NOVATEUR PUBLICATIONS
INTERNATIONAL JOURNAL OF INNOVATIONS IN ENGINEERING RESEARCH AND TECHNOLOGY
[IJIERT] ISSN: 2394-3696 Website: ijiert.org
VOLUME 11, ISSUE 02, February -2024

FIRE FIGHTING ROBOTIC VEHICLES

Prof. Shaikh Z. A. R. [1],
Mr. Pintu Kumar Mahato [2],
Mr. Chitranjan Kumar [3],
Mr. Aniruddh Ghayale [4],
Mr. Mujjfar Shaikh [5]
Lecturer Electrical Engineering [1]
(V V P Polytechnic Solapur – 413008)
Students of Department of Electrical Engineering [2,3,4,5]
(V V P Polytechnic Solapur – 413008)

Article History: *Received on: 17/11/2023*
Accepted on: 31/01/2024

DOI: *https://doi.org/10.26662/ijiert.v11i2.pp8-14*

ABSTRACT

The project is designed to develop a fire fighting robot using Arduino uno . The robotic vehicle is loaded with water pump which is controlled by servos. An ATMega 328 microcontroller is used for the desired operation. At the transmitting end using commands are sent to the receiver to control the movement of the robot either to move forward, and left or right etc. At the receiving end tow motors are interfaced to the microcontroller where two of them are used for the movement of the vehicle and the one to position the robot. The ultrasonic sensor adequate range with obstacle detection, while the receiver driver module used to drive DC motors via motor driver IC for necessary work. A water tank along with water pump is mounted on the robot body and its operation is carried out from the microcontroller output through appropriate command from the transmitting end. The whole operation is controlled by an ATmega 328 microcontroller. A motor driver IC is interfaced to the microcontroller through which the controller drives the motors,three ir flame sensors are fixed on robot chassis to sense the fire and to reach the destination to putoff the fire.

INTRODUCTION

Cultural property management protects institutional assets from threats like climate, pollution, theft, vandalism, and fire. Fire is a major concern because it can quickly destroy irreplaceable items. To combat this, the creation of a fire-fighting robot is proposed. Autonomous robots, capable of operating independently, are programmed to respond to stimuli. A basic example is the bump-and-go robot, which changes direction upon encountering obstacles, using sensors like ultrasonics. Advanced robotics involves developing smarter, more perceptive robots that can navigate various environments effectively.

LITERATURE SURVEY

For many years robotics have become popular in many ways because of its variety of design andtechnological advancement. Our motivation to design a fire fighter robot is to help the community in effectively firefighting by sensing the fire and quickly acting without heavy lossesof property or life. In some projects a tracking line

is assigned for the robot to follow these pathsto extinguish the fire. In some designs ultrasonic sensors are used. When it comes to simulationof this design it will make it difficult to implement it in real time situations. From the different projects reviewed, certain objectives helped us to choose a popular technique to fight fire efficiently by controlling it remotely by wireless technology application and using two mainsensors on Temperature sensor, GAS sensor due to their ability to detect fire and fireextinguisher pump.1 Systems, Man and Cybernetics, 2006. SMC '06. IEEE International Conference on 8-11 Oct.2006 The adaptive fusion method is proposed for fire detection of firefighting robot.

