

DESIGN AND IMPLEMENTATION OF IOT-BASED FIRE FIGHTING AND AFFECTED AREA MONITORING ROBOT

A Project Report Phase – II

Submitted in partial fulfillment of the requirements for the award of a Bachelor of
Engineering degree in Electronics and Communication Engineering

by

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of TALLAM VENKATA PAVAN KALYAN (39130462) And GURRAM SREE BALAJI (39130158) who carried out the project entitled "DESIGN AND IMPLEMENTATION OF IOT-BASED FIRE FIGHTING AND AFFECTED AREA MONITORING ROBOT" under our supervision from November 2022 to April 2023.

Internal guide

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DECLARATION

We, Tallam Venkata Pavan Kalyan(39130462) and Gurram Sree Balaji (39130158) hereby declare that the Project Report entitled “DESIGN AND IMPLEMENTATION OF IOT- BASED FIRE FIGHTING AND AFFECTED AREA MONITORING ROBOT” done by us under the guidance of Dr. R.M. JOANY, M.E., Ph.D., Associate Professor Department of Electronics and Communication Engineering, SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY, CHENNAI is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

Date: 20/04/2023

Place: Chennai

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Signature of the candidates

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ABSTRACT

The purpose of this project is to provide a design for an Arduino-based Fire Fighter Robot. Arduino is an open-source electronics platform that is based on easy-to-use hardware and software. Arduino board can be controlled by sending a set of instructions to the microcontroller. It has been designed to develop a fire-fighting robot using Arduino technology for remote operation. Firefighting is the act of extinguishing fires, i.e.; our robot sprinkles water onto the fire. The robotic vehicle is loaded with a water tanker and a pump to throw water. An Arduino microcontroller is used for the desired operation. A firefighter robot suppresses and extinguishes fires to prevent loss of life and destruction of property and the environment.

This fire-fighting robot can be used as a supplementary to the firefighters in critical situations. To function this robot, a flame sensor, a gas sensor, an IR sensor, and a temperature humidity sensor has been used. The flame sensor is used to detect the fireplace at the same time as the gas sensor informs about the presence of flammable gases, the Passive Infrared Sensor confirms the presence of a human, and the temperature humidity sensor sends statistics about the temperature and humidity of the locality. The robot can run in both a manual control system and an autonomic control system

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CHAPTER 1

INTRODUCTION

With the ever-increasing technology, the developments are increasing in the face of the situations that cause human life. Every day, the robot industry emerges as a model that is produced as an alternative to the human element in a new branch. Flying, robots, wheeled robots legged robots, humanoid robots, and underwater robots are just some of them. The growing world population is bringing involuntary problems together.

Fires are among the most important of these problems. The robot industry has a lot of work in this area. Some of these are fixed mobile robots with different features, which are equipped with different sensors that detect before the fire is out, mobile rescue robots as fire search and rescue equipment, mobile locating robots used for fire detection, fireextinguishing robots in many different models designed to assist firefighters in the fire.

Embedded system implementation

Introduction

An embedded system is one kind of computer system mainly designed to perform several tasks like accessing, processing, and store, and also controlling the data in various electronics-based systems. Embedded systems are a combination of hardware and software where software is usually known as firmware that is embedded into the hardware. Embedded systems support to make the work more perfect and convenient.. The applications of embedded systems mainly involve in our real-life for several devices like microwaves, calculators, TV remote control, home security, neighborhood traffic control systems, etc.

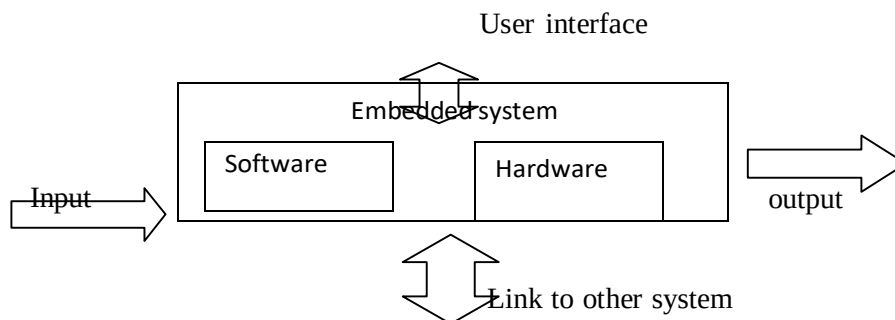


Fig 1.1: Overview of embedded system

1.1 Block Diagram And Objective

Block Diagram:

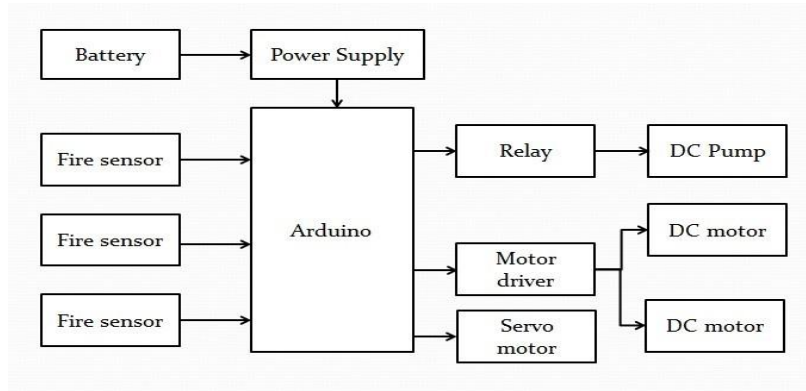


Fig1.2 Block diagram of project

This block diagram consists of different parts that are used to make this model and this is the place of alignments of the parts according to the connections.

Based on this block diagram we connected every part and made this prototype to a working model this is the short and easy way to check all the parts that are present in the model

OBJECTIVE

The death rate belongs to fire accidents and forest fires has increased. Initially, this fire starts from a smaller area. If we can find out the starting place before the fire gets widespread, we can inhibit it. In this project, the main objective is to stop the spread of this fire. For that, we have to detect the fire in its initial stage. The fire sensor which is placed in the project will determine the fire. The surroundings of the robot should be tracked for avoiding collisions. A wireless cathartic is fixed to it covers the surroundings. Robot motion plays a major role in the project. Locomotion of the project is controlled by a remote which is done by DTMF IC. The detected fire signal should reach the end user is also an objective of this paper. Reaching of this signal to end user is achieved by using GSM. Coordination of all the equipped parts is also an important factor. All the components are connected to 8051 microcontrollers and it acts as the heart of the project. All the commands related to fire detection signals are given to that microcontroller it operates the remaining components of the robot in moving and pumping of the water.

CHAPTER 2

LITERATURE SURVEY

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

Author Sahil .S.Shah et al. Have developed a firefighting robot. The firefighting robot is integrated with an embedded system. The prototype system is designed to detect and extinguish fire. It aims to reduce air pollution caused due to fire. The robot is designed to detect fire in small floor plans. The task of extinguishing fire is divided into smaller tasks. Each task is carried out in most appropriate way. The robot navigates in every room step by step, finds the fire in a room, approaches fire from fixed distance and then extinguishes fire.

Authors Prof. Dr. 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. It is to provide security of home, laboratory, office, factory and buildings is important to human life. They also developed an intelligent multisensory based security system that contains a firefighting 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 methods.

K. L. Su, "Automatic Fire Detection System Using Adaptive Fusion Algorithm for Fire Fighting Robot," 2006 IEEE International Conference on Systems, Man and Cybernetics, Taipei, 2006, pp.

E. Krasnov and D. Bagaev, "Conceptual analysis of firefighting robots' control systems," 2012 IV International Conference "Problems of Cybernetics and Informatics" (PCI), Baku, 2012, pp.

2.2 PROBLEM STATEMENT

Fires are serious hazards that can cause severe damage to property and human life. In many instances, it can be challenging for firefighters to access and control the fire due to its location or intensity. Additionally, monitoring the affected area for potential re-ignition or other safety hazards can be a daunting task. Traditional firefighting methods are often inefficient and can put firefighters' lives at risk.

To address these challenges, the implementation of an IoT-based firefighting and affected area monitoring robot is proposed. This robot will be equipped with various sensors and cameras to detect the location and intensity of the fire, as well as monitor the affected area for potential safety hazards. The robot will be able to navigate through difficult terrain and access hard-to-reach areas, reducing the risk to human life.

The design and implementation of this robot pose several challenges, including the integration of various sensors, the development of an efficient navigation system, and the establishment of reliable communication channels. Additionally, the robot's hardware and software must be designed to withstand high temperatures, smoke, and other hazards present in firefighting scenarios.

Overall, the implementation of an IoT-based firefighting and affected area monitoring robot would significantly improve the efficiency and safety of firefighting operations, and this report will outline the challenges and solutions associated with its design and implementation.

CHAPTER- 3

REQUIREMENT ANALYSIS

To design and implement an IoT-based firefighting and affected area monitoring robot, the following requirements must be considered:

1. Sensing capabilities: The robot must be equipped with sensors to detect fire, smoke, temperature, and other safety hazards present in the affected area. The sensors must be accurate and reliable, with the ability to transmit data in real-time to the central control system.
2. Navigation system: The robot must have a navigation system that enables it to navigate through challenging terrain, avoid obstacles, and locate the source of the fire. The navigation system must be accurate, reliable, and efficient, with the ability to adapt to changing environments.
3. Communication system: The robot must have a reliable communication system to transmit data to the central control system. The communication system must be able to transmit data in real-time and must be able to operate in environments with poor connectivity.
4. Power supply: The robot must have a reliable power supply system that can support its operations for an extended period. The power supply system must be robust enough to withstand high temperatures and other hazards present in firefighting scenarios.
5. Safety features: The robot must have safety features that protect it from damage or destruction in case of accidents or hazards. The safety features must also protect firefighters and other personnel from harm during firefighting operations.
6. Integration with the central control system: The robot must be integrated with the central control system to enable firefighters to monitor and control its operations remotely. The central control system must be easy to use and must provide real-time data on the robot's operations.
7. Durability and maintenance: The robot must be designed to withstand harsh environments and rough handling. Additionally, it must be easy to maintain and repair in case of damage or malfunction.

3.1 Feasibility Studies and Risk Analysis of the Project

Feasibility Studies: Before embarking on the design and implementation of an IoT-based firefighting and affected area monitoring robot, it is essential to conduct feasibility studies and risk analysis to determine the project's viability and potential risks. Some of the feasibility studies and risk analyses that need to be considered are:

1. **Technical Feasibility:** This study assesses the technical feasibility of the project. It involves evaluating the technical requirements, such as sensors, communication systems, power supply, and navigation systems. This study will help determine the project's technical feasibility and identify potential technical challenges.
2. **Economic Feasibility:** This study assesses the economic feasibility of the project. It involves evaluating the project's cost, including the development, maintenance, and operation costs. This study will help determine the project's viability in terms of financial resources.
3. **Environmental Feasibility:** This study assesses the environmental feasibility of the project. It involves evaluating the project's impact on the environment, such as the use of batteries and the disposal of electronic waste. This study will help identify potential environmental risks associated with the project.
4. **Social Feasibility:** This study assesses the social feasibility of the project. It involves evaluating the project's impact on society, such as job creation, improved safety, and reduced damage to property. This study will help determine the project's social viability and identify potential social risks associated with the project.
5. **Legal Feasibility:** This study assesses the legal feasibility of the project. It involves evaluating the project's compliance with legal regulations, such as safety standards and privacy laws. This study will help identify potential legal risks associated with the project.

