motor Drive

DC Motors

A Direct Current (DC) motor (Figure 7) is a rotating electrical device that converts the direct current, of electrical energy, into mechanical energy.



Figure 7: DC Motor

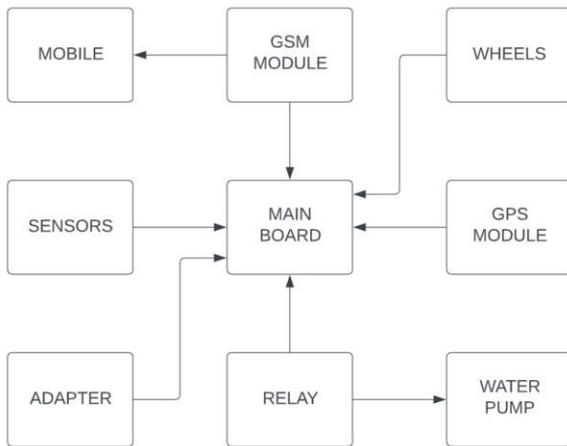
GSM Module

SIM800 is a quad-band GSM/GPRS module that works on frequencies GSM 850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz(Shanghai SIMCom Wireless Solutions Ltd, 2013). This module is responsible for sending the SMS alert to a predefined mobile number.



Figure : GSM Module

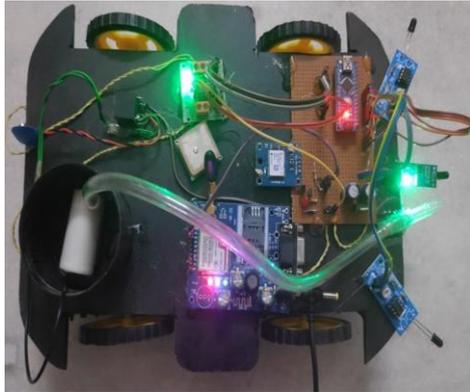
System Operation



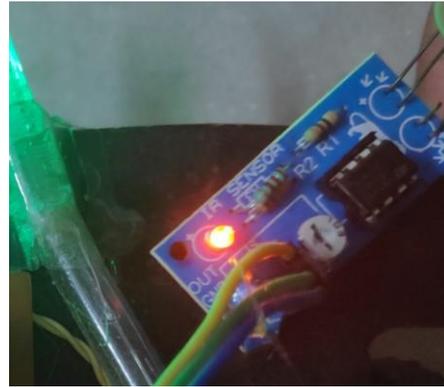
RESULTS

The robot effectively detected fires extinguished the fire source by spraying water. The robot was able to detect the fire at different intensities (760nm to 1100nm). The robot can detect small fires from roughly 0.8 metres. Once the fire is detected the robots starts the water sprinkler to extinguish it within few seconds. The GSM modules helps send the message simultaneously as soon as the fire is detected. Through testing, the system demonstrated its reliability and safety. This robot mainly for residential purposes due to its structure and design [12]. Fig.3 – Fig.6 show how the robot operates when it detects the fire to extinguish it. Fig.7 shows the message sent to the registered phone number.





Initial Startup Stage



Fire Detected

Conclusion

The prototype of the fire fighter robot was efficiently designed. This prototype has facilities to be integrated with many sensors making it move forward. The toolkit detects the infrared light emitted by the fire with photo diode and sends signal to controller. We intend to extend this work to provide a keypad programmed to allow manipulation of robot to move desired direction with help of motor driver module and extinguish the flames using water tank which is rotated at 180 degrees with help of servo in order for faster result. This future work will also explore to the use of a long distance sensor with suitable hardware to get more better and faster results in addition to the characters.

References

- Haksar, M. and Schwager, N. (2018) Distributed Deep Reinforcement Learning for Fighting Forest Fires with a Network of Aerial Robots. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 10671074.
- Jeelani, S. E. (2015.) Robotics and medicine: A scientific rainbow in hospital. Journal of Pharmacy & Bioallied Sciences 7(Suppl 2):, S381-S383.
- C. Xin, D. Qiao, S. Hongjie, L. Chunhe and Z. Haikuan, "Design and Implementation of Debris Search and Rescue Robot System Based on Internet of Things," in International Conference on Smart Grid and Electrical Automation (ICSGEA), 2018.
- K. Altaf, " Design and Construction of an Automated Fire Fighting Robot," in Proceedings of International Conference on Information and Emerging Technologies , 2007.
- <https://www.electronicshobby.com/sim900a-gsm-gprs-module-india>
- https://www.gravitechthai.com/product_detail.php?d=1488