BLOCK DIAGRAM

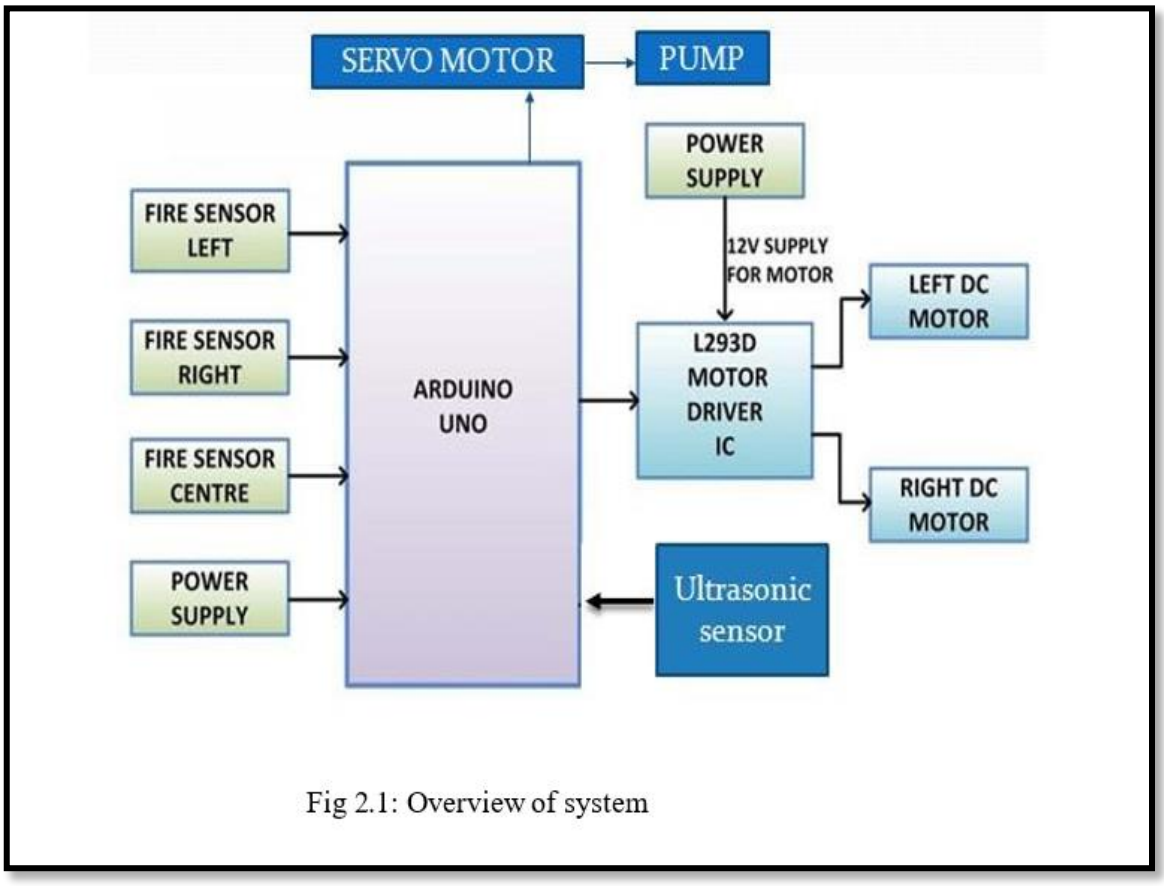
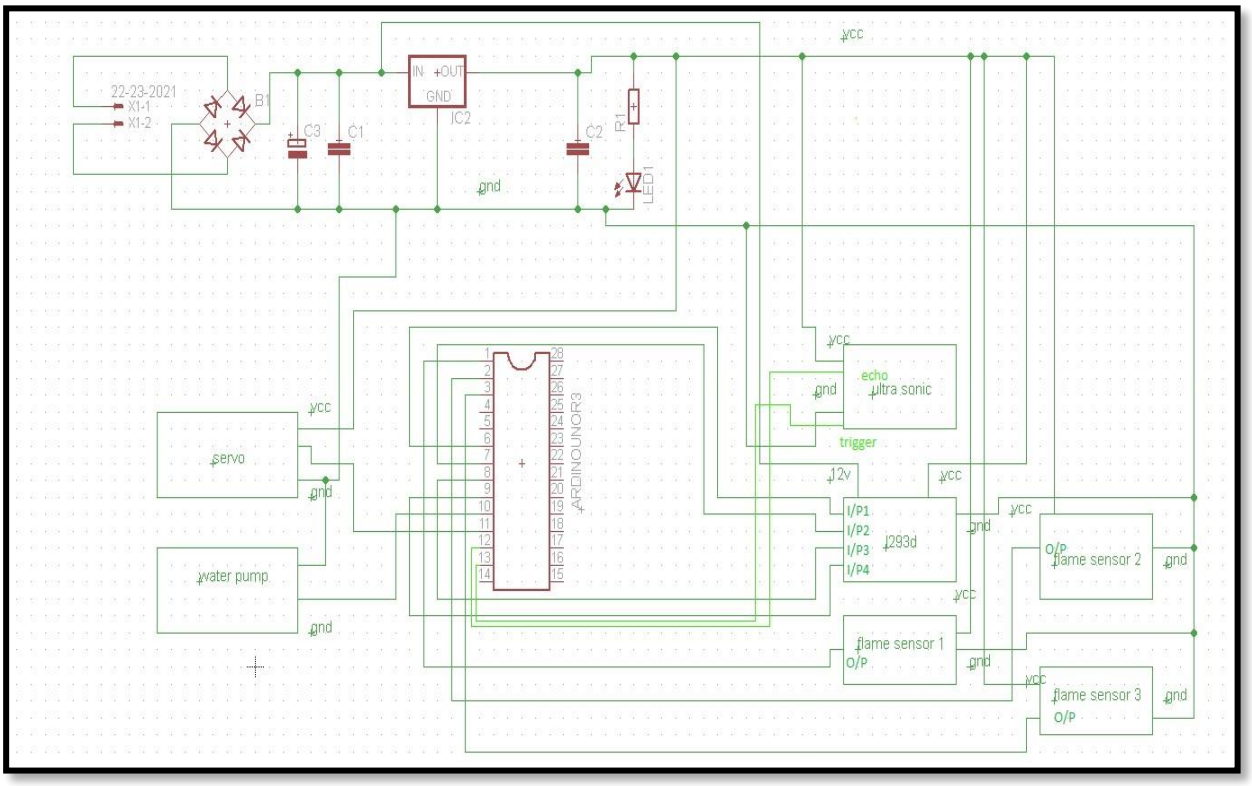