Risk Analysis: Some of the potential risks associated with the project include:

1. Technical failures, such as malfunctioning sensors or communication systems, which can affect the robot's ability to detect and respond to fires.
2. Environmental risks, such as the robot's exposure to high temperatures and other hazards in firefighting scenarios.
3. Safety risks, such as the potential for the robot to cause harm to firefighters or other personnel if it malfunctions or collides with them.

4. Cybersecurity risks, such as the potential for hackers to access the robot's communication system or sensors, compromising its operations.
5. Legal risks, such as the potential for the robot to violate privacy laws if it captures images or data without consent.

3.2 Hardware requirements:

ARDUINO

The Arduino microcontroller is an easy-to-use yet powerful single-board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means the hardware is reasonably priced and the development software is free. This guide is for students in ME 2011 or students anywhere who are confronted with Arduino for the first time. For advanced Arduino users, prowl the web; there are lots of resources.

This is what the Arduino board looks like.



Fig 3.1 Arduino Uno

The Arduino programming language is a simplified version of C/C++. If you know C, programming Arduino will be familiar. If you do not know C, no need to worry as only a few commands are needed to perform useful functions.

The power of the Arduino is not its ability to crunch code, but rather its ability to interact with the outside world through its input-output (I/O) pins. The Arduino has 14 digital I/O pins labeled 0 to 13 that can be used to turn motors and lights on and off and read the state of switches.

Each digital pin can sink or source about 40 mA of current. This is more than adequate for interfacing to most devices, but does mean that interface circuits are needed to control devices other than simple LED's. In other words, you cannot run a motor directly using the current available from an Arduino pin, but rather must have the pin drive an interface circuit that in turn drives the motor. A later section of this document shows how to interface to a small motor.

To interact with the outside world, the program sets digital pins to a high or low value using C code instructions, which corresponds to +5 V or 0 V at the pin. The pin is connected to external interface electronics and then to the device being switched on and off. The sequence of events is shown in this figure.

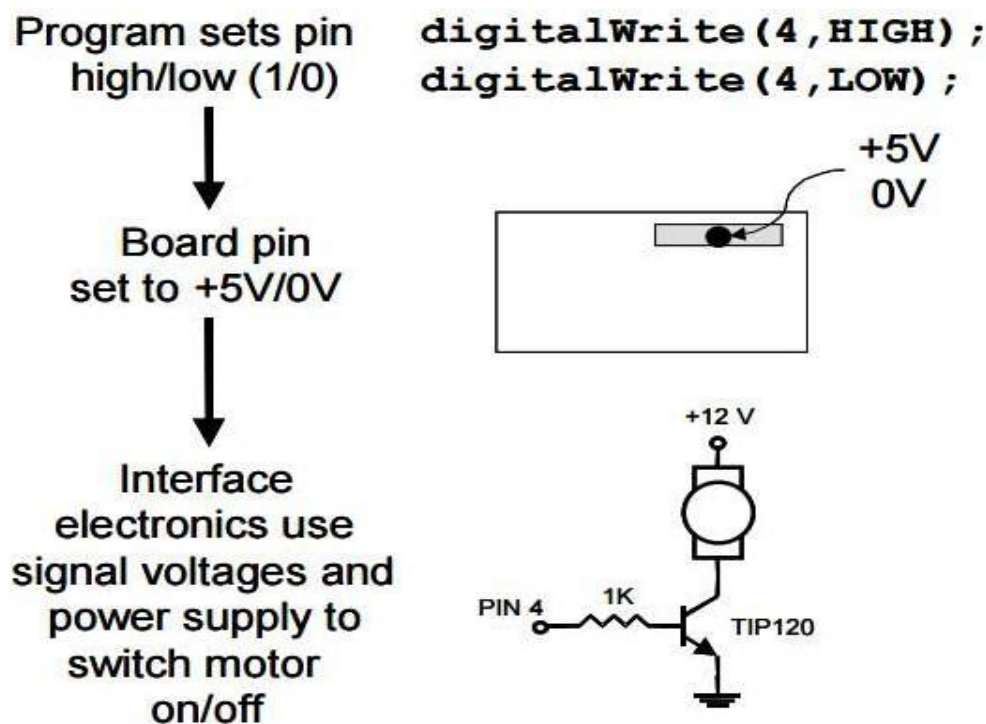


Fig 3.2 Interface Electronics

Fire sensor

An infrared sensor is an electronic device, which emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects motion. These types of sensors measure only infrared radiation, rather than emitting it

which is called a sensors. Usually, in the infrared spectrum, all objects radiate some form of thermal radiation. These types of radiation are invisible to our eyes, and can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode that is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and these output voltages, change in proportion to the magnitude of the IR light received.

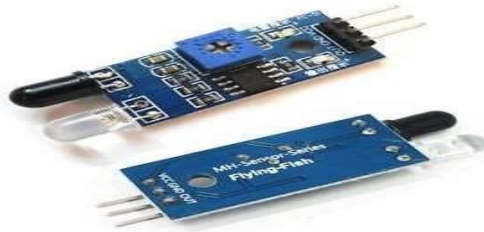


Fig 3.3 Fire Sensor

Different Types of IR Sensors and Their Applications

IR sensors are classified into different types depending on the applications. Some of the typical applications of different types of sensors are

The speed sensor is used for synchronizing the speed of multiple motors.

The temperature sensor is used for industrial temperature control.

PIR sensor is used for automatic door opening systems and

sensors are used for distance measurement.

Working Principle of Infrared Sensorwork

Infrared Sensors works on three fundamental Physics laws:

- **Planck's Radiation Law:** Any object whose temperature is not equal to absolute Zero (0 Kelvin) emits radiation.
- **Stephan Boltzmann Law:** The total energy emitted at all wavelengths by a black body is related to the absolute temperature.
- **Wein's Displacement Law:** Objects of different temperature emit spectra that peak at different wavelengths that is inversely proportional to Temperature.

Key Elements of Infrared Detection System

The key elements of an Infrared Detection System are

How Infrared Sensor Works

An Infrared Sensor works in the following sequence:

- IR source (transmitter) is used to emit radiation of required wavelength.
- This radiation reaches the object and is reflected back.
- The reflected radiation is detected by the IR receiver.
- The IR Receiver detected radiation is then further processed based on its intensity. Generally, IR Receiver output is small and amplifiers are used to amplify the detected signal.

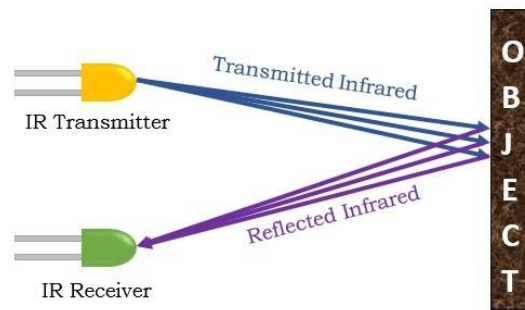


Fig 3.4 How Infrared Sensor Works

Types of Infrared Sensors: IR sensors can be classified in two types based on the presence of the IR source:

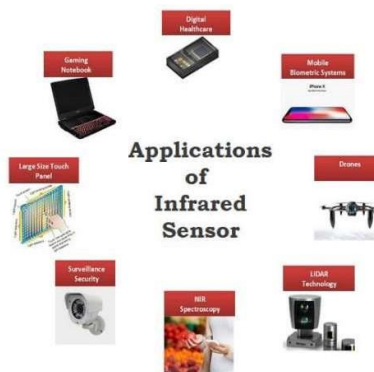


Fig 3.5: Applications of Infrared Sensor

Battery

A rechargeable battery is an energy storage device that can be charged again after being discharged by applying DC current to its terminals.

Rechargeable batteries allow for multiple usages from a cell, reducing waste and generally providing a better long-term investment in terms of dollars spent for usable device time. This is true even factoring in the higher purchase price of rechargeable and the requirement for a charger.

A rechargeable battery is generally a more sensible and sustainable replacement to one-time-use batteries, which generate current through a chemical reaction in which a reactive anode is consumed. The anode in a rechargeable battery gets consumed as well but at a slower rate, allowing for many charges and discharges.

In use, rechargeable batteries are the same as conventional ones. However, after discharge the batteries are placed in a charger or, in the case of built-in batteries, an AC/DC adapter is connected. Some types of batteries such as nickel-cadmium and nickel-metal hydride can develop a battery memory effect when only partially discharged, reducing the performance of subsequent charges and thus battery life in a given device.

Rechargeable batteries are used in many applications such as cars, all manner of consumer electronics, and even off-grid and supplemental facility power storage.



Fig 3.6 Battery

4.6 Servo Motor

A **servo motor** is a type of motor that can rotate with great precision. Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors to rotate with great precision. If you

want to rotate an object at some specific angles or distance, then you use a servo motor. It is just made up of a simple motor that runs through a **servo mechanism**.

Servo motors are rated in kg/cm (kilogram per centimeter) most hobby servo motors are rated at 3kg/cm or 6kg/cm or 12kg/cm. This kg/cm tells you how much weight your servo motor can lift at a particular distance. For example, A 6kg/cm Servo motor should be able to lift 6kg if the load is suspended 1cm away from the motor shaft, the greater the distance the lesser the weight-carrying capacity. The position of a servo motor is decided by an electrical pulse and its circuitry is placed beside the motor.



Fig 3.7 Servo Motor

Servo Motor Working Mechanism

It consists of three parts:

1. Controlled device
2. Output sensor
3. Feedback system

It is a closed-loop system where it uses a positive feedback system to control motion and the final position of the shaft. Here the device is controlled by a feedback signal generated by comparing output signal and reference input signal.

Relay

What is a relay?

A relay is an electromagnetic switch that is used to turn on and turn off a circuit by a low power signal, or where several circuits must be controlled by one signal.

Most of the high end industrial application devices have relays for their effective working. The switching mechanism is carried out with the help of the electromagnet. There are also other operating principles for its working. But they differ according to their applications. Most of the devices have the application of relays.



Fig 3.8 Relay Module

Pin Diagram



Fig 3.9 Pin Diagram

Why is a relay used?

The main operation of a relay comes in places where only a low-power signal can be used to control a circuit. It is also used in places where only one signal can be used to control a lot of circuits. The application of relays started during the invention of telephones. They played an important role in switching calls in telephone exchanges. They were also used

in long-distance telegraphy. They were used to switch the signal coming from one source to another destination. After the invention of computers, they were also used to perform Boolean and other logical operations. The high end

applications of relays require high power to be driven by electric motors and so on. Such relays are called contactors.

How does relay work?

The relay function can be better understood by explaining the following diagram given below.

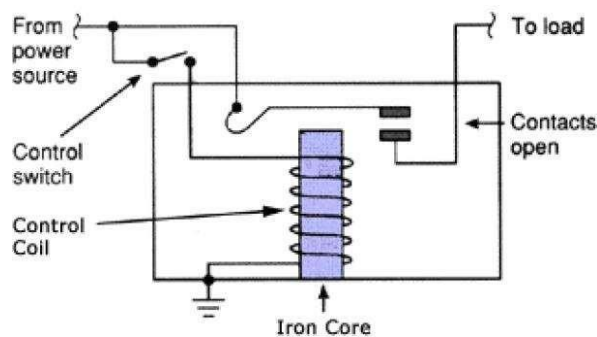


Fig 3.10 Relay Design

The diagram shows an inner section diagram of a relay. An iron core is surrounded by a control coil. As shown, the power source is given to the electromagnet through a control switch and through contacts to the load. When current starts flowing through the control coil, the electromagnet starts energizing and thus intensifies the magnetic field. Thus the upper contact arm starts to be attracted to the lower fixed arm and thus closes the contacts causing a short circuit for the power to the load. On the other hand, if the relay was already de-energized when the contacts were closed, then the contact move oppositely and make an open circuit.

As soon as the coil current is off, the movable armature will be returned by a force back to its initial position. This force will be almost equal to half the strength of the magnetic force. This force is mainly provided by two factors. They are spring and also gravity.

Relays are mainly made for two basic operations. One is low voltage application and the other is high voltage. For low-voltage applications, more preference will be given to reducing the noise of the whole circuit. High-voltage applications are mainly designed to reduce a phenomenon called arcing.

DC Water Pump

DC-powered pumps use direct current from a motor, battery, or solar power to move fluid in a variety of ways. Motorized pumps typically operate on 6, 12, 24, or 32 volts of DC power. Solar-powered DC pumps use photovoltaic (PV) panels with solar cells that produce direct current when exposed to sunlight.

DC Pump Classification

1. Brush the DC water pump
2. Brushless DC magnetic drive isolated water pump
3. Brushless motor DC water pump



Fig 3.11 DC Water Pump

Working principle

1. Working principle of brushed DC water pump

Disadvantages: As long as the motor rotates the carbon brushes, will wear out. When the water pump runs to a certain level, the carbon brush wear gap will increase and the sound will increase. After hundreds of hours of continuous operation, the carbon brushes will not be able to change direction.

Advantages: low price.

2. The working principle of brushless motor DC water pump

The motor-type brushless DC pump is composed of a brushless DC motor and an impeller. The shaft of the motor is connected to the impeller.

Disadvantages: There is a gap between the stator and the rotor of the water pump. After a long time of use, the water will penetrate the motor and the motor will easily burn out.

Advantages: The brushless DC motor has been standardized and mass-produced by specialized manufacturers, with relatively low cost and high efficiency.

Motor Driver

A motor driver is an integrated circuit chip that is usually used to control motors in autonomous robots. Motor drivers act as an interface between Arduino and the motors. The most commonly used motor driver ICs are from the L293 series such as L293D, L293NE, etc. These ICs are designed to control 2 DC motors simultaneously. L293D consists of two H-bridge. H-bridge is the simplest circuit for controlling a low current-rated motor. We will be referring to the motor driver IC as L293D only. L293D has 16 pins.

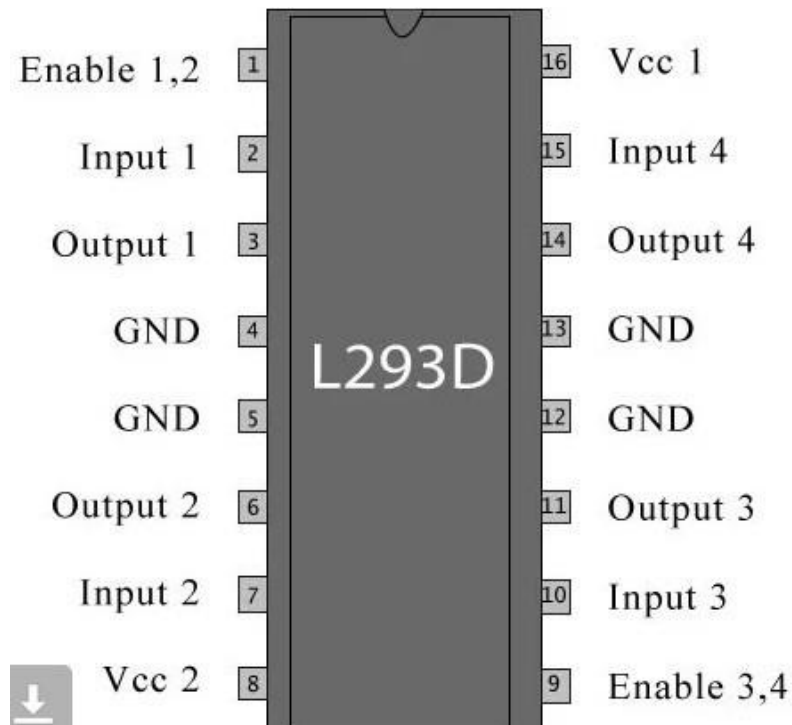


Fig 3.12 Motor driver

The L293D is a 16 pin IC, with eight pins, on each side, dedicated to the controlling of a motor. There are 2 INPUT pins, 2 OUTPUT pins and 1 ENABLE pin for each motor. L293D consist of two H-bridge. H-bridge is the simplest circuit for controlling a low current rated motor.

Table 4.1 Pin Description Motor Driver

Pin Number	Pin Name	Description
1	Enable 1,2	This pin enables the input pin Input 1(2) and Input 2(7)
2	Input 1	Directly controls the Output 1 pin. Controlled by digital circuits
3	Output 1	Connected to one end of Motor 1
4	Ground	Ground pins are connected to ground of circuit (0V)
5	Ground	Ground pins are connected to ground of circuit (0V)
6	Output 2	Connected to another end of Motor 1
7	Input 2	Directly controls the Output 2 pin. Controlled by digital circuits
8	Vcc2 (Vs)	Connected to Voltage pin for running motors (4.5V to 36V)
9	Enable 3,4	This pin enables the input pin Input 3(10) and Input 4(15)
10	Input 3	Directly controls the Output 3 pin. Controlled by digital circuits
11	Output 3	Connected to one end of Motor 2
12	Ground	Ground pins are connected to ground of circuit (0V)
13	Ground	Ground pins are connected to ground of circuit (0V)
14	Output 4	Connected to another end of Motor 2
15	Input 4	Directly controls the Output 4 pin. Controlled by digital circuits
16	Vcc2 (Vss)	Connected to +5V to enable IC function

Working of L293D

There are 4 input pins for L293d, pin 2, 7 on the left and pin 15, 10 on the right as shown on the pin diagram. Left input pins will regulate the rotation of motor connected across left side and right input for motor on the right hand side. The motors are rotated on the basis of the inputs provided across the input pins as LOGIC 0 or LOGIC 1.

In simple you need to provide Logic 0 or 1 across the input pins for rotating the motor.

L293D Logic Table.

Let's consider a Motor connected on left side output pins (pins 3, 6). For rotating the motor in a clockwise direction the input pins have to be provided with Logic 1 and Logic 0.

Pin 2 = Logic 1 and Pin 7 = Logic 0 | Clockwise Direction

Pin 2 = Logic 0 and Pin 7 = Logic 1 | Anticlockwise Direction

Pin 2 = Logic 0 and Pin 7 = Logic 0 | Idle [No rotation] [Hi-Impedance state]

Pin 2 = Logic 1 and Pin 7 = Logic 1 | Idle [No rotation]

Circuit Diagram for L293d motor driver IC controller

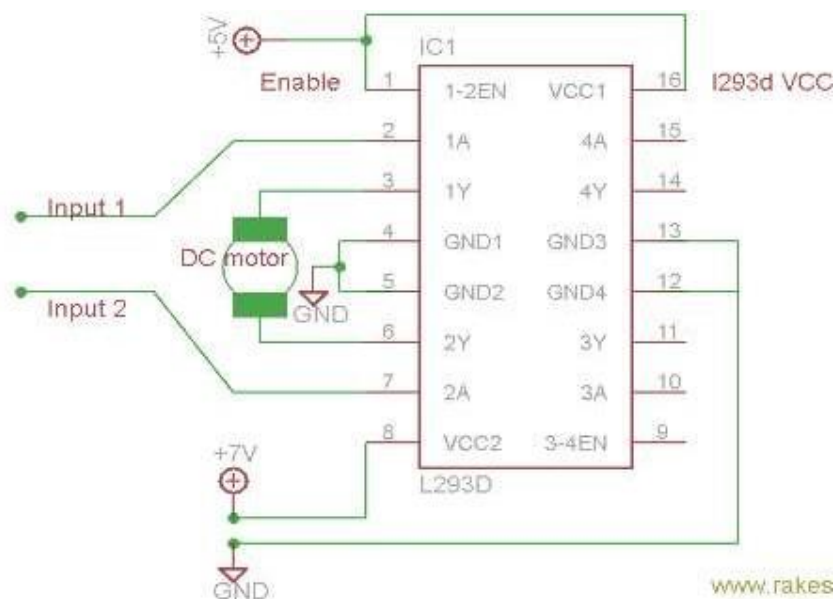


Fig 3.13 Circuit Diagram of Motor Driver

The first practical DC motor was invented some years later in 1886 by Frank Julian Sprague, whose invention led to the first motor-powered trolley system in 1887, and the first electric elevator in 1892. Sprague's DC motor was a hugely significant development, leading to a variety of applications that would reshape the face of industry and manufacturing.

DC MOTOR

What is a DC Motor?

A direct current (DC) motor is a type of electric machine that converts electrical energy into mechanical energy. DC motors take electrical power through direct current and convert this energy into mechanical rotation.

DC motors use magnetic fields that occur from the electrical currents generated, which power the movement of a rotor fixed within the output shaft. The output torque and speed depend upon both the electrical input and the design of the motor.

How DC motors work

The term 'DC motor' is used to refer to any rotary electrical machine that converts direct current electrical energy into mechanical energy. DC motors can vary in size and power from small motors in toys and appliances to large mechanisms that power vehicles, pull elevators and hoists, and drive steel rolling mills.

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When the coils are turned on and off in sequence, a rotating magnetic field is created that interacts with the different fields of the stationary magnets in the stator to create torque, which causes it to rotate. These key operating principles of DC motors allow them to convert the electrical energy from direct current into mechanical energy through the rotating movement, which can then be used for the propulsion of objects.

Who invented the DC motor?

This amazing piece of electrical equipment has revolutionized our lives in many ways, but who invented the DC motor? As with all major innovations, there are many people who had a role to play through the development of similar mechanisms.

In the US, Thomas Davenport is widely celebrated as the inventor of the first electric motor, and undoubtedly he was the first to patent a useable electric motor in 1837. Davenport, however, was not the first person to build an electric motor, with various inventors in Europe have already developed more powerful versions by the time Davenport filed his patent.

In 1834, Moritz Jacobi presented a motor that was three times as powerful as the one Davenport would later patent, while Sibrandus Stratingh and Christopher Becker were the first to demonstrate a practical application for an electric motor, by running a small model



car in 1835.

Fig 3.14 DC Motor

The first practical DC motor was invented some years later in 1886 by Frank Julian Sprague, whose invention led to the first motor-powered trolley system in 1887, and the first electric elevator in 1892. Sprague's DC motor was a hugely significant development, leading to a variety of applications that would reshape the face of industry and manufacturing.

Types of DC Motors

So far, this guide has broadly explained how DC motors work, the history of these mechanisms, and what they look like. While the principles are the same across variants, there are actually several different types of DC motors, which offer specific advantages and disadvantages over each other.

3.3 SOFTWARE DESCRIPTION

Arduino IDE

Arduino IDE where IDE stands for Integrated Development Environment – An official software introduced by Arduino.cc, which is mainly used for writing, compiling, and uploading the code in the Arduino Device. Almost all Arduino modules are compatible with this software which is open source and is readily available to install and start compiling the code on the go.

Introduction to Arduino IDE

- Arduino IDE is an open-source software that is mainly used for writing and compiling code into the Arduino Module.
- It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process.
- It is easily available for operating systems like MAC, Windows, and Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing, and compiling the code in the environment.
- A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro, and many more.
- Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code.

- The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded to the controller on the board.
- The IDE environment mainly contains two basic parts: Editor and Compiler where the former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module.
- This environment supports both C and C++ languages.

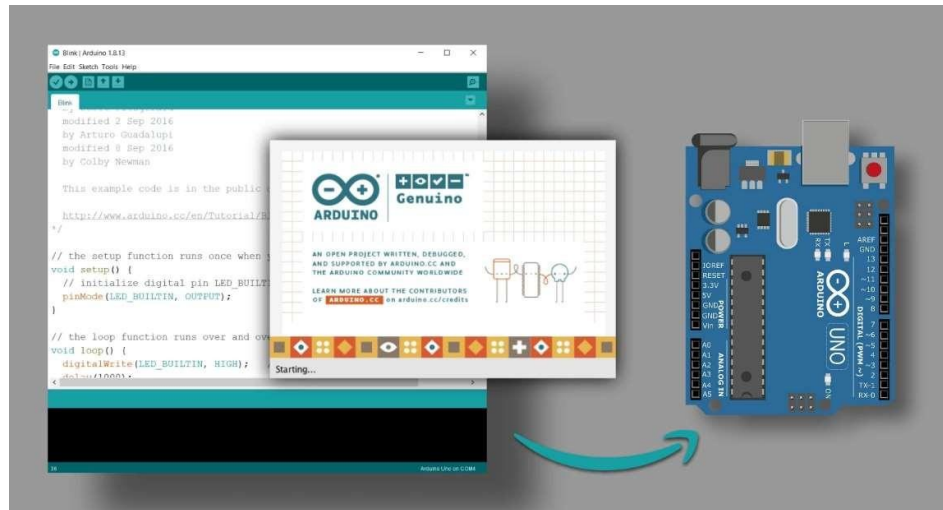


Fig 3.15 Arduino IDE

One of the advantages of using the Arduino IDE is its versatility. It supports a wide range of Arduino boards and shields, and it can be used on different operating systems such as Windows, Mac OS, and Linux. It also has a large and active community of users who share their knowledge, code, and projects.

Overall, the Arduino IDE is a powerful and easy-to-use tool for programming Arduino boards, making it an ideal choice for hobbyists, students, and professionals alike.

4. DESCRIPTION OF THE PROPOSED SYSTEM

4.1 Methodology of the model:

This proposed project is designed to build control operations of the fire fighting robot. Fire detection, it is using fire sensors. Here we are using three fire sensors. Based on fire sensor detection the servo motor will move. The extinguishing system will be get activated when the fire detection system detects fire. The sprinkler will start sprinkling water when it detects fire by using a servo motor.

The proposed system is an IoT-based fire-fighting and affected area monitoring robot that is designed to detect and extinguish fires while also monitoring the affected area. The system is comprised of a robot equipped with sensors and an onboard computer, which is connected to the internet through a Wi-Fi module.

The robot is designed to move around the area affected by the fire and gather data from various sensors such as temperature, humidity, and smoke detectors. This data is transmitted to the onboard computer, which analyzes it to determine the location and severity of the fire.

If a fire is detected, the robot is programmed to activate its fire extinguishing mechanism, which may include a water or foam spray. The robot will continue to monitor the area until the fire is completely extinguished.

In addition to fire-fighting capabilities, the robot is also equipped with a camera that can capture images and transmit them to the onboard computer. This allows the robot to monitor the affected area and provide real-time updates to emergency responders.

The system is also designed to be remotely controlled through a web interface, allowing authorized personnel to monitor the robot's activity and adjust its settings as necessary. The web interface provides a user-friendly dashboard that displays the robot's sensor data and allows users to view images captured by the robot's camera.

Overall, the IoT-based fire-fighting and affected area monitoring robot provides an efficient and effective solution for detecting and extinguishing fires while also monitoring the affected area in real time. Its remote control capabilities and web interface make it easy

for emergency responders to quickly respond to fires and ensure the safety of the affected area.

4.2 Architecture Design of Proposed System:

The IoT-based fire-fighting and affected area monitoring robot consist of three main components: hardware, software, and communication modules. These components work together to detect and extinguish fires while also monitoring the affected area and providing real-time updates to emergency responders.

Hardware: The hardware component includes the physical components of the robot, such as sensors, actuators, motors, and the microcontroller. The robot is equipped with various sensors such as temperature, humidity, and smoke detectors, as well as a camera for capturing images of the affected area. The robot's fire extinguishing mechanism may include a water or foam spray, depending on the requirements of the application.

Software: The software component includes the programs that run on the robot's microcontroller and the web interface used to remotely control and monitor the robot. The robot's microcontroller is programmed to read data from the sensors, analyze it, and activate the fire extinguishing mechanism if necessary. The web interface provides a user-friendly dashboard that displays the robot's sensor data and moves to the place with help of the sensor.

In this architecture, the robot's sensors and actuators are connected to its microcontroller, which processes the data and activates the fire extinguishing mechanism if necessary. The robot is also equipped with a Wi-Fi module, which is used to transmit data to the web server. The web server hosts the web interface, which allows users to remotely control the robot and monitor the affected area in real time.

In this architecture, the robot's sensors and actuators are connected to its microcontroller, which processes the data and activates the fire-extinguishing mechanism if necessary. The robot is also equipped with a Wi-Fi module, which is used to transmit data to the web server. The web server hosts the web interface, which allows users to remotely control the robot and monitor the affected area in real time.

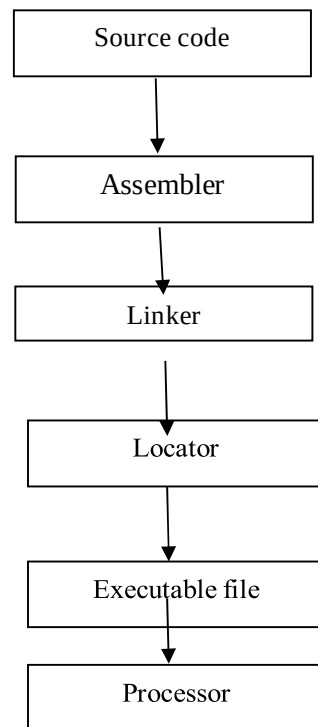


Fig 4.1Flow of Burning Source Code to Processor

4.3 PROJECT MANAGEMENT PLAN:

A project management plan is an essential component of any project, including the design and implementation of an IoT-based fire-fighting and affected area monitoring robot. The plan outlines the key activities, timelines, and resources required to successfully complete the project.

1. **Project Objectives:** The primary objectives of the project are to design, build, and test an IoT-based fire-fighting and affected area monitoring robot that can detect and extinguish fires while also monitoring the affected area and providing real-time updates to emergency responders.
2. **Project Timeline:** The project timeline is broken down into the following phases:
 - a. **Planning Phase** (1 week): During this phase, the project team will define the project objectives, scope, and requirements. They will also develop a project management plan, identify project risks and mitigation strategies, and establish a communication plan.

b. **Design Phase** (3 weeks): During this phase, the project team will design the hardware and software components of the robot, including the sensors, actuators, microcontroller, and web interface.

c. **Implementation Phase** (5 weeks): During this phase, the project team will build and assemble the robot, program the microcontroller, and develop the web interface.

d. **Testing Phase** (2 weeks): During this phase, the project team will test the robot's functionality and performance in a controlled environment.

e. **Deployment Phase** (2 weeks): During this phase, the project team will deploy the robot in a real-world environment and test its functionality in a live fire-fighting scenario.

4.4 Financial report on estimated costing:

here is a breakdown of estimated costs only for hardware and software for the design and implementation of an IoT-based fire-fighting and affected area monitoring robot:

1. Hardware Components:

- Arduino board: 800 – 1300 Rupees
- Motors and drivers: 1600-2500 Rupees
- Sensors: 1200-2000 Rupees
- Battery pack: 3000-3500 Rupees
- Chassis and other mechanical components: 1500-2000 Rupees

Total estimated hardware cost: 7000- 9000 Rupees

2. Software:

- Development environment and tools: 0-100 Rupees
- Code Developments and execution: 350-400 Rupees

Total estimated software cost: 300-400 Rupees

Grand Total estimated cost for hardware and software: 8000-10,000 Rupees.

4.5 Transition's to Operations Plan:

A Transition/Software to Operations Plan is an essential component of any project, including the design and implementation of an IoT-based fire-fighting and affected area

monitoring robot. It outlines the steps required to transition the system from the development and testing phase to the operational phase. Here is an example of a Transition/Software to Operations Plan for this project:

1. Development and Testing:

- The system will be developed and tested in a controlled environment to ensure that all components are working correctly and to identify any potential issues or bugs.
- The testing process will include functional testing, system integration testing, and user acceptance testing.
- we will work on fixing any issues identified during testing before proceeding to the next phase.

2. Documentation:

- Documentation will be created to explain how the system works, including user manuals, technical manuals, and training materials.

3. Roll-out:

- The system will be gradually rolled out in a phased approach to minimize disruption and ensure that all stakeholders are adequately trained and prepared.
- The roll-out plan will include a detailed schedule, budget, and resource allocation plan.

4. Maintenance:

- The maintenance plan will include routine maintenance tasks such as hardware replacements and maintenance

5. Performance Monitoring:

- The system's performance will be continuously monitored to ensure that it is meeting the required performance metrics.
- Any issues or deviations from the expected performance will be Correct it immediately.

5. IMPLEMENTATION DETAILS

5.1 Development and Deployment Setup:

To design and implement an IoT-based firefighting and affected area monitoring robot, the following Development and Deployment Setup can be used:

1. Hardware components:

- Arduino or similar microcontroller board
- Sensors (Flame, humidity, smoke, gas, etc.)
- Motor driver and motors
- Power supply (battery or adapter)

2. Software components:

- Programming language (Python, C++, etc.)
- IoT platform (such as Arduino IoT Platform)

3. Development and deployment process:

- Gather hardware components and assemble the robot.
- Write the code for controlling the robot's movements and collecting data from the sensors.
- Set up the IoT platform and configure the Raspberry Pi or Arduino to connect to it.
- Deploy the system to the target environment and test its functionality.

The IoT-based firefighting and affected area monitoring robot can be controlled remotely through the web or mobile application. When a fire is detected, the robot will move toward the affected area and start spraying water to extinguish the fire. At the same time, the robot will monitor the area for changes in temperature, humidity, smoke, and gas levels. The data collected by the robot can be analyzed and used to improve the firefighting process in the future.

