IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Fire Fighting Robot Using Arduino

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Abstract:

Fire-Fighting is an extremely dangerous task but still often being carried out by human operators, thus putting human life, invaluable as it is, in a very precarious situation. In Industry oil and many other inflammable materials are used for production and other industrial purposes. Under such conditions the chance of fire accidents is more. So a suitable protective measure to extinguish the fire in case of fire accidents within the workplace should be employed. Today robotics is one of the fastest growing engineering fields and they are designed to remove the human factor from labor and dangerous work. The use of robots is more common today than ever before and Fire extinguisher robot becomes essential to protect the human life. Robot is a device, which performs human task or behave like a human-being. It needs expertise skills and complex programming to design. For designing a fire fighter robot, many sensors and motors were used [4]. The robot can detect and extinguish a fire by itself. Fire Fighting is a very dangerous task, and it involves working in a dangerous environment comprising of dense smoke, oxygen deficient atmosphere and elevated temperatures etc. Most of Fire Fighters suffer serious burn injuries, dense smoke obscures their vision [3]. There are several possibilities of fire in any remote area or in an industry. In worst cases scenario, fire causes heavy loses both financially and by taking lives, robotics is the best possible way to guard human lives, a fire-fighting robot is designed and built with an embedded system The use of robots is one of the alternative mediums for reducing fireman casualties and enhancing fireman capabilities. The robot is designed in such a way that it searches fire and tries to extinguish it. Hence in this work, A Novel Fire Fighting Robot with Arduino is presented.

Keywords:

Firefighting robot, flame sensor, Arduino Uno, Dc submersible pump

Methodology:

In this section, the prototype of robotic system is presented, in which it consists of IR flame sensors, servo motors, submersible water pump, motor driver, mini breadboard, BO motors, rubber wheels, processor, and communication module for exchanging data between the fire-fighting robot and Arduino software. The robot carries four main functions: First, it initializes itself i.e. its sensors gets initializes as the power is supplied. Second, robot

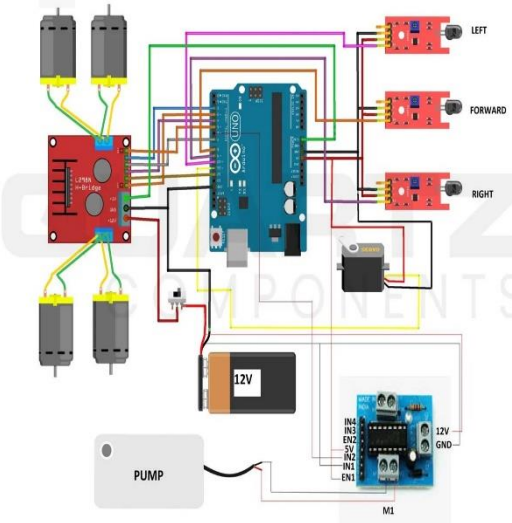
sense the surrounding environment (for instance for the level of temperature) and identify the fireplace. Third, robot sends the navigating information and starts to navigate itself towards the fireplace. Fourth, finally the robot starts to extinguish the fire with the help of servo motors and submersible water pump

Introduction:

Fire-Fighting is an extremely dangerous task but still often being carried out by human operators, thus putting human life, invaluable as it is, in a very precarious situation. In Industry oil and many other inflammable materials are used for production and other industrial purposes.

An Arduino Uno-based Fire Fighting robot is a technologically advanced and innovative solution designed to combat and mitigate the destructive impact of fires in various environments. Fires pose significant threats to both life and property, and traditional firefighting methods often entail substantial risks. This robot integrates cutting-edge hardware and software components with the Arduino Uno microcontroller, a versatile and widely used platform for building interactive and programmable electronic systems. The importance of the proposed thesis is to make a reliable, safe, and smart system to reduce limitations and faults like false alarms, which cause panic among the people and even the loss of money with the use of new technology and make the places safe from the hazardous fire. Additionally, having a compact size and automatic small and narrow spaces with hazardous environments such as tunnels or nuclear power plants Furthermore, this robot can increase productivity, safe, efficiency and quality of the task given A human operator can monitor the robot by using camera which connects to a smart phone or remote devices .Finally, robots can be used in
situations where human access is not possible, such as in collapsed buildings or in remote locations. The paper aims to motivate the robotics community to develop a real-world application based on what it can accomplish