Fig 2.1: Overview of system

PROBLEM IDENTIFICATION

The proposed model is able to detect presence of fire using flame sensor and calculates object distance using ultrasonic sensor and moves the robot to fire accident location. It contains gear motors and motor driver to control the movement of robot. When it detects fire it communicates with microcontroller (Arduino MEGA) and the robo will move towards the fire affected area. The fire extinguisher is mounted on the robotic vehicle which is then controlled over the wireless communication so that it extinguishes the fire automatically.

CIRCUIT DIAGRAM



METHODOLOGY

The methodology is divided into three parts. The first part is on the design structure, followed by hardware description and the finally on the programming design. This robot's main function is to detect fire and move towards the fire automatically to extinguish it from a safe distance using a water sprinkler. This robot's movement and behavior will be fully controlled by the Arduino microcontroller. This advanced robot allows a user to control a fire fighter robot equipped with water tank and gun remotely wirelessly for extinguishing fires. For this purpose the system uses Radio frequency (RF) remote for remote operation along with RF receiver based microcontroller circuit for operating the robotic vehicle and water pump. The RF based remote transfers user's commands through radio frequency signals which are then received by the receiver circuit. The receiver circuit then decodes the data sent by the user. The receiver then forwards the data to the microcontroller. Now the microcontroller processes these instructions and then instructs the vehicle motors to run the vehicle in desired direction.

COMPONENTS DESCRIPTION

1. L293D Driver module

The Motor Driver is a module for motors that allows you to control the working speed and direction of two motors simultaneously. This Motor Driver is designed and developed based on L293D IC.L293D is a 16 Pin Motor Driver IC. This is designed to provide bidirectional drive currents at voltages from 5 V to 36 V.

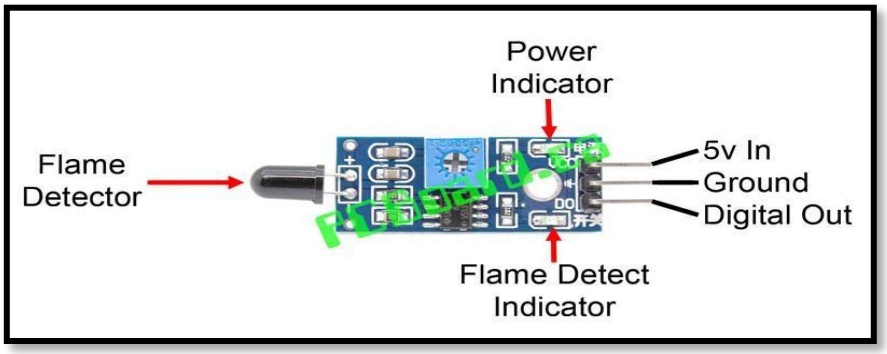


Figure 3.1: L293D motor driver module

2. Flame Sensor Module

A flame sensor module that consists of a flame sensor (IR receiver), resistor, capacitor, potentiometer, and comparator LM393 in an integrated circuit. It can detect infrared light with a wavelength ranging from 700nm to 1000nm.The far-infrared flame probe converts the light detected in the form of infrared light into current changes. Sensitivity is adjusted through the onboard variable resistor with a detection angle of 60 degrees.

Working voltage is between 3.3v and 5.2v DC, with a digital output to indicate the presence of a signal. Sensing is conditioned by an LM393 comparator.

