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Experimental Investigation on Automated Fire Protection System

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Abstract: *With its unique ability to fight flames on its own, the 360 Fire Fighting Robots improves efficiency and safety in dangerous situations. The brain of this system is an Arduino microcontroller, which uses inputs from sophisticated fire sensors to determine what to do. The robot can precisely locate the fire because to the sensors' ability to detect heat and flames. The robot has a motorized base that allows it to go in the direction of the fire and rotate 360 degrees to cover the entire area. Its main purpose is to quickly put out fires while causing the least amount of harm and danger to human fire fighters. With its ability to efficiently battle fires by combining mobility, accuracy, and cognitive decision-making, this robot represents a significant development in automated emergency response.*

Keywords: automated fire protection system

I. INTRODUCTION

A robot is characterized as a mechanical design that can do human tasks or behave like a person. Creating a robot necessitates specialized knowledge and advanced programming. It is about constructing systems and connecting motors, flame sensors, and wiring, among other vital components. A fire fighter robot is one that includes a miniature fire extinguisher. The automation extinguished fire by connecting a tiny fire extinguisher to the robot. This paper describes the design and building of a fire-sensing and extinguishing robot. The following ideas are implemented in this robot: ambient detection and comparative motor controller. This paper describes the design and building of a fire-sensing and extinguishing robot. It senses the fire accident using thermistors, ultraviolet or visible sensors. For the first detection of the flame, UV sensors / thermistors / flame sensors will be employed. When a flame isspotted, the robot hums an alert using the accompanying buzzer and activates an electrical valve, releasing sprinkles of water on the flame. The project helps to generate interests and innovations in the fields of robotics while working towards a viable and feasib2le solution to save lives and limit the risk of property damage. This project aims to create a fire fighting robotic vehicle that can be operated in both manual and autonomous modes. DC motors, a wheel, a microcontroller, sensors, and a miniature fire extinguisher canister are used. Microcontroller controls all the parts of the robot by programming, and as the fire sensor senses the fire, an amplifier amplifies the signal and sends it to microcont1roller. The robotic vehicle's live video streaming system is used to extinguish the fire in many directions.

II. LITERATURE REVIEW

Vinayak Tilavi, Sairaj Ghