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Design, Analysis and Fabrication of 360 Degree Fire Protection System

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Abstract: ***Large factories, warehouses, and industrial production facilities always run the risk of fires breaking out. Lack of appropriate firefighting measures could result in disastrous consequences and along with financial losses might even lead to massive loss of human life.***
In such situations, it is ideal to install a Fire Monitor also known as a deluge gun. Fire monitors are an aimable and controllable high-capacity water jet used to deal with large fires. Unlike Fire extinguishers, Fire Monitors are permanently installed and cannot be moved.
Using an array of heat sensors, this fire monitor detects any changes in ambient temperature and sends the user an alert about the same.
While traditional fire monitor systems need a human operator to change the direction of the water jet and aim it appropriately, this fire monitor has been equipped with RF control and an onboard camera. Thereby allowing the user to operate it from a safe distance.
Keywords: Arduino Nano, Water Sprinkler, Stepper Motor, Microcontroller, Sprinkler

I. INTRODUCTION

Fire is a rapid chemical combination of three elements; fuel, heat and oxygen resulting in the production of heat and flame. Automated fire monitor & controller systems are basically certain form of programmable electronic devices that can be used to identify threats or attacks of fire in surrounding. In other to abolish the traditional methods of preventing fire in places using human interferences, this project was implemented to design and construct a fire monitoring, prevention and control system for various places .

Any likelihoods of fire disaster in a market shop is intelligently detected using sensors, & alarm is started to give a siren about the calamity, controlled to avoid viral spread using a fire fighting mechanism.

The requirement for automated firefighting is continuously increasing. Remote-controlled monitors, especially in combination with automated fire detection, allow a targeted but flexible firefighting operation in limited areas. The technical development in drive engineering, sensor technology and control technology offer some great future potential. By giving it a span to cover an area via remote controller without and human interface. Automated firefighting systems are well known as sprinkler systems and also spray nozzles. But for several years automated firefighting systems with remote-controlled monitors are used for fire protection of tank farms, petroleum loading terminals, aircraft hangars, thermal power plants, production facilities, recycling plants, waste incineration plants

A Fire monitoring and control system is designed to detect the presence of fire by monitoring environmental changes associated with combustion with the help various sensors like heat sensor.

Along with a pump and solenoid valve attached to the system for its easy open close operations with a camera mounted on the top for the perfect view as the flow of the water output towards extinguishing fire.

A. Uses

- The wide range of monitors and the possibility to select from a variety of mountable nozzles provide flexibility and enhance performance to achieve effective fire protection for high-risk areas.
- Remote-controlled monitors enable targeted firefighting operations in confined spaces and can be used for extinguishing agents like water.
- Durable, lightweight& portable construction comes with adjustable flow nozzle Programmable automatic oscillation and stow position60 to 70 degree vertical motion to cover long range.