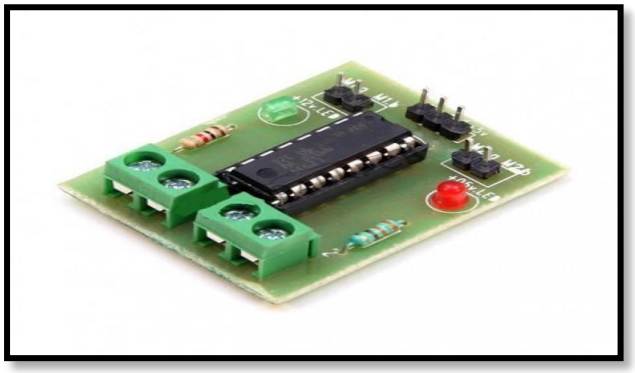


Figure 3.2: flame sensor module

3. Photo diode

A photodiode converts light into current or voltage and includes optical filters, lenses, and surface areas. Its response time slows as the surface area increases. Similar to semiconductor diodes, photodiodes are designed to be light-sensitive, often using a PIN junction instead of a standard PN junction. They resemble LEDs but work in reverse, with the shorter end as the cathode and the longer end as the anode. In forward bias, current flows from anode to cathode, opposite to the photocurrent flow.

4. LM393 Comparator

Here the LM393 IC do the voltage comparing here, a reference voltage (UR) is set by the adjustable potentiometer, when the analog output value over this value, the LM393 will output a digital value to indicate this sensor is triggered by reaching this setup threshold

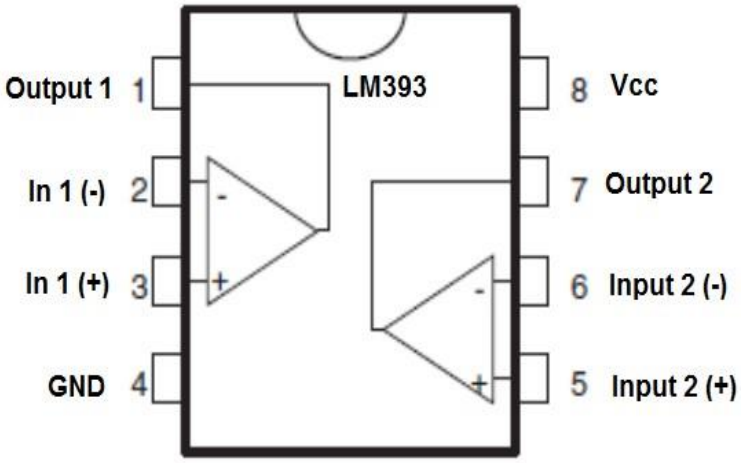


Fig circuit diagram of LM393 comparator

5. Ultrasonic Sensor

An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sonar sensor and the object.

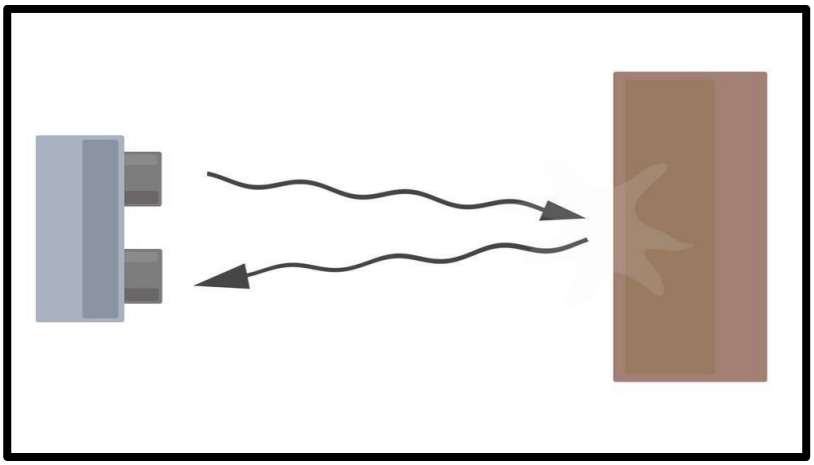


Fig ultrasonic sensor description

6. DC Motor:

Motors convert electrical energy into mechanical energy.A **DC motor** is an electric motor that runs on direct current (DC) electricity

The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion.

7. Water Pump and Servo Motor

A servo is a DC motor enhanced with gear reduction, a position sensor, and control circuitry, making it user-friendly like an Arduino to a microcontroller. It has a high gear ratio (e.g., 180:1) for reduced speed and increased torque, ideal for precise angular positioning up to 180 degrees or more. Servos are controlled by feedback from a potentiometer attached to the output shaft.

