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360 Degrees Rotating Fire Protection System

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ABSTRACT

This system is a remote-controlled fire monitor system designed to fight large fires in factories, warehouses, and industrial facilities. Traditional fire sprinklers have drawbacks, such as spraying small amounts of water over a large area, which can damage electronics and furniture. Our system is different because it directs water only at the fire source, reducing damage to surrounding equipment. It uses two motors to control the nozzle's direction and a powerful pump to spray water. A wireless remote allows the user to control the system from a safe distance, and an onboard camera helps in aiming. The nozzle can move in two directions (X and Y) and provides 360-degree coverage. Currently, this version is remote-controlled from a short distance, but future versions will be operated by the fire department for better safety and efficiency.

Keywords:

Pump Motor, DC motors, RF Controller Remote, Receiver Circuitry, Pipings and Nozzle, Pipe Joints and Fittings, Bearings, Rotating Frame, Base Frame, Arduino UNO, NRF24L01 RF Transceiver Module,

INTRODUCTION

Fire accidents happen often in many countries, including India. Many people have lost their lives and property because of these accidents. Fire is one of the biggest threats to businesses and daily life. To reduce the damage and save lives, fire extinguisher robots can be very helpful. Fires often happen in places like garment factories, petrol pumps, gas stations, and chemical companies, which can also harm the environment. To improve fire safety, we have made a small model of a remote-controlled fire protection system that can work without human help. This robot can move in all directions (360 degrees) and spray water to stop the fire. It uses a special chip called PIC18F4550 and other circuits to work automatically. When a fire is detected, the robot can also send an SMS to the owner's phone using a SIM card. This way, people can know about the fire quickly and take action. The system is controlled using Bluetooth and a mobile app. The app lets the user control the robot, move the water nozzle, and turn on the water pump. The system can be used in homes, offices, factories, and malls. It is easy to install, use, and maintain. This project shows how modern technology can help make fire safety better, faster, and safer for everyone.

MATERIAL SELECTION FOR FABRICATION FOR 360 DEGREES ROTATING FIRE PROTECTION SYSTEM

CHASSIS FABRICATION:

Figure 1: Chassis Fabrication.

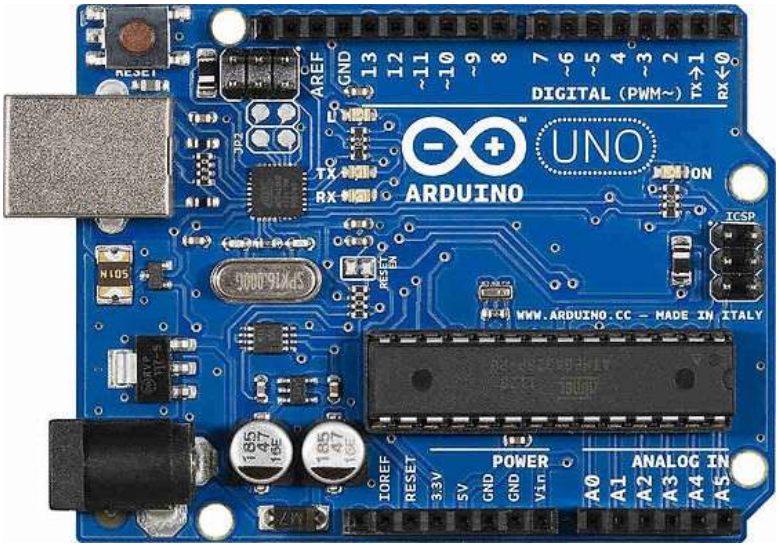
The chassis of the Bluetooth and Mobile-Controlled 360-Degree Fire Protection System is fabricated using mild steel, selected for its strength, durability, and affordability. The compact, rectangular frame provides a stable base for the rotating mechanism, motor, and other components. Fabrication involved cutting steel sections to size, welding them into a rigid frame, and drilling mounting holes for the motor and electronics. The structure was coated with anti-rust paint to enhance longevity. The design ensures stability, easy integration of components, and flexibility for potential modifications. The chassis was tested for alignment and strength to ensure smooth and reliable operation.

DC Motor:

Figure 2: DC Motor

A DC motor is a device that changes electrical energy into movement. It works using direct current (DC) electricity, which flows in one direction. When power is given to the motor, it starts to spin and can move things like wheels or fans. The speed and direction of the motor can be controlled easily. It has simple parts, is small in size, and is easy to use. DC motors are used in many machines like toys, robots, and tools. In our project, the DC motor helps to move the water nozzle or other parts. It is a good choice because it is cheap, easy to control, and works well with batteries.