Circuit Diagram :



.Design Structure :-

In this section, the prototype of robotic system is presented, in which it consists of IR flame sensors, servo motors, submersible water pump, motor driver, mini breadboard, BO motors, rubber wheels, processor, and communication module for exchanging data between the fire-fighting robot and Arduino software. Fig 2 shows the basic prototype of our firefighting robot. The robot carries four main functions: First, it initializes itself i.e. its sensors get initializes as the power is supplied. Second, robot sense the surrounding environment (for instance for the level of temperature) and identify the fireplace. Third, robot sends the navigating information and starts to navigate itself towards the fireplace. Fourth, finally the robot starts to extinguish the fire with the help of servo motors and submersible water pump.

Hardware implementation :

The hardware part is one of the crucial parts in the development of firefighting robot. It includes Arduino UNO, IR flame sensors, servo motors, submersible water pump, motor driver, mini breadboard, BO motors, and rubber wheels. Fig shows the block diagram of firefighting robot which consists of three IR flame sensors as the input of the system. Arduino UNO
is used as a micro-controller that connects other components. L293D Motor driver is used to drive motors and is capable of running two DC motors (Left DC motor and Right DC motor)

Hardware used :-

1. Arduino board (e.g., Arduino Uno)
2. IR flame sensors (3x)
3. Motor driver module (e.g., L298N)
4. DC water pump motor
5. Robot chassis with motors (typically DC motors) 6.
6.Power supply (e.g., battery pack)
7.Car chassis
8. Wheels with motor

1) ARDUINO UNO:

Fig. shows the Arduino UNO board. It is basically a micro-controller kit that is used to get data from peripheral devices (sensors, motors, etc.). The Arduino UNO Micro-controller board is based on the ATmega328P IC. The ATmega328P is good platform for robotics application which makes robot to extinguish fire in real time. Arduino UNO board consist the sets of

digital and analog pins that may act as an interface to various expansion boards and other circuits. It contains everything needed to support the microcontroller**.**

2) flame sensor :-

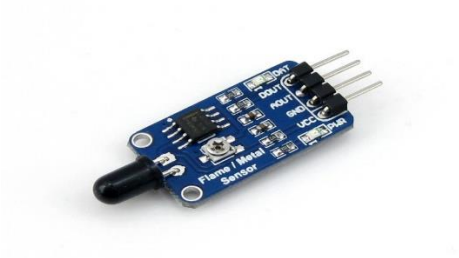


fig shows the IR Flame Sensor. The IR flame sensor senses the environment and detects the presence of fire or flame. The module is based on the IR receiver and basically detects the presence of flammable and harmful gases likes nitrogen, hydrogen, carbon mono oxide. The signal detection capacity is adjustable. The robot contains three flame sensors

3) Motor Drive Module :-

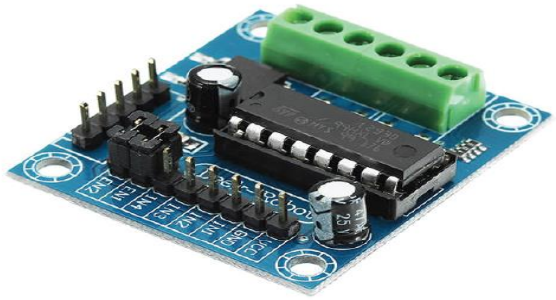
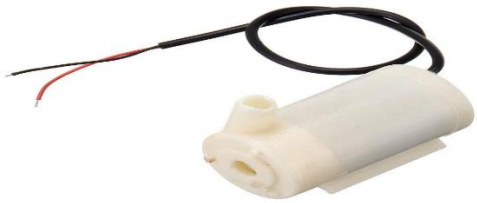


Fig .shows the L293D Motor Driver. L293D is a Motor Driver or Motor Driver IC which is responsible for the movement of DC motor on either direction. L293D is a 16-pin IC through which we are able to run two DC motors simultaneously in any direction

4) Servo Motor :

Fig shows the Servo Motors. Servo Motors are electronic devices that are mainly used for providing specific velocity and acceleration.

