FIRE EXTINGUISHING ROBOT

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ABSTRACT

According to the National Crime Records Bureau (NCRB), it is estimated that more than 1.2 lakh deaths have. Been. Caused because of fire accidents in India from 2010-2014. Even though there are a lot of precautions taken. For Fire accidents, these natural/man-made disasters do occur now and then. In the event of a fire breakout, to rescue people and to put out the fire we are forced to use human resources which are not safe. With the advancement of technology especially in Robotics it is very much possible to replace humans with robots.to fight the fire.

This would improve the efficiency of firefighters and would also prevent them from risking human lives. Today we are going to build a Fire Fighting Robot using Arduino, which will automatically sense the fire and start the water pump.

In this project, we will learn how to build a simple robot using Arduino that could move towards the fire and pump out water around it to put down the fire.

The use of robots in firefighting has become increasingly common due to the dangers involved in such situations.

This project proposes the design and implementation of a firefighting robot using Arduino, a flame sensor, and a water pumps. The robot is intended to detect fire and extinguish it with the help of the water pump. The design of the robot involves the use of an Arduino board to control the various components, including the flame sensor and the water pump. The flame sensor is used to detect the presence of fire, and the water pump is used to spray water to extinguish the flames. The Arduino board processes the data from the flame sensor and sends signals to activate the water pump when required.

The robot is equipped with a water tank, which can be filled with water before deployment. The water pump is powered by a battery, which is also placed in the robot. The robot is designed to move autonomously.

The proposed design has several advantages over traditional firefighting techniques. First, it reduces the risk of injury to human firefighters. Second, it can access areas that are difficult for human firefighters to reach.

Third, it can operate in hazardous environments without risking human lives. Fourth, it can operate continuously without fatigue, unlike human firefighters.

In conclusion, the proposed firefighting robot using Arduino, flame sensor, and water pump is an efficient ineffective way to fight fires. It can reduce the risk of injury to human firefighters and operate in hazardous environments. Further research is required to improve the design and functionality of the robot.

Objective

The objective of a fire-fighting robot is to assist firefighters in extinguishing fires in hazardous and hard-to-reach areas. Fire-fighting robots are designed to perform tasks that are too dangerous for human firefighters to undertake or where access to the fire is restricted. The main goal of a fire-fighting robot is to reduce the risks involved in fire-fighting operations and to provide assistance to human firefighters in their efforts to extinguish the fire. The robot is typically equipped with sensors and cameras that can detect the location and intensity of the fire, as well as the presence of smoke and other hazardous conditions. Fire-fighting robots are often designed to be autonomous, meaning that they can operate independently of human intervention. They are equipped with advanced navigation systems that enable them to move around obstacles and navigate through complex environments. The robots are also designed to be highly maneuverable, allowing them to access tight spaces and areas that are difficult to reach. In addition to extinguishing fires, fire-fighting robots can also be used to perform other tasks related to firefighting, such as removing debris and providing support to

firefighters on the ground. Overall, the objective of a fire-fighting robot is to provide a safer and more effective means of fighting fires in hazardous environments.

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 initialized as the power is supplied. Second, robots sense the surrounding environment (for instance for the level of temperature) and identify thefireplace. Third, robots send the navigating information and start 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.

ATmega328P microcontroller (Arduino UNO):

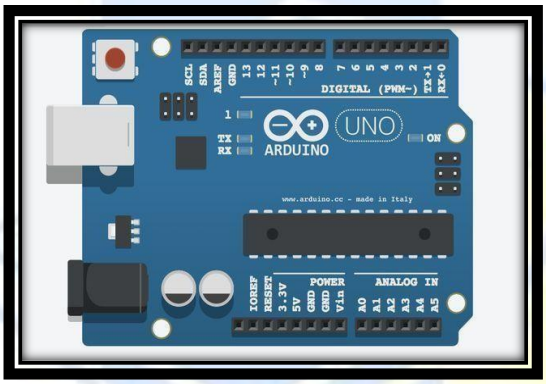

Fig 1: Arduino Uno microcontroller-based development board

A Microcontroller is a compact device with a processor, storage, and configurable input/output devices on a single integrated circuit. We'll be using the Arduino UNO board, which combines a microcontrollerwith all of the extras needed to quickly create and debug projects. The ATmega3288based UNO is a microcontroller board.

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people. just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) to load new code onto the board -- you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

Flame Sensor

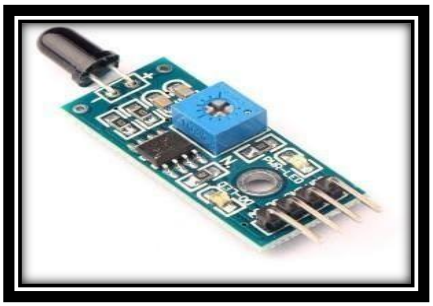

Fig 2 Flame sensor

A flame sensor is the most sensitive to normal light of any sensor. This sensor senses flame if thelight source emits a wavelength between 760nm and 1100nm.The detection angle would be 60oand can be achieved from 100cm. This sensor's output is either an analog or digital signal. The infrared flame flash method is used by this sensor as shown in Figure.