ARDUINO-UNO MICROCONTROLLER:

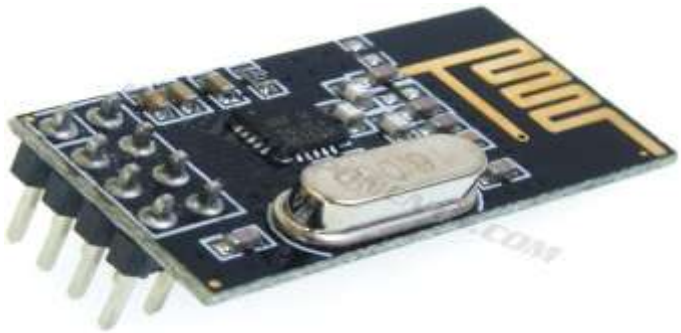


The Arduino Uno is a versatile and widely used microcontroller board built around the ATmega328P microcontroller. It operates at a standard voltage of 5V and features 14 digital I/O pins, 6 of which support PWM outputs, along with 6 analogue input pins for sensor interfacing. With a clock speed of 16 MHz, 32 KB of flash memory, 2 KB of SRAM, and 1 KB of EEPROM, the Arduino Uno is well-equipped to handle a variety of tasks in real-time. It supports multiple communication interfaces, including USB, UART, SPI, and I²C, making it highly adaptable for integrating peripherals like Bluetooth modules, motor drivers, and sensors.

NRF24L01 Wireless Module Mini Power Enhancement 2.4G Wireless Transceiver Module:

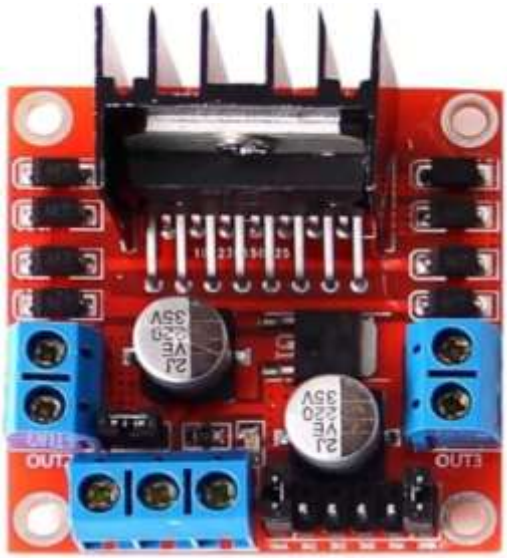
The NRF24L01 Wireless Module Mini Power Enhancement is a compact 2.4G wireless transceiver module that boosts wireless communication capabilities. It enhances power efficiency and extends transmission range, making it ideal for various electronics projects. This module facilitates reliable wireless

data exchange between devices, making it a valuable tool for applications such as home automation, IoT, and robotics.



L298N BASED MOTOR DRIVER MODULE -2A:

This L298N Based Motor Driver Module – 2A is a high power motor driver perfect for driving DC Motors and Stepper Motors. It uses the popular L298 motor driver IC and has the onboard 5V regulator which it can supply to an external circuit. It can control up to 4 DC motors, or 2 DC motors with directional and speed control This L298N Based Motor Driver Module – 2A is perfect for robotics and mechatronics projects and perfect for controlling motors from microcontrollers, switches, relays, etc. Perfect for driving DC and Stepper motors for micro mouse, line-following robots, robot arms, etc.



RELAY MODULE:

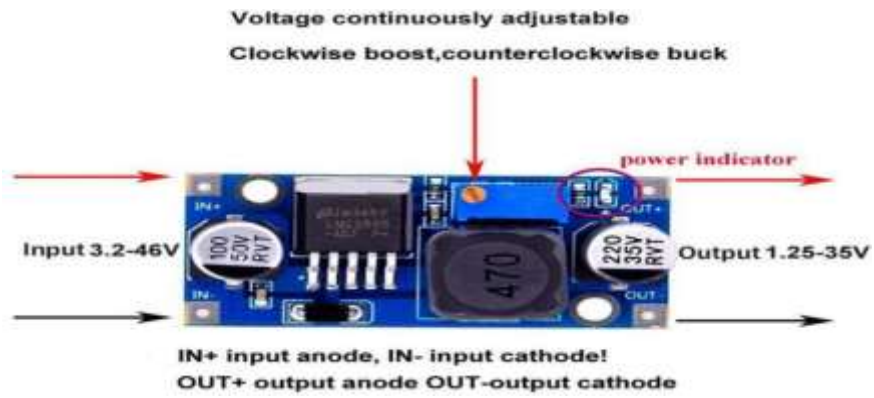
A relay is an electromechanical or electronic switch that allows a low-power signal to control a high-power circuit. In the Bluetooth and Mobile-Controlled 360-Degree Fire Protection System, a relay is used to activate and control high-power components, such as water pumps or extinguishing mechanisms, based on signals from the Arduino Uno. Relays typically consist of an electromagnet, a movable armature, and a set of contacts. The relay enables the Arduino to control high-voltage devices indirectly, as the microcontroller itself cannot directly manage such loads. By sending a simple digital HIGH or LOW signal to the relay's input pin, the Arduino can toggle the connected high- power circuit on or off. This functionality ensures the seamless integration of low-power control with high-power components, enhancing the overall safety and efficiency of the fire protection system.