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II. LITERATURE REVIEW

1) Dr. Arvind Mahalle, et al.,(2023) Design and Development of 360 Degree Fire Protection System, The project objectives, which included designing a system that could detect fires in all directions and extinguish them quickly, were successfully met. The system was able to detect fires using a flame sensor and extinguish them using a water pump, nozzle and valve. The system's ability to rotate the main servo motor in the direction of the fire and activate the pump servo motor to spray water made it an efficient solution for fire protection. The system's advantages, including 360 degree coverage and customizable design, make it a versatile solution for various environments and applications. The system can be modified to suit the unique requirements of different buildings and environments, ensuring enhanced safety and security.
2) P.Naveen kumar, et al.,(2022) 360 Degree Rotating Fire Protection System, There are many possible ways to put out fires but it always safer to use the constantly this idea to reduce the involvement of fire fighters thereby decreasing the risk of physical injuries and life threats. Comparing this prototype with the existing technology we implement the sensor and wireless technology. Nowadays the fire fighting technologies 4 are fully manual. in scope of future we implement wireless technology to control the fires.
3) Dhamak Sagar, et al.,(2022) 360 Degree Rotating Fire Protection System, It has sometimes been impossible for fire-fighting personnel to access the site of a fire, even as the fire causes tremendous property damage and loss of human life, due to high temperatures or the presence of explosive materials. In such environments, fire-fighting robots can be useful for extinguishing a fire. Thus, Fire-fighting robots are operated in places where fire fighters are unable to work. Besides that, fire fighting robot can be use for protecting fire fighters from extreme danger in petro chemical, chemical dangerous product, toxicity or exploder fire accidents. Therefore, it also can reduce the human injury from a fire burning. The security of home, laboratory, office, factory and building is important to human life. We develop security system that contains a fire protection robot using sensor.
4) S Murugananthan, et al.,(2023) Design and Fabrication of 360 Degree Fire Protection System, Robots have become out to be an aspect wherein many human beings have shown their interest and gained reputation due to the development of many technologies. Consequently, it has been decided to design some thing that may make human existence less difficult and more cozy, and the interest of this assessment is to make a "far flung managed 360 degree fireplace protection device." The proposed "faraway controlled 360 diploma fire safety machine" is designed for extinguishing hearth in a small floorplan of a residence, workplace, or shopping mall of precise dimensions with the help of family water and a water pump.
5) Prof. V. D. Yadav, et al.,(2023) 360 Degree Rotating Fire Protection System, Usual fire protection systems installed in buildings have the following disadvantage. They spray small amounts of water from each sprinkler which may not be enough to put out the fire. The sprinklers are not targeted and spray an entire floor or building ruining computers, furniture and paperwork. While this sprayer gun can spray water in desired quantity only at fire outbreak point to stop fire without ruining complete office furniture and electronics. This demo version is made to be remote controlled from few meters but future version will operate remotely from fire department.
6) Dr. Vishnu Agrawal, et al,.(2022) 360 Degree Rotating Fire Protection System, Fire monitors and sprayers are an amiable and controllable high-capacity water jet used to deal with large fires. Unlike Fire extinguishers, Fire Monitors are permanently installed and cannot be moved. While traditional fire monitor systems need a human operator to change the direction of the water jet and aim it appropriately, this fire monitor has been equipped with RF control and an onboard camera. There by allowing the user to operate it from a safe distance.
7) Shrirang Sandip Panat, et al,.(2022) Design and Development of a 360-degree Fire Extinguisher Robot using Microcontroller, The Design and development of a Fire Fighting Robot will provide an impactful solution for society and help save lives. The solution uses Flame sensors to detect the fire hazard, Microcontroller to analyse data from sensors and decide the right course of managing the fire hazard. After analysing it uses WIFI module as a communicating device to alert a human being in charge of the control by raising an alarm through activation of the LED. The user activates the Fire extinguisher robot using the Blynk application to spray water with the help of a pump onto the fire guided by servo motor to synchronize the direction of water output.
8) Veeresh Kumar K S, et al,.(2023) Fabrication Of Automatic Fire Protection System, This fire detection system uses robotics in the fields of electrical and mechanical engineering. It consists of a fire detector, micro-controller, stepper motor, DC motor, and an AGV. The fire detector identifies fires and sends the information to the micro-controller. The micro-controller, programmed with a fuzzy logic algorithm, determines the direction for the firefighting apparatus's head movement. A stepper motor rotates the head clockwise or anticlockwise as directed. A DC motor controls the valve in the nozzle to regulate the flow of extinguishing agents.

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III. METHODOLOGY

Fabrication is an important industry that involves cutting, manipulating and assembling materials to produce desired structures. And while different fabrication companies use different techniques, most rely on three basic processes: cutting, bending and assembling.

A. Fabrication

The first process of fabrication is cutting. During this process, the metal fabrication company cuts one or more pieces of raw metal for use in the creation of a new metal structure or product. Whether it's steel, aluminium, iron or any other common type of metal, though, cutting metal requires special tools. After cutting raw metal, metal fabrication companies must bend it. Again, there are different ways to bend metal after cutting it. Some metal fabrication companies hammer the metal sheets or sections into the desired shape. Hammering can be done by hand, or it can be done using a machine (power hammering). The third and final process of metal fabrication is assembling. As the name suggests, this process involves assembling the metal sheet or sections into the desired finished product. Assembling is typically performed via welding, though other steps may be included in the process as well.

IV. COMPONENTS

1) MS sheet for base plate 8mm thickness
2) Ms sheet for the 2 plates of stepper mounting and mechanism mounting thickness 6mm
3) MS sheet for laser cutting of the stand 6mm thickness
4) MS sheet used for clamps and motor mounts thickness 4mm
5) MS rod used for making of cap for stepper motor mount
6) MS round pipe ID 60mm Od 70mm
7) MS square pipe 30mmx30mm
8) MS shaft
9) 1hp water pump
10) Remote
11) Circuit
12) Heat senor
13) SMPS

SI NO.	COMPONENTS	FIGURE
1	Mini Buck Module	
2	Flame Sensor	
3	RF Receiver and Transmitter HC-12	
4	DC Motor – 10 rpm	
5	Bearings	