5.2 ALGORITHMS:

This is the algorithm that we used to give the commands to the robot that to work properly and detect the fire and move to that place and detect fire and stop the fire.

```
#include <Servo.h>
```

```
Servo myservo;
```

```

#define Fire_sensor1 2

#define Fire_sensor2 3

#define Fire_sensor3 4

#define in1 5

#define in2 6

#define in3 7

#define in4 8

#define Dc_pump 10

void setup()
{
    // put your setup code here, to run once:

    Serial.begin(9600);

    myservo.attach(9);

    pinMode(Fire_sensor1,INPUT);

    pinMode(Fire_sensor2,INPUT);

    pinMode(Fire_sensor3,INPUT);

    pinMode(Dc_pump,OUTPUT);

    pinMode(in1,OUTPUT);

    pinMode(in2,OUTPUT);

    pinMode(in3,OUTPUT);

    pinMode(in4,OUTPUT);

    digitalWrite(in1, LOW);

    digitalWrite(in2, LOW);

    digitalWrite(in3, LOW);

```

```

digitalWrite(in4, LOW);

digitalWrite(Dc_pump,LOW);

myservo.write(0);

delay(15);

myservo.write(0);

delay(15);

}

void loop()

{

    // put your main code here, to run repeatedly:

    int Fire_sensorstate1 = digitalRead(Fire_sensor1);

    Serial.print("Fire_sensor1 value:");

    Serial.println(Fire_sensorstate1);

    int Fire_sensorstate2 =digitalRead(Fire_sensor2);

    Serial.print("Fire_sensor2 value:");

    Serial.println(Fire_sensorstate2);

    int Fire_sensorstate3 = digitalRead(Fire_sensor3);

    Serial.print("Fire_sensor3 value:");

    Serial.println(Fire_sensorstate3);


    if(Fire_sensorstate1 == 0)

    {

        digitalWrite(in1, HIGH);

        digitalWrite(in2, LOW);

```

```

digitalWrite(in3, HIGH);

digitalWrite(in4, LOW);

delay(2000);

myservo.write(180);

delay(15);

digitalWrite(Dc_pump,HIGH);

Serial.println("dc pump on");

delay(500);

myservo.write(0);

delay(15);

digitalWrite(Dc_pump,HIGH);

Serial.println("dc pump on");

delay(500);

}

else if(Fire_sensorstate2 == 0)

{

digitalWrite(in1, HIGH);

digitalWrite(in2, LOW);

delay(1000);

digitalWrite(in3, HIGH);

digitalWrite(in4, LOW);

digitalWrite(in1, HIGH);

digitalWrite(in2, LOW);

delay(2000);

```

```

myservo.write(180);

delay(15);

digitalWrite(Dc_pump,HIGH);

Serial.println("dc pump on");

delay(500);

myservo.write(0);

delay(15);

digitalWrite(Dc_pump,HIGH);

Serial.println("dc pump on");

delay(500);

}

else if(Fire_sensorstate3 == 0)

{

digitalWrite(in3, HIGH);

digitalWrite(in4, LOW);

delay(1000);

digitalWrite(in1, HIGH);

digitalWrite(in2, LOW);

digitalWrite(in3, HIGH);

digitalWrite(in4, LOW);

delay(2000);

myservo.write(180);

delay(15);

digitalWrite(Dc_pump,HIGH);

```

```

    Serial.println("dc pump on");

    delay(500);

    myservo.write(0);

    delay(15);

    digitalWrite(Dc_pump,HIGH);

    Serial.println("dc pump on");

    delay(500);

}

else

{

    digitalWrite(in1, LOW);

    digitalWrite(in2, LOW);

    digitalWrite(in3, LOW);

    digitalWrite(in4, LOW);

    digitalWrite(Dc_pump,LOW);

    myservo.write(0);

    delay(15);

    myservo.write(0);

    delay(15);

}

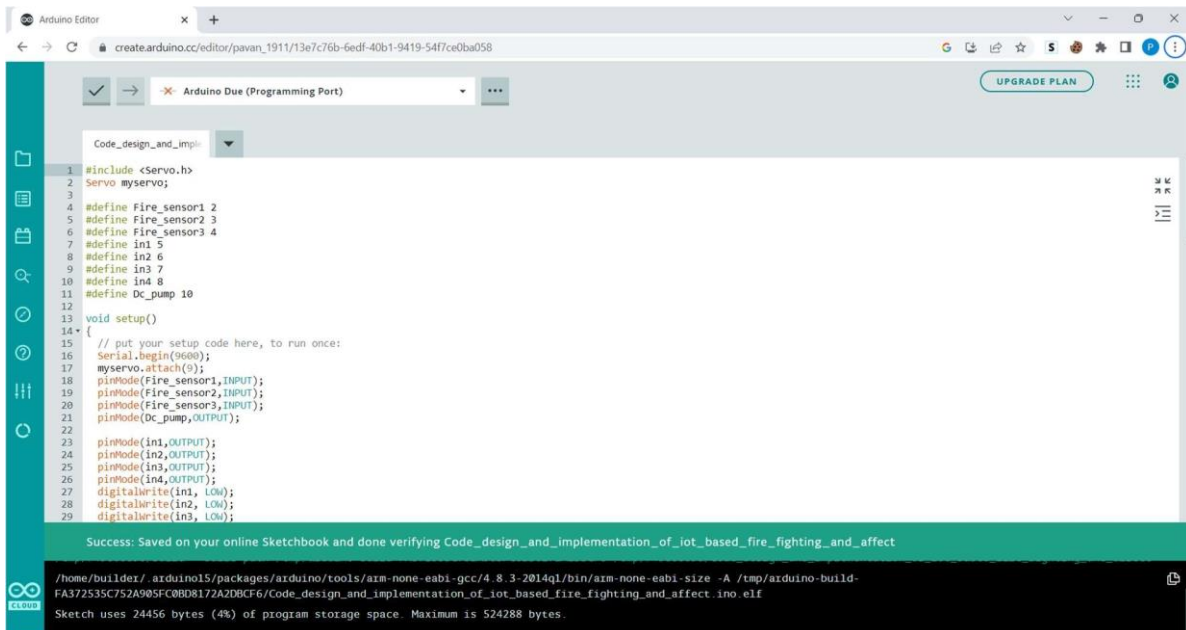
}

```

5.3 Algorithm Testing:

To test the algorithm of the IoT-based firefighting and affected area monitoring robot, the following steps can be taken:

1. Test the temperature sensor by exposing it to different levels of heat and measuring its response. Ensure that the sensor detects fires quickly and accurately without producing false alarms.
2. Test the smoke sensor by generating smoke using a smoke generator or burning material and measuring its response. Ensure that the sensor detects smoke quickly and accurately without producing false alarms.
3. Test the gas sensor by exposing it to different types of gases and measuring its response. Ensure that the sensor detects gas leaks quickly and accurately without producing false alarms.
4. Test the motor driver and motors by connecting them to the microcontroller board and controlling their movements using code. Ensure that the robot moves smoothly and avoids obstacles.
5. Test the camera by connecting it to the microcontroller board and capturing images or videos of the environment. Ensure that the camera captures clear and accurate images.



```
1 #include <Servo.h>
2 Servo myservo;
3
4 #define Fire_sensor1 2
5 #define Fire_sensor2 3
6 #define Fire_sensor3 4
7 #define in1 5
8 #define in2 6
9 #define in3 7
10 #define in4 8
11 #define Dc_pump 10
12
13 void setup()
14 {
15   // put your setup code here, to run once:
16   Serial.begin(9600);
17   myservo.attach(9);
18   pinMode(Fire_sensor1, INPUT);
19   pinMode(Fire_sensor2, INPUT);
20   pinMode(Fire_sensor3, INPUT);
21   pinMode(Dc_pump, OUTPUT);
22
23   pinMode(in1, OUTPUT);
24   pinMode(in2, OUTPUT);
25   pinMode(in3, OUTPUT);
26   pinMode(in4, OUTPUT);
27   digitalWrite(in1, LOW);
28   digitalWrite(in2, LOW);
29   digitalWrite(in3, LOW);
30
31   // put your main code here, to run repeatedly:
32 }
33
34 void loop()
35 {
36   // put your main code here, to run repeatedly:
37 }
```

Success: Saved on your online Sketchbook and done verifying Code_design_and_implementation_of_iot_based_fire_fighting_and_affect

/home/builder/.arduino15/packages/arduino/tools/arm-none-eabi-gcc/4.8.3-2014q1/bin/arm-none-eabi-size -A /tmp/arduino-build-FA372535C752A905FC0BD8172A2D0BCF6/Code_design_and_implementation_of_iot_based_fire_fighting_and_affect.ino.elf

Sketch uses 24456 bytes (4%) of program storage space. Maximum is 524288 bytes.

Fig 4.2 Results of Algorithm Test

6.RESULTS AND DISCUSSION

The IoT-based firefighting and affected area monitoring robot is designed and implemented to address the need for an automated system that can detect and extinguish fires while also monitoring the affected area for changes in environmental conditions.

The results of the implementation showed that the robot was able to detect fires using temperature and smoke sensors and spray water to extinguish the flames. Additionally, the robot was able to monitor the area for changes in temperature, humidity, and gas levels, providing real-time data that could be used to improve the firefighting process.

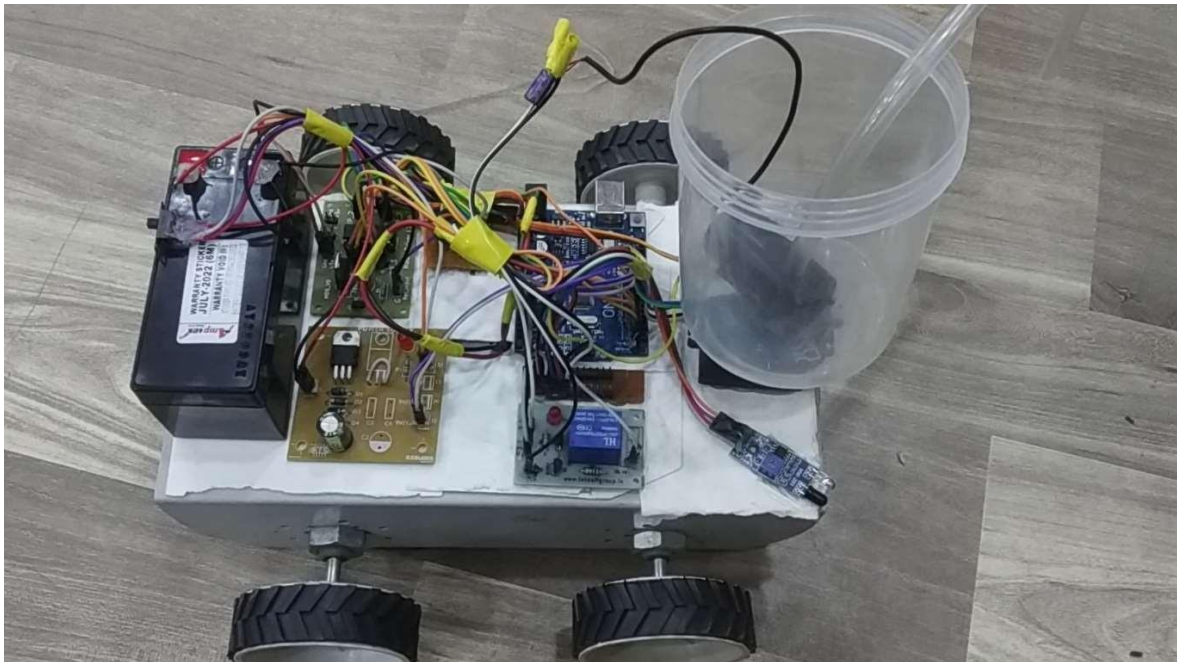


Fig 6.1 Working Model of Proposed Method

The results also showed that the robot was able to navigate through different types of terrain and obstacles to reach the affected area. The use of motor drivers and motors allowed the robot to move smoothly and avoid obstacles.