PUMP MOTOR

This Ultra-Quiet DC 12V 3M 240L/H Brushless Submersible Water Pump is a low-cost, small size Submersible Pump. It can take up to 240 liters per hour with a very low current consumption from 300mA. Just connect the tube pipe to the motor outlet, submerge it in water, and power it. The black cooler pump

comes with a heavy-duty cable and a 5mm DC female jack at the end to connect directly to the 12V power supply. It is widely used in prototype projects as well as for decoration purposes.

LM2596 BUCK CONVERTER:



LM2596 HV DC-DC Buck Converter 4.5-40V to 3-35V Adjustable Step Down Module is LM2596 HV DC-DC Buck Converter 4.5 - 40V to 3-35V Adjustable Step Down Module. This step down power module is adjustable with a potentiometer.

NEED OF 360 DEGREES ROTATING FIRE PROTECTION SYSTEM

360-degree rotating fire protection system is designed to provide comprehensive fire suppression coverage in a wide range of environments. Here are some of the needs and advantages of such a system:

1. Complete Coverage: A 360-degree rotating fire protection system ensures that every corner of the protected area is covered, leaving no blind spots. This is particularly important in large open spaces, such as warehouses, industrial facilities, or open-plan offices, where conventional fixed fire protection systems may have limitations in reaching certain areas.

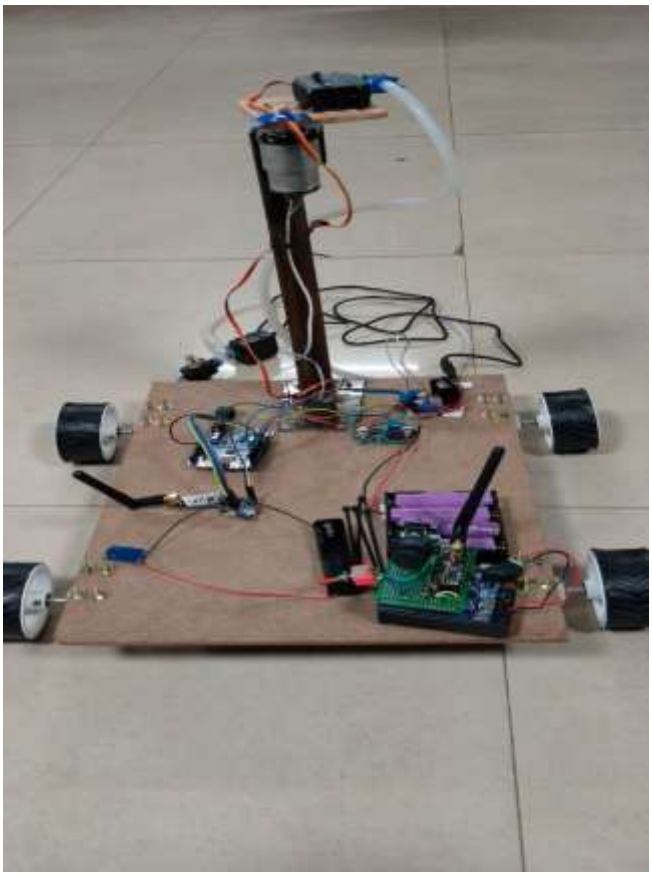
2. Rapid Response: With its ability to rotate and cover a large area, a 360-degree system can quickly detect and respond

to fires. It minimizes the time needed to identify the fire location, reducing the risk of fire spreading and causing extensive damage.

3. Flexibility and Adaptability: The rotating feature of the system allows it to be adaptable to changing environments. It can be customized to specific needs and adjusted as the layout of the protected area changes. This flexibility makes it suitable for various applications and ensures optimal fire protection.

4. Enhanced Safety: By providing comprehensive coverage, a 360-degree rotating system enhances safety for occupants, employees, and valuable assets. It helps to minimize the risks associated with fires, including property damage, injuries, and loss of life.