Fig shows the flame sensor. This sensor is able to detect a flame by sensing light wavelengths between 760 –1100 nanometers. The test distance depends on the flame size and sensitivity settings.The detection angle is 60 degrees, so the flame does not have to be right in front of the sensor.

There are two sensor outputs.

Submersible Water Pump:

Submersible Water Pump is ideal for making automatic watering system using Arduino. The water pump is an important part of the robot as it will pump water to extinguish the fire.

Motor Drivers:

The L298N is a dual H-Bridge motor driver which allows speed and direction control of two DC motors at the same time. The module can drive DC motors that have voltages between 5 and 35V, with a peak current up to 2A.

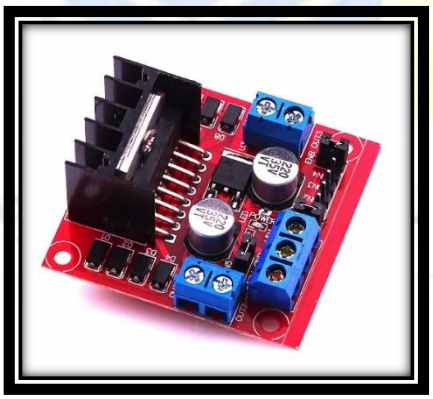

Fig 3 L298N Motor Driver Module Pinout

BO Motors

BO (Battery Operated) light weight DC geared motor which gives good torque and rpm at lower voltages. This motor can run at approximately 150 RPM when driven by a single Li-Ion cell.

Dc motor converts electrical energy into mechanical energy.

Why DC gear motor used in robot Motor control circuit?

DC MOTOR concept is where gears reduce the speed of the vehicle but increase its torque is known as gear reduction. In DC motor is assembled with multiple gear setup. Speed of motor is counted in terms of rotations of the soft per minute is called RPM. RPM means Revolution Per Minute. The setup assemble helps to increase the torque and reduce the motor speed. For all micro-controller-based Robots, this type of DC motor can be used.

Relay

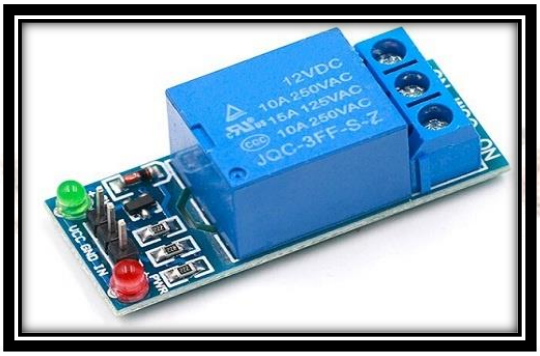

Figure 4. Relay

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A relay is a switch that is powered by electricity as shown in Figure 7. A magnetic field is generated by coil of the relay is which the current flows through, which attracts a lever and changes the switch contacts. There are two switch places on their lay, both of which are double throw switches. There isno electrical connection between the two circuits within the relay. Only magnetic and mechanical connections exist. Relays are incredibly basic instruments.

Robot chassis

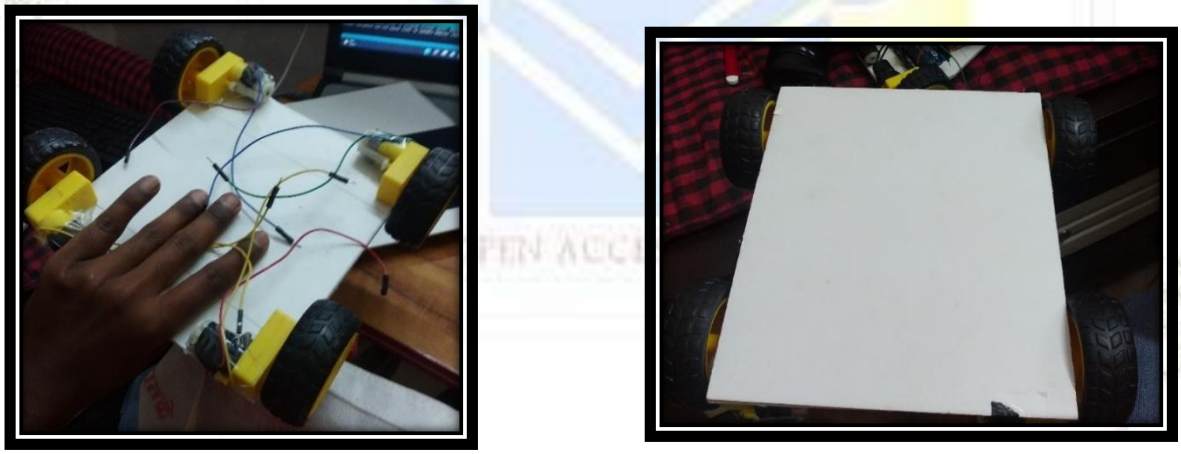

Fig 5 Fig Robot chassis

A robot's chassis is made using tough foam sheet, which is best material for prototyping of robot body. Motors are arranged as shown in the image above.