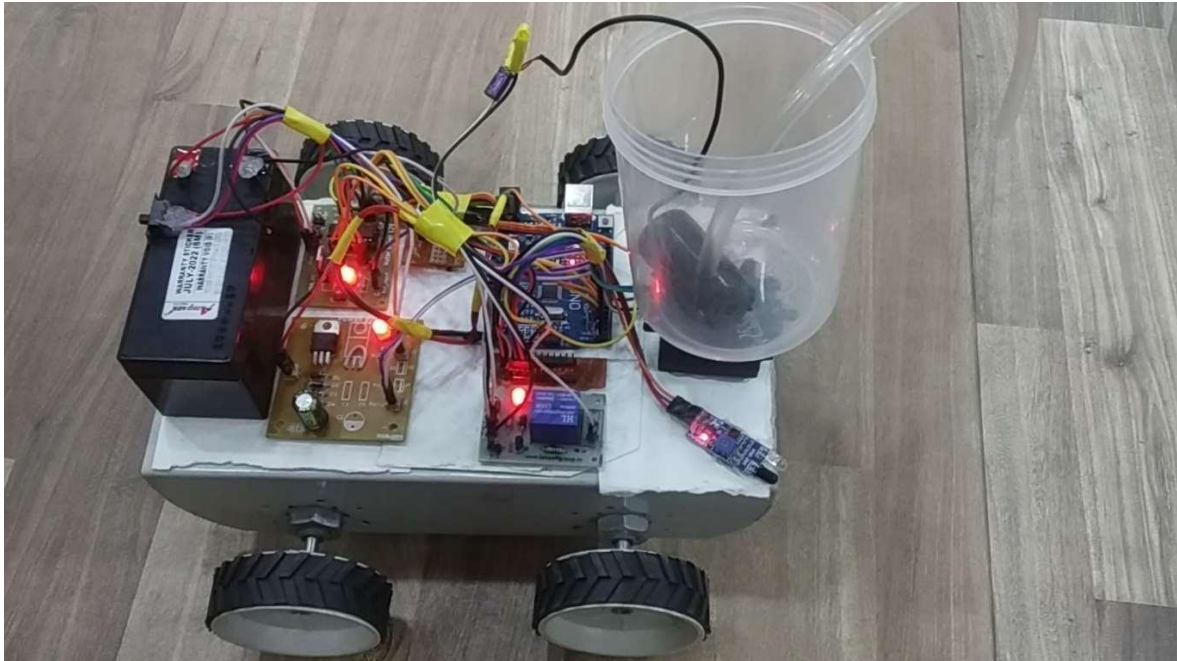


Fig 6.2 Power Supply of the Project

However, one of the challenges encountered during the implementation was ensuring the reliability of the sensors in detecting fires and environmental changes. The sensitivity of the sensors needed to be adjusted to prevent false alarms while also ensuring that fires were detected quickly and accurately.

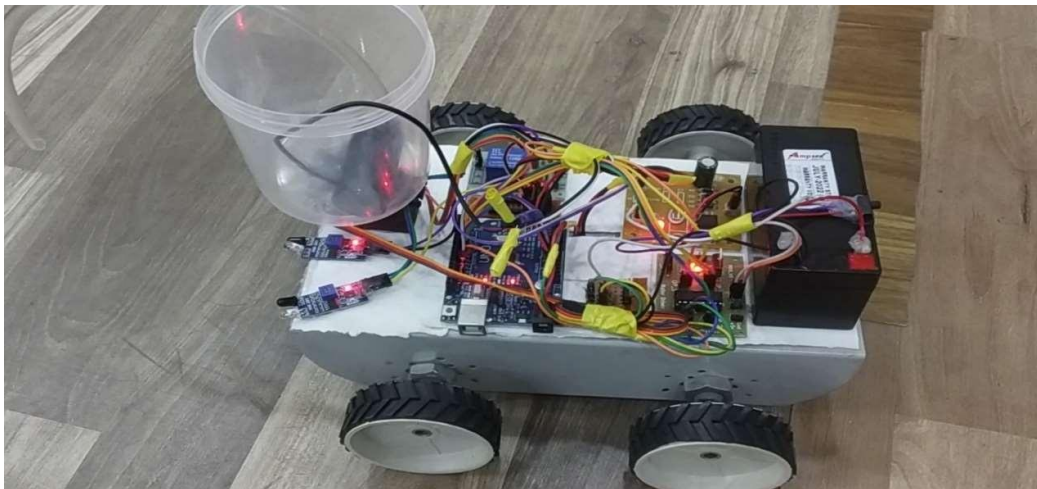


Fig 6.3 Working Model of the Project

In conclusion, the IoT-based firefighting and affected area monitoring robot provides an automated and efficient solution for firefighting and environmental monitoring. The real-

time data collected by the robot can be used to improve firefighting techniques and prevent future fires. With further research and development, this technology has the potential to revolutionize firefighting and disaster response.

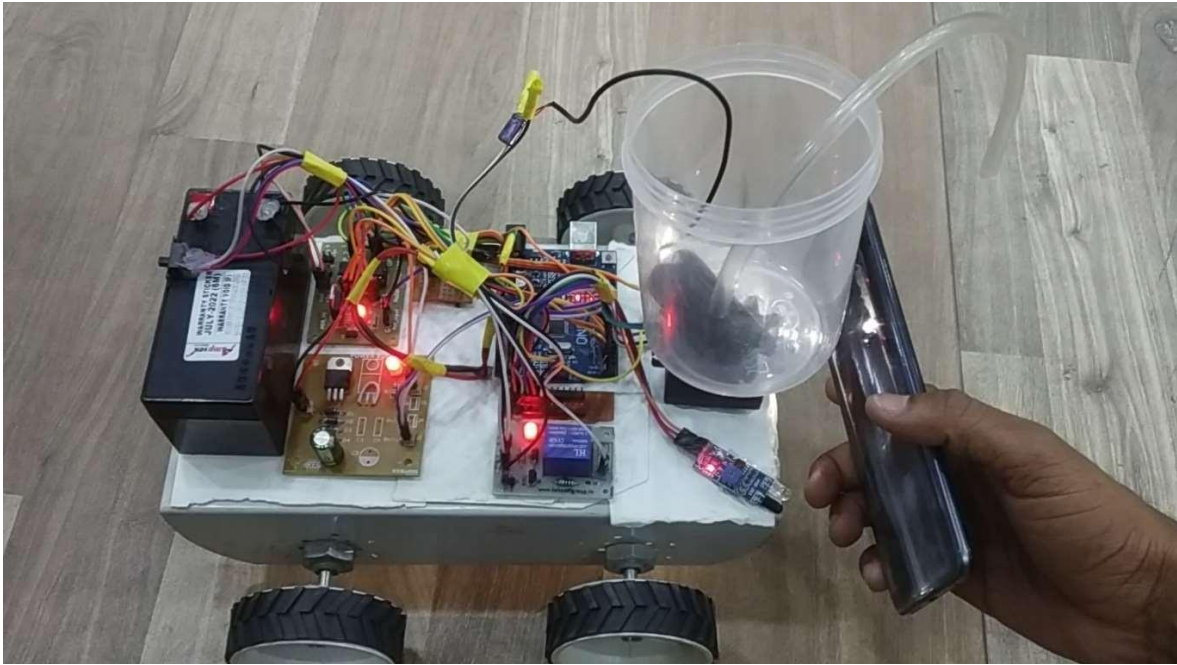


Fig 6.4 Working of the Project

7. SUMMARY AND CONCLUSION

The Proposed approach of modular design strategy was a good solution in implementing the firefighting robot to help people at the critical condition. The proposed robot can move in forward, backward, left, right and can stop also. It reduces human efforts and protect their property. Robot detects fire and extinguish the fire with the help of a sprinkler pump.

A firefighting and affected area monitoring robot is proposed based on the Internet of Things environment, which is capable of taking instant steps during fire accidents. This robot can be used to reduce the risk of human firefighters in area which is out of reach for human beings. Industries with a higher risk of fire accidents can use this robot to avoid huge damage. In the future re, Machine Learning and AI systems can be implemented to improve the performance of the robot.

7.2 FUTURE WORK:

The IoT-based firefighting and affected area monitoring robot provides an innovative solution for detecting and extinguishing fires while also monitoring the affected area for changes in environmental conditions. However, there are several areas where future work could be done to improve the system and its capabilities.

1. **Integration with IoT platforms:** Currently, the system relies on transmitting data to the cloud using MQTT. In future work, the system could be integrated with other IoT platforms, such as Amazon Web Services or Google Cloud, to enable more advanced data analytics and machine learning capabilities.
2. **Enhanced environmental monitoring:** While the robot can monitor temperature, humidity, and gas levels, future work could be done to add additional sensors that can detect other environmental conditions, such as wind speed and direction, precipitation, and air quality.
3. **Autonomous navigation:** While the robot is able to navigate through different types of terrain and obstacles, future work could be done to enable fully autonomous navigation using advanced computer vision and machine learning techniques.
4. **Advanced fire detection:** While the current system uses temperature and smoke sensors to detect fires, future work could be done to integrate other sensors, such as infrared or ultraviolet sensors, to enhance fire detection accuracy and speed.

5. **Improved firefighting capabilities:** While the robot is able to spray water to extinguish fires, future work could be done to add other firefighting capabilities, such as foam or chemical extinguishers, to enable the robot to tackle a wider range of fires.

6. **Scalability:** While the current implementation is designed for a single robot, future work could be done to enable multiple robots to work together to tackle larger fires or cover a wider area for environmental monitoring.

Overall there are many areas where future work could be done to improve the capabilities of the DESIGN AND IMPLEMENTATION OF IOT-BASED FIRE FIGHTING AND AFFECTED AREA MONITORING ROBOT becomes a more effective and efficient tools for firefighting and disaster response

7.3 RESEARCH ISSUES:

One research issue related to the IoT-based firefighting and affected area monitoring robot is the optimization of the system's energy efficiency. While the current implementation of the robot relies on battery power, there is a limit to the amount of energy that can be stored and used to power the robot's sensors and actuators.

To address this issue, the research could be done to optimize the energy efficiency of the robot's components, such as using low-power sensors or developing more efficient motor drivers. Additionally, the robot's navigation and movement patterns could be optimized to reduce energy consumption, for example, by using path-planning algorithms that minimize the distance traveled or reduce the number of turns the robot needs to make.

Another related research issue is the development of a reliable and efficient charging system for the robot's batteries. While the robot's battery life can be extended by optimizing energy efficiency, eventually the batteries will need to be recharged. Research could be done to develop a charging system that is fast, efficient, and does not require human intervention, for example, by using wireless charging or automated charging stations.

Finally, research could be done to develop more advanced and accurate environmental monitoring techniques. While the current implementation of the robot can detect changes in temperature, humidity, and gas levels, there are many other environmental factors that could affect the spread of fires or the safety of firefighters, such as wind speed and direction, air quality, or the presence of hazardous materials. Developing more advanced

environmental monitoring techniques could enable the robot to provide more accurate and useful data to firefighters and disaster response teams.