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6	Stepper Motor 60kg/cm	
7	Solenoid Valve 24 V & 0.75 inch	
8	Nozzle 0.5 & 0.75 inch	

V. EMBEDDED SYSTEM

An Embedded System is a combination of computer hardware and software, and perhaps additional mechanical or other parts, designed to perform a specific function. An embedded system is a microcontroller-based, software driven, reliable, real-time control system, autonomous, or human or network interactive, operating on diverse physical variables and in diverse environments and sold into a competitive and cost conscious market. An embedded system is not a computer system that is used primarily for processing, not a software system on PC or UNIX, not a traditional business or scientific application. High-end embedded & lower end embedded systems. High-end embedded system - Generally 32, 64 Bit Controllers used with OS. Examples Personal Digital Assistant and Mobile phones etc .Lower end embedded systems - Generally 8,16 Bit Controllers used with an minimal operating systems and hardware layout designed for the specific purpose.

VI. SOFTWARE REQUIREMENTS

A. Arduino IDE

Arduino is an open-source prototyping based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

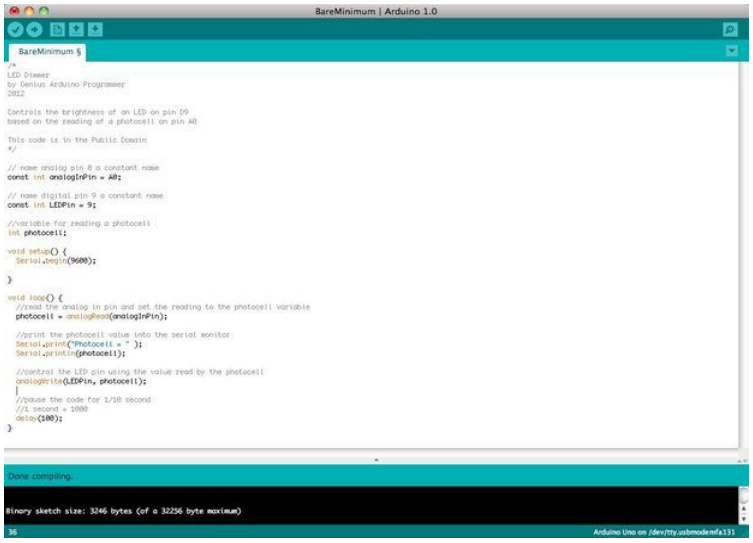

Fig-1 Arduino

VII. 3D CAD VIEW

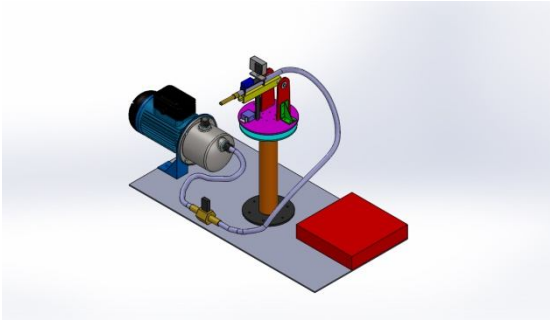

Fig-2 Iso View

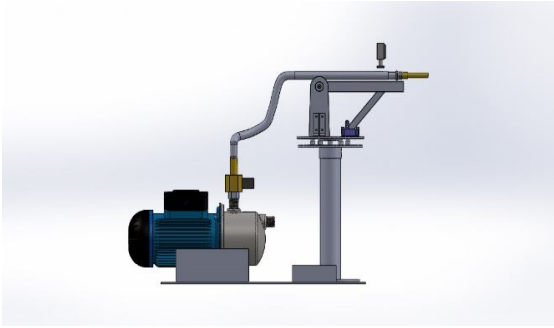

Fig-3 Side View

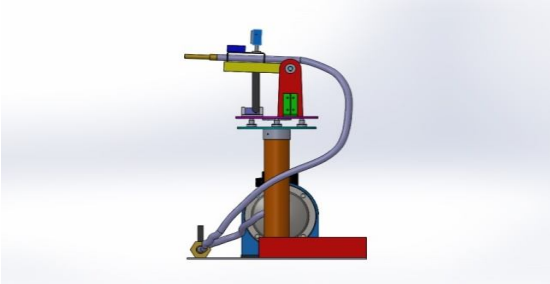

Fig-4- Front View

VIII. CONCLUSION

The technical development in the field of drive engineering, sensor technology and control technology offers some great future potential to detect fires in their initial phase as well as to fight fires in a localized and resource-conserving manner by use of monitors. In addition, a focus must be placed on what firefighters around the world use to fight fires. In live operations, the extinguishing agent flow is adapted to the requirements set by the fire incident. The availability of remote-controlled monitors and nozzles where the extinguishing agent flow rate can be adjusted by remote-control without interruption of the operation makes it possible to apply this procedure also to automated firefighting systems. If it is therefore successful to apply experience and procedures from practical firefighting to automated firefighting systems, the seeming paradox of “less extinguishing agent leads to a higher level of fire protection” can become reality.