SOFTWARE USED:

Arduino IDE

For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on a programming language named Processing, which also supports the languages C and C++.The open source Arduino IDE makes it easy to write code and upload it tothe board.

Working Concept of Fire Fighting Robot:

The main brain of this project is the Arduino, but in-order to sense fire we use the **Fire sensor module** (flame sensor) that is shown below.

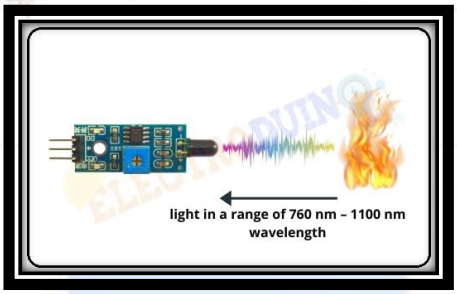

Fig 6 Fire Sensor Module

As you can see these sensors have an **IR Receiver (Photodiode)** which is used to detect the fire. Howis this possible? 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 acrossthe IR Receiver, so that if a fire is detected the output pin (DO) will give 0V(LOW) and if the is no firethe output pin will be 5V(HIGH).

So, we place three such sensors in three directions of the robot to sense on which direction the fire is burning.

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 containerwe can carry water, a 5V pump is also placed in the container and the whole container is placed on topof a **servo motor** so that we can control the direction in which the water has to be sprayed. Let's proceedwith the connections now

Circuit diagram

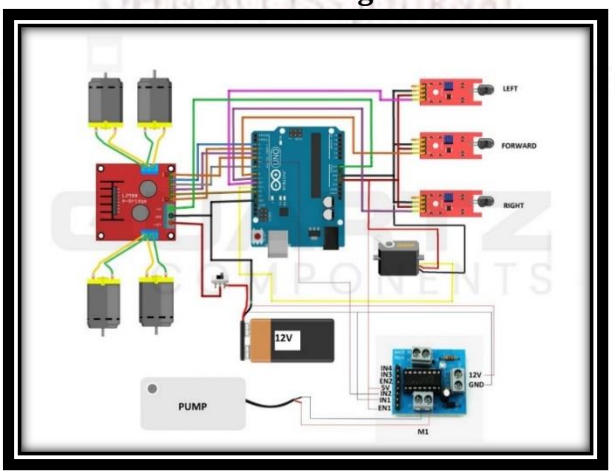

Fig 7 Circuit Diagram

The Arduino UNO development board issued to control this firefighting robotic system. A fire flame sensor (IR) for detecting and sensing the approaching fire are all mounted on a servomotor for obstacle detection and free path navigation. In addition, for extinguishing the flames, it also makes use of a water tank and a spray gun mechanism. With the aid of a 12V pump, water is pumped from the main water tank to the water nozzle.

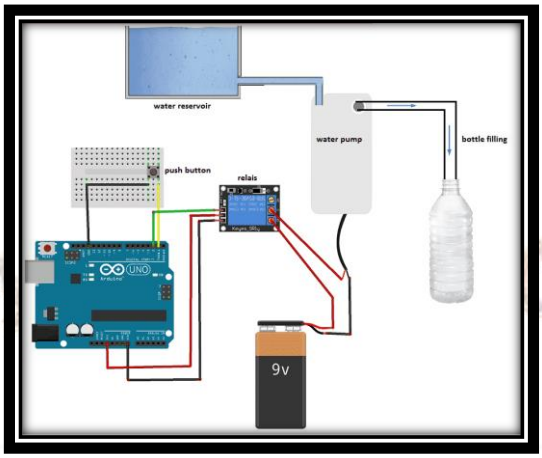

Fig 8 Circuit Diagram

RESULT DISCUSSION

Fire Fighting Robot has been developed to reduce human life lost and to develop such a device thatautomatically sense fire and extinguish it without human intervention. In this the fireplace is detected using the IR Flame sensors and are connected to Arduino UNO, which controls the movement of Motor drive that helps the robot to reach the fireplace and extinguishes it with the pumping mechanisms. In the industry if any fire accident occurs, there is a need for a personto monitor continuously and rectify it. In this process if any time delay takes place irreparableloss occurs in industry. The firefighting robot continuously monitors the surroundings and helps in extinguishing the fire. Fig 11 shows the overall prototype of Fire Fighting Robot

CONCLUSION

The paper not only demonstrates the effective implementation of a firefighting robot, but also adds new features that make it more realistic to recognize the severity of the fire and theform of gases present, which is critical to preventing further fire spread

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