5) DC Submersible Water Pump :



The water pump is used to artificially supply water for a particular task. It can be electronically controlled by interfacing it to a microcontroller. It can be triggered ON/OFF by sending signals as required. The process of artificially supplying water is known as pumping. There are many varieties of water pumps used.

This project employs the use of a small water pump which is connected to a H-Bridge. The pumping of water is a basic and practical technique, far more practical than scooping it up with one's hands or lifting it in a hand-held bucket. This is true whether the water is drawn from a fresh source, moved to a needed location, purified, or used for irrigation, washing, or sewage treatment, or for evacuating water from an undesirable location. Regardless of the outcome, the energy required to pump. water is an extremely demanding component of water consumption. All other processes depend on or benefit either from water descending from a higher elevation or some pressurized plumbing system water is an extremely demanding component of water consumption. All other processes depend on or benefit either from water descending from a higher elevation or some pressurized plumbing system.

Working:

The main brain of this project is the Arduino, but in-order to sense fire we use the Fire sensor module. THE sensors have an IR Receiver (Photodiode) which is used to detect the fire. When fire burns it emits a small amount of Infra-red light, this light will be received by the IR receiver on the sensor module. Then we use an Op-Amp to check for change in voltage across the IR Receiver, so that if a fire is detected the output pin (DO) will give 0V(LOW) and if the is no fire the output pin will be 5V(HIGH).

We Detect The Direction of the fire we can use the motors to move near the fire by driving our motors through the L293D module. When near a fire we have to put it out using water. Using a small container we can carry water, a 5V pump is also placed in the container and the whole container is placed on top of a servo motor so that we can control the direction in which the water has to be sprayed**.**

Advantages:

1. The ability to detect the source of fire.
2. Extinguish it and increase the knowledge about fire behavior from the incident area.
3. Reduced Risk to Human Life.
4. Faster Response Time: Firefighting robots are capable of responding to emergency situations faster than human firefighters. This can be especially beneficial in situations where human firefighters may be delayed due to traffic, bad

weather, or other factors.

5. Increased Safety: Firefighting robots are able to enter dangerous environments that may be too hazardous for human firefighters. This is especially important when dealing with hazardous materials such as chemicals and toxic substances.
6. Enhanced Mobility: Firefighting robots are often equipped with powerful motors and can traverse terrain that may be difficult for humans to access. This can be very helpful in situations where the fire is located in an area that is not easily accessible to human firefighters.
7. Improved Accuracy: Firefighting robots are typically equipped with sophisticated sensors that can detect fire, heat, and smoke more accurately than the human eye. This helps to ensure that the fire is extinguished quickly and efficiently.
8. Cost Savings: Firefighting robots are often cheaper to operate than human firefighters. This can result in significant cost savings in terms of training, equipment, and manpower.

Applications:

1. Firefighting robots can enter burning buildings to locate and extinguish fires without endangering human lives.
2. They are used to suppress fires in industrial facilities where chemical or electrical hazards exist.
3. Firefighting robots assist in forest fire monitoring and control by navigating through rough terrain.
4. They help extinguish fires in confined or hard-to-reach spaces such as tunnels or basements.
5. Robots equipped with thermal imaging can detect hotspots and prevent fire re-ignition.
6. In hazardous material fires, robots minimize exposure to toxic fumes for first responders.

Future Scope :

The future of firefighting robots is very promising. In the coming years, it is expected that robots will become increasingly autonomous and will be able to navigate dangerous environments, detect and analyze fires, and take action to extinguish them. Additionally, robots could be used to search for and rescue victims, detect hazardous materials, and monitor situations remotely. There is also potential for robots to be equipped with thermal cameras, allowing them to detect hot spots and better direct firefighters on the ground.

Furthermore, the development of artificial intelligence and machine learning could allow robots to make decisions and coordinate with each other in more sophisticated ways. Finally, it is likely that robots will be used in more applications to assist firefighters, such as providing medical aid and helping to contain fires.

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 better and faster results addition to the characters

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