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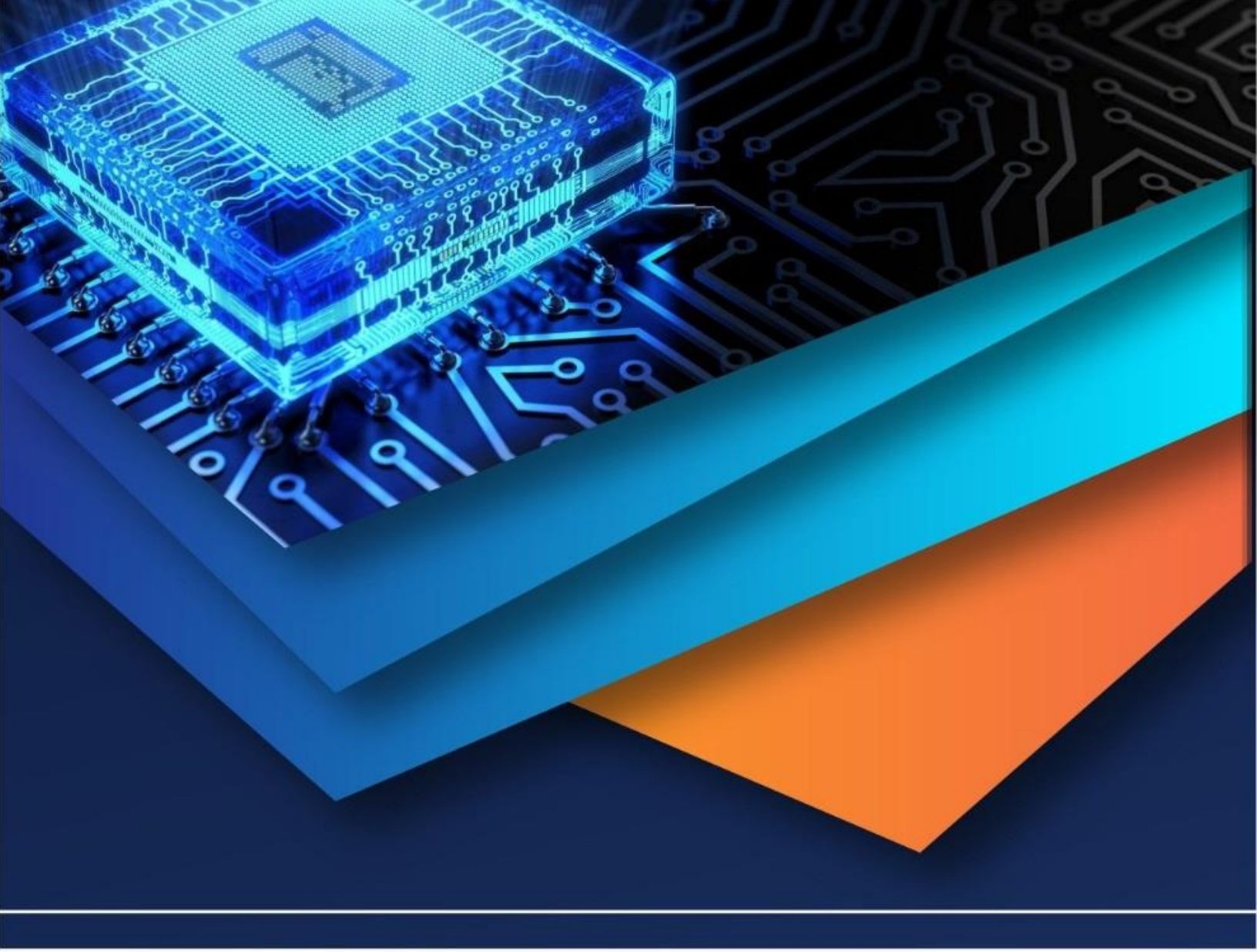

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