8. MICROCONTROLLER ATMEGA 328

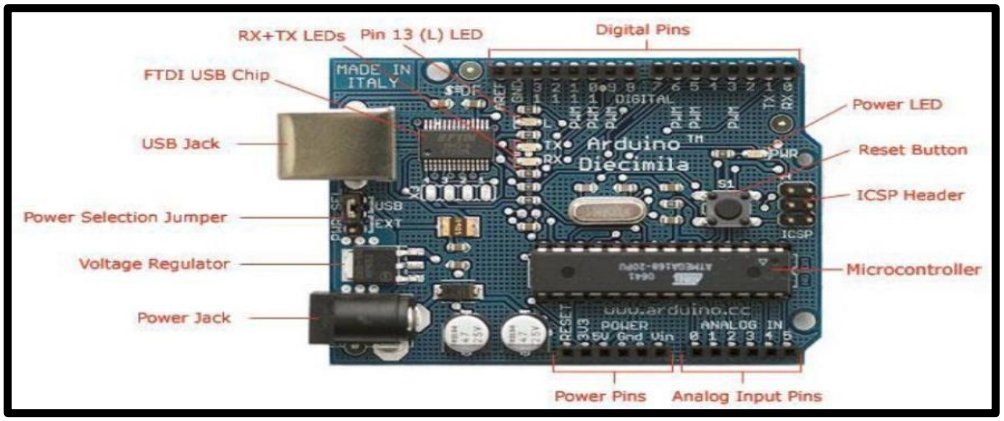


Figure 3.3: Arduino UNO board

The Atmel 8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byteoriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. The device achieves throughputs approaching 1 MIPS.

RESULT

Design And Implementation:

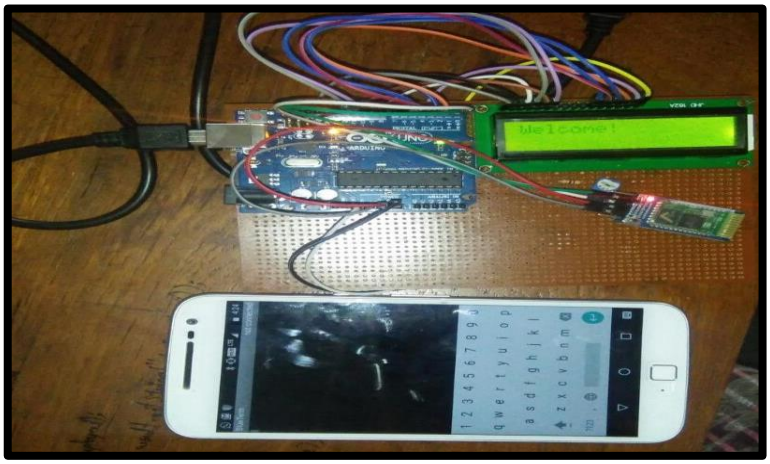


Figure: Snapshot of the System

ADVANTAGES

- Prevention from dangerous incidents.
- Minimization of o ecological consequences
- financial loss can be prevented.
- a threat to a human life can be minimized.
- No supervision is required to control robot

APPLICATIONS

- Can be used in extinguishing fire where probability of explosion is high. For eg.

Hotel kitchens, LPG/CNG gas stores, etc.

- Can be used in Server rooms for immediate action in case of fire
- Can be used in extinguishing fire where probability of explosion is high. For eg.

Hotel kitchens, LPG/CNG gas stores, etc.

- Every working environment requiring permanent operator's attention, At power plant control rooms
- Can be used in serach and rescue operation
- Can Used in domestic cold storage places

CONCLUSION

The prototype of a firefighter robot is designed to integrate various sensors, moving forward by detecting infrared light from fires. Future enhancements include a keypad for directional control, a motor driver module for movement, a water tank with a 180-degree rotating servo for extinguishing fires, and a long-distance sensor for improved speed and efficiency.

REFERENCES

1. P. D. Minns, C Programming For the PC the MAC and the Arduino Microcontroller System. Author House, 2013
2. M. Banzi, Getting started with arduino. " O'Reilly Media, Inc.", 2009
3. A. M. Gibb, New media art, design, and the Arduino microcontroller: A malleable tool. PhD thesis, Pratt Institute, 2010
4. M. Margolis, Arduino cookbook. " O'Reilly Media, Inc.", 2011
5. D. Mellis, M. Banzi, D. Cuartielles, and T. Igoe, "Arduino: An open electronic prototyping platform, " in Proc. CHI, vol. 2007, 2007