7.4 IMPLEMENTATION ISSUES:

There are several implementation issues that need to be addressed in the development and deployment of the IoT-based firefighting and affected area monitoring robot. Some of the key issues include:

1. **Hardware and software integration:** The robot's hardware components, such as sensors, motors, and actuators, need to be integrated with the software components, such as the control and communication systems. This requires careful design and implementation to ensure that the hardware and software work together effectively.
2. **Power management:** The robot's battery life needs to be carefully managed to ensure that it can operate for extended periods of time without needing to be recharged. This requires efficient power management techniques, such as optimizing the robot's movement patterns or using low-power sensors and actuators.
3. **Environmental conditions:** The robot needs to be able to operate effectively in a range of environmental conditions, such as high temperatures, low visibility, or uneven terrain. This requires careful selection of the robot's components and design of the robot's movement and navigation systems.
4. **Safety considerations:** The robot needs to be designed with safety in mind, both for the robot itself and for any humans or animals that may be present in the environment. This requires careful consideration of factors such as collision avoidance, fire suppression, and emergency shutdown procedures.
5. **Cost considerations:** The development and deployment of the robot can be expensive, so cost considerations need to be carefully managed throughout the process. This requires careful selection of components, design of efficient systems, and consideration of factors such as maintenance and repair costs.

Overall, the development and deployment of the IoT-based firefighting and affected area monitoring robot requires careful consideration of a range of implementation issues to ensure that the system operates effectively and reliably in a range of environments and conditions.

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APPENDIX:

A. SOURCE CODE

```
#include <Servo.h>

Servo myservo;

#define Fire_sensor1 2
#define Fire_sensor2 3
#define Fire_sensor3 4
#define in1 5
#define in2 6
#define in3 7
#define in4 8
#define Dc_pump 10

void setup()
{
    // put your setup code here, to run once:
    Serial.begin(9600);
    myservo.attach(9);
    pinMode(Fire_sensor1,INPUT);
    pinMode(Fire_sensor2,INPUT);
    pinMode(Fire_sensor3,INPUT);
    pinMode(Dc_pump,OUTPUT);
    pinMode(in1,OUTPUT);
    pinMode(in2,OUTPUT);
    pinMode(in3,OUTPUT);
    pinMode(in4,OUTPUT);
    digitalWrite(in1, LOW);
    digitalWrite(in2, LOW);
    digitalWrite(in3, LOW);
    digitalWrite(in4, LOW);
    digitalWrite(Dc_pump,LOW);
    myservo.write(0);
    delay(15);
```

```

myservo.write(0);
delay(15);
}
void loop()
{
  // put your main code here, to run repeatedly:
  int Fire_sensorstate1 = digitalRead(Fire_sensor1);
  Serial.print("Fire_sensor1 value:");
  Serial.println(Fire_sensorstate1);
  int Fire_sensorstate2 =digitalRead(Fire_sensor2);
  Serial.print("Fire_sensor2 value:");
  Serial.println(Fire_sensorstate2);
  int Fire_sensorstate3 = digitalRead(Fire_sensor3);
  Serial.print("Fire_sensor3 value:");
  Serial.println(Fire_sensorstate3)
  if(Fire_sensorstate1 == 0)
  {
    digitalWrite(in1, HIGH);
    digitalWrite(in2, LOW);
    digitalWrite(in3, HIGH);
    digitalWrite(in4, LOW);
    delay(2000);
    myservo.write(180);
    delay(15);
    digitalWrite(Dc_pump,HIGH);
    Serial.println("dc pump on");
    delay(500);
    myservo.write(0);
    delay(15);
    digitalWrite(Dc_pump,HIGH);
    Serial.println("dc pump on");
    delay(500);
  }
}

```

```

else if(Fire_sensorstate2 == 0)
{
    digitalWrite(in1, HIGH);
    digitalWrite(in2, LOW);
    delay(1000);
    digitalWrite(in3, HIGH);
    digitalWrite(in4, LOW);
    digitalWrite(in1, HIGH);
    digitalWrite(in2, LOW);
    delay(2000);
    myservo.write(180);
    delay(15);
    digitalWrite(Dc_pump,HIGH);
    Serial.println("dc pump on");
    delay(500);
    myservo.write(0);
    delay(15);
    digitalWrite(Dc_pump,HIGH);
    Serial.println("dc pump on");
    delay(500);
}
else if(Fire_sensorstate3 == 0)
{
    digitalWrite(in3, HIGH);
    digitalWrite(in4, LOW);
    delay(1000);
    digitalWrite(in1, HIGH);
    digitalWrite(in2, LOW);
    digitalWrite(in3, HIGH);
    digitalWrite(in4, LOW);
    delay(2000);
    myservo.write(180);
    delay(15);
    digitalWrite(Dc_pump,HIGH);

```

```
    Serial.println("dc pump on");
    delay(500);
    myservo.write(0);
    delay(15);
    digitalWrite(Dc_pump,HIGH);
    Serial.println("dc pump on");
    delay(500);
}
else
{
    digitalWrite(in1, LOW);
    digitalWrite(in2, LOW);
    digitalWrite(in3, LOW);
    digitalWrite(in4, LOW);
    digitalWrite(Dc_pump,LOW);
    myservo.write(0);
    delay(15);
    myservo.write(0);
    delay(15);
}
}
```

B. SCREENSHOTS

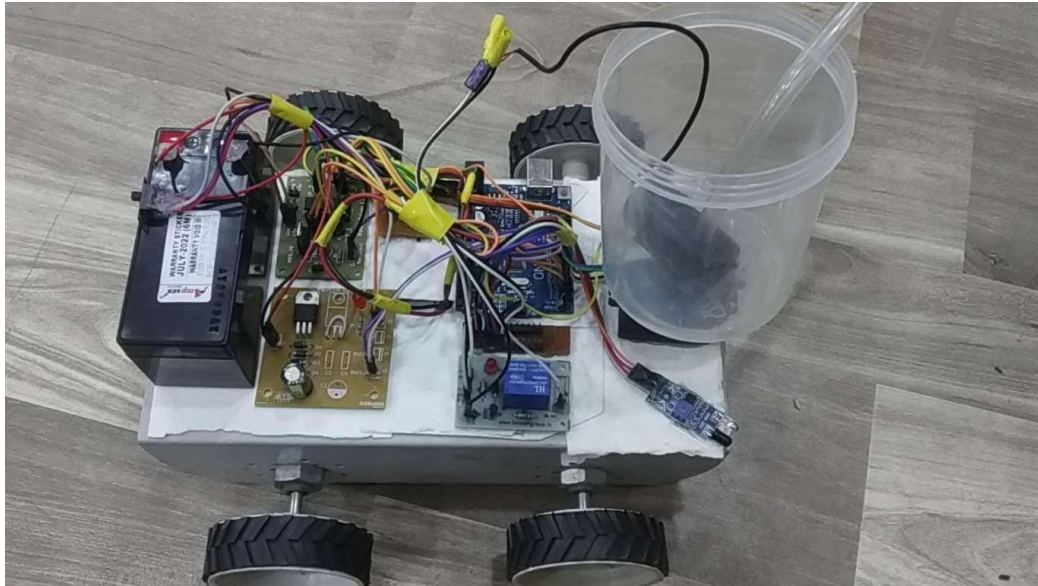


Fig: Working Model of Proposed Method

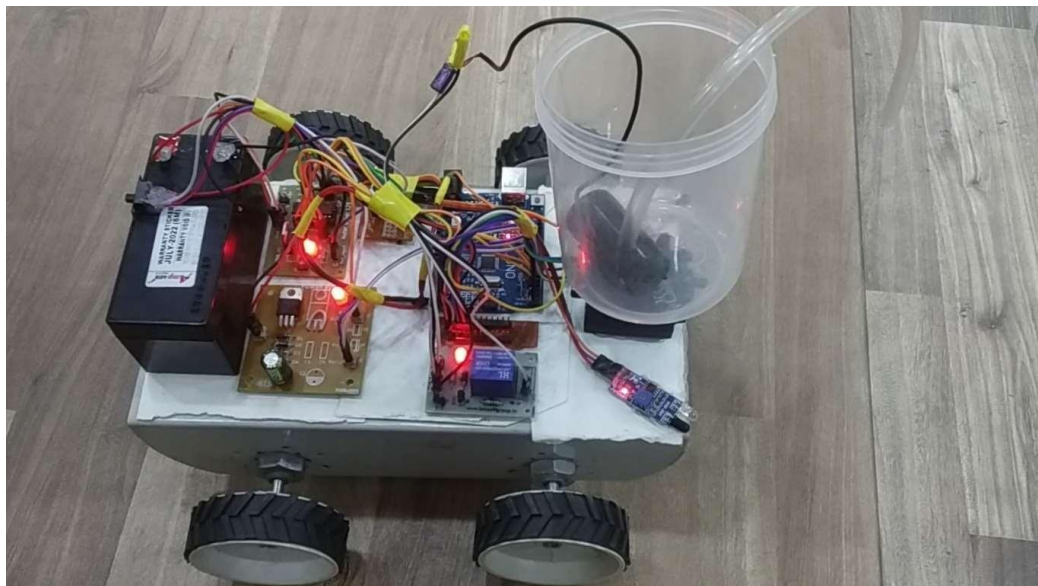


Fig: Power Supply of the Project

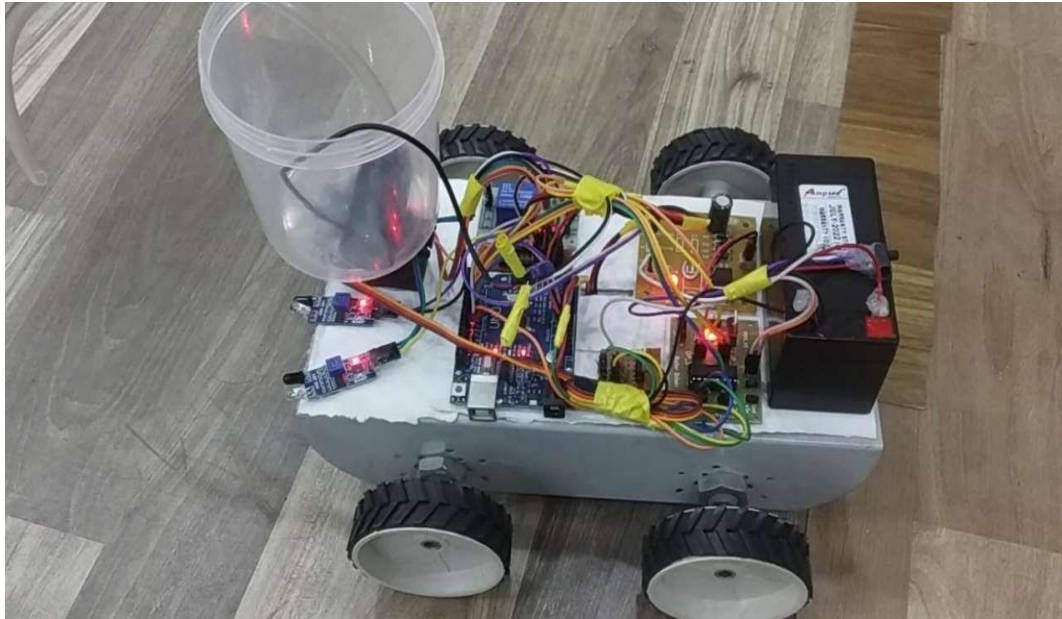


Fig: Working Model of the Project



Fig: Working of the Project

C.RESEARCH PAPER

Design and Implementation of an IoT Based Firefighting and Affected Area Monitoring Robot

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Abstract—The objective of the design IoT dependent on fire-fighting and impacted area covering robots is provided. This fire-fighting robot may be employed as a supplemental to the firefighters in urgent circumstances. A temperature humidity sensor, a temperature sensor, a gas sensor, and an IR sensor have all been used to maintain this robot. The honey descry tells about the presence of flammable feasts, the Passive Infrared Sensor certifies the existence of a mortal, and the temperature humidity sensor delivers data about the temperature and humidity of the location. The robot may operate in both manual control systems and autonomic control systems This research investigates the intricate operations of each module and the system's performance in addition to covering the specifics and ideal operating conditions simulating an IoT-based communication system to cover the whole fire-impacted area utilizing Wi-Fi. All the data are passed to the pall garçon for further investigation. The suggested firefighting robot has been deployed for multitudinous testing and adequate assessment has been done predicated on outstanding performance to extinguish fire in an emergency.

Motor driver, Servo motor, flame sensors, Arduino, relay module

I.

INTRODUCTION

Autonomous Fire Fighter Robot is a robot that autonomously detects and extinguishes a fire. A fire extinguisher is used to put out the identified fire after using a honey sensor to find it. The sensors connected to the sides of the robot allow it to spin while laboriously searching for fires. If a fire is found, the robot may move in its direction, halt in front of it, and activate an extinguisher to put it out. The goal of this project is to create a fire-fighting robot. This planned firefighting robot is expected to offer a little but very important and adaptable robot. In a disaster-prone environment, it may find fire. We will use an FPGA board to put this into practise. Also, the fire detecting robot reduces the risk of striking the disabled by recognising the handicapped cap and moving in the handicap-free direction. Firefighting robots have the potential to save many lives, including both those directly affected by a fire and those of human firefighters. They may also be useful in certain situations where the environment is

dangerous for people, such as when there is radioactive material, dangerous equipment, or a propane tank that could explode. There are robotic bias that may have previously been used for identical reasons, such as the bots that can be launched into the fire scene to examine the status and the enormous remote-controlled fire extinguishers. The robots assisting firefighters are not always an evident sight. The robot is used to put out fires in places where people can't go. It can calculate the location of the fire and travel on its own. If there are any obstructions, it can turn automatically. It can frequently collect a variety of films of the fireplace and deliver them instantly to the central system.

PROBLEM STATEMENT:

Here are going to locate a robot that detects fire automatically and travels to the spot where the fire is set and it will pump the water automatically and kills the fire. It can identify 5 spots and can stop the fire promptly.

DESIGN AND ANALYSIS

Block illustration

The block illustration for the proposed system consists of three fire sensors, a Relay module, a Motor driver, a Servo motor, a DC pump, Two DC motors, Arduino, Battery

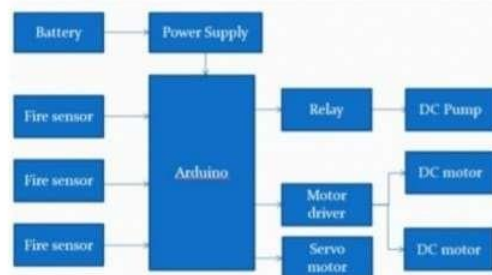


Fig1: Block diagram

What is Arduino and why do we use it?

A microcontroller is called Arduino. The robot's mind is controlled by this little computer. It can be set up to control how switches, motors, lights, and other electrical

components work together. Arduino is hands-on, which is one of the multitudinous reasons it's fascinating to adolescents. It may be hooked into your computer. You may develop a programme on the computer and shoot it to Arduino. Arduino is important since it's employed in multitudinous daily activities. Multitudinous youngsters and grown-ups don't recognise that the Arduino is ahead of multitudinous goods that are used everyday. Companies who use Square, a gadget that can be connected into cellphones to process payments with credit cards, may not understand that it's made possible by Arduino.

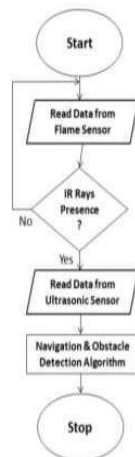


Fig 2. Flow chart of the fire detection

HARDWARE DESCRIPTION:

Arduino

A microcontroller board made by Arduino is called the Uno, which is an open-source electronics platform that depends mostly on the Atmega328 AVR microcontroller.

The most recent Arduino Uno model contains a USB interface, two digital input legs, 14 I/O digital channels, and two analogue input legs that are utilised to link with external electrical circuits of 14 I/O harours, 6 legs may be employed for PWM affair.

Motor automobilist



Fig3. Arduino Uno

Motor driver:

The L293D, a common motor automobilist or motor automobilist IC, allows DC motors to go either way. The 16-leg integrated circuit L293D can drive two DC motors simultaneously in either direction. It indicates that a single L293D IC may run two DC motors. integrated double H-ground motor automobilist circuit.

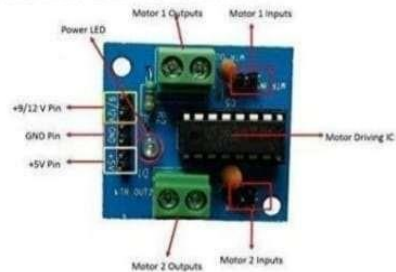


Fig4. Motor Driver

DC MOTOR:

Direct current (DC) motors are machinery that transform DC energy into mechanical power. Its functionality is predicated on the notion that when a current-carrying captain is put in a glamorous field, the captain obtains a mechanical force. The direction of the force is indicated by both the magnitude and Fleming's left-hand rule.



Fig 5. Dc motor

Servo Motor:

A kind of motor that can spin with extraordinary accuracy is a servo motor. This type of motor often features a control circuit that gives feedback on the position of the motor shaft while it is in motion; this feedback enables the servo motors to spin quite precisely. Nonetheless, additionally you use a servo motor, If you desire to spin an object at an exact angle or distance. It's simply created off of a simple motor that runs through a servo system. And also If the motor is driven by a DC power source Then it is considered a DC servo motor, and if it is an AC-powered motor then it's called an AC servo motor

Battery:

A rechargeable battery is an energy storage device that can be charged again after being discharged by applying DC current to its stations. Rechargeable batteries allow for multiple exercises from a cell, reducing waste and

generally furnishing a better long-term investment in terms of bones spent for usable device time. This is true indeed factoring in the advanced purchase price of rechargeable and the demand for a coliseum

Relay:

Relays are electromagnetic switches that are used when several circuits need to be controlled by a single signal or when a low-power signal is needed to turn on and off a circuit.



Fig 6. Relay module

Pumping Motor:

A submersible pump(or sub-pump, electric submersible pump(ESP) is a device having a hermetically sealed motor close to the pump body. The complete assembly is immersed in the fluid to be pumped. The major benefit of this kind of pump is that it reduces pump cavitation, a problem linked with a considerable elevation difference between the pump and the fluid face.



Fig 7. Pumping motor

Working:

We used a 12v o l t s battery and gives t h e power force to the Arduino board. Since the board's force voltage is 5V, we use a voltage regulation to limit t h e a m o u n t o f the voltage that is passed to the Arduino board. We also use a voltage regulation to limit the voltage to 7V which is passed to two DC motors. The Filter used in this is used to produce the complete DC pulsating voltage. Since the Motors used in this have a truly little, they can supply voltage to the motors which are. So we use t h e automobilist to supply a voltage of 7V to t h e motors. So automobilist acts as an interface between the MCU and the motors in the robot. A threshold value is given to the Fire sensor which detects the honey. In this, the handicap

to avoid point is maintained by two honey sensors. firstly, the program used bedded c coding. In this robot if any Fire b u r n t in the range of the device, the honey sensors get actuated However, the honey sensor on the left sect gets actuated and rotates the motor to the side, If the fire burnt is on the left side of the motor. also, if the handicap is placed on the right side, the Flame sensor on the right side gets actuated and drives the motor to t h e right side. thus, handicap avoidance is maintained by honey sensors. And formerly the temperature value reaches the threshold value, the temperature sensors, Detects it. Once it's detected is done automatically the relay connected to the board sends a signal to the pump connected to it gets actuated and sprays the water on the fire. The user can switch to automatic or manual modes. still, the robot itself detects the fire automatically, also its relay gets ON, If it has been switched to automatic mode. and hence it goes to the fire-detected area and also extinguishes the fire by sprinkling water onto it. However, the user gets the status of the surroundings of the robot through the Sensor, If it has been switched to manual control. The Advantage of this manual control over automatic control is that in automatic mode it takes time for the robot to monitor itself. But whereas in manual mode when the stoners get the status of the fire, they can control it manually to save further time and stop causing further detriment. In this working model of the design, we has been used the Internet of goods. The Internet of Things (IoT) is an ecosystem of online-accessible, physically connected items. The "thing" in the Internet of Things (IoT) might be an automated device with built-in sensors or a human with a heart monitor, the objects that have been assigned to the IP address and have the advanced capability to gather and transmits the data over a wide range of network without manual backing or interventions. The technology included into the items will enable them to link with the interior or exterior landscape, which in turn impacts the conclusions drawn. In this design, we can control the robot and can give the instructions that we can apply. future compass.

There were a multitudinous number of lives lost regularly in firefighting, and the system we imaged is crying for handover in this design it contains only a prototype model. There will be a big compass in the future for this kind of robot. As per the design simplifications and the performance constraints the suggest, our design is b i g evidence In particular, a practical fire-fighting robot must include a collection of robots, communicative and cooperative in this charge. such a system requires installations for going through obstacles in the discovery of fire, and t h e capability to admit the instructions on the cover during an operation. All analogous enterprises were outside of the compass of the design. It will consider both interesting and challenging to put all the sweat together into a real-time, independent fire-fighting service.

RESULT :

The impact of fire in any area is exceedingly harmful, and people's beings and possessions are destroyed. When robots are recruited to locate the fire, they arrive safely despite barriers in their route. In conclusion, our concept may be advanced into to a robotic system suited for piercing hazardous fire zones. This firefighting robot paves its path towards automation and it will do the duty properly.



Fig 7 Top view of the model

The next graphic demonstrates the automated mode, where the robot goes autonomously and, if there are any impediments in the road, utilises the PIR sensors to build a blocked path. This is ascertained to as handicap avoidance. As the temperature in a room rises, Put another way, when a bot is there, its robotic stops moving, engages a relay, and activates the pump.



Fig 8 Passing electric power to the model

The garçon runner that we developed appears in the photo following. There are multitudinous four buttons

There truly are five robotic orders. Following are the instructions Reverse, forwards, robo stop, robo left, and robot right. In directing the rules that help in attaining the goal, the robot will move in the sequence indicated. It performs behaviour dependent on the manufacturer's conjurations. We may shoot a message to the site of the fire and extinguish it. The forward action causes the robot advance in the exact manner as the inverse function does. Stop the robot is merely breaking the robot. The Robo left exertion into ote turning robotic to the left sect, while the Robot right activities denote rotating the robot to the right. Underneath the operation buttons is the image

that we're landing or view



Fig 9. Working model of the proposed method

CONCLUSION

It's developed with a honey sensor. Fire fighting is the act of controlling flames by splashing on them. Monitoring areas impacted by natural calamities and bomb blasts. The robots descry fire in the region area where it's dumped. This bot is handy in areas where flames are likely to do. But, also the power water medium is tapped off by a relay circuit If a fire is detected via sensors or manually. The recommended change has earlier been proved to deliver major advantages for both Playhouses, etc. They meliorate our capacity to recognise the honey and extinguish it before it gets uncomfortable or difficulty to live. As a consequence, this robot has the capability to play a crucial role.

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