FABRICATION



APPLICATIONS

1. Industrial Facilities
2. Warehouse and Storage Facilities
3. Data Centers
4. Commercials Buildings and Complex
5. Healthcare Centers
6. Transportation Facilities
7. School, Colleges

CONCLUSION

In conclusion, the 360-degree fire protection system represents a significant advancement in fire safety, offering a comprehensive and automated solution for fire detection and suppression. With its ability to cover all directions and respond quickly through Bluetooth-controlled mobile interfaces, the system provides enhanced safety and efficiency in various environments, from industrial facilities to residential buildings. Despite its limitations, such as the need for regular maintenance and the dependency on a continuous power supply, the system's benefits outweigh these challenges. Future developments, including IoT integration, AI, energy efficiency improvements, and customized designs, will further enhance its functionality, making it a valuable tool in safeguarding life and property. As fire safety continues to evolve, this system holds the potential to become an integral part of modern fire protection strategies across diverse sectors. Incorporating a fully automated mobile platform with advanced sensors could allow the system to autonomously move toward the fire source, further improving response time and precision in fire suppression.

FUTURE SCOPE:

For large-scale facilities or hazardous environments, integrating the fire protection system with drones or robots could enable the system to reach dangerous or inaccessible areas, enhancing overall coverage and safety.

These future modifications would not only increase the effectiveness of the 360- degree fire protection system but also ensure that it remains a cutting-edge solution for modern fire safety challenges.

REFERENCES

1.Szpakowski, D.M.; Jensen, J.L. A review of the applications of remote sensing in fire ecology. Remote Sens. 2019, 11, 2638. [CrossRef]

2. Veraverbeke, S.; Dennison, P.; Gitas, I.; Hulley, G.; Kalashnikov a, O.; Katagis, T.; Kuai, L.; Meng, R.; Roberts, D.; Stavros, N. Hyperspectral remote sensing of fire: State-of-the-art and future perspectives. Remote Sens. Environ. 2018, 216, 1053121. [CrossRef]

3. Yuan, C.; Liu, Z.; Zhang, Y. Aerial images-based forest fire detection for firefighting using optical remote sensing techniques and unmanned aerial vehicles. J. Intell. Robot. Syst. 2017, 88, 6353654. [CrossRef]

4.. Hendel, I.G.; Ross, G.M. Efficacy of Remote Sensing in Early Forest Fire Detection:A Thermal Sensor Comparison. Can. J. Remote Sens. 2020, 1315. [CrossRef]

5.Toreyin, B.U.; Dedeo ˘glu, Y.; Gudukbay, U.; Cetin, A.E. Computer vision based method for real-time fire and flame detection. PatternRecognit. Lett. 2006, 27, 49358. [CrossRef]

6.JohnstonRPD,SonebiM,LimJBP,ArmstrongCG,WrzesienAM,AbdelalG,HuY(2015)Thecollapsebehaviourofcold-formedsteelportalframesatelevatedtempera-tures.JStructFireEng6(2):77–101

7. Amanda M. Stasiewicz, Travis B. Paveglio -Rangeland Ecology & Management –Year –2018.

8. Lexter J. Resullar, Angelou Joefred N. Congreso, Fernando Comandante, Floramyr P. Sarvida, Phd. &Engr. Gideon G. Buniel. MIT -Asian Journal of Basic Science & Research -Volume 2, Issue 4, Pages 21-51 –Year –2020.

9. Wang Zhan, Zhaozhan Gu, Juncheng Jiang,Le Chen -Process Safety and Environmental Protection –Year –2020.

10. GeovanaPires AraujoLima, Josiane DantasViana Barbosa,ValterEstevao˜ Beal, Marcelo Albano Moret S. Goncalves, Bruna Aparecida Souza Machado, Juliano Zaffalon Gerber, Benjamin S. Lazarus -International Journal of Disaster Risk Reduction –Year –2021.

11.Zafiris Triantafyllidis, Luke A. Bisby -Construction and Building Materials –Year –2020.12.T.A.ROBERTS,I.BUCKLAND,L.C.SHIRVILL,B.J.LOWESMITHandP.SALATER -Process Safety and Environmental Protection.

13.Henrik Bjelland, Ove Nja, Atle William Heskestad, Geir Sverre Braut -Safety Science –Year –2021.

14. Jaewook Kwon -Case Studies in Fire Safety –Year –2014.

15. Jia Wui Lim, Til Baalisampang, Vikram Garaniya,Rouzbeh Abbassi, Faisal Khan, Jie Ji -Journal of Loss Prevention in the Process Industries –Year –2019.

16.Zhou Xiaomenga, Zhou Biao, Jin Xiang -Journal of Cultural Heritage –Year –2010.

17. Serge Bourbigot, Johan Sarazin, Tsilla Bensabath, Fabienne Samyn, Maude Jimenez -Fire Safety Journal –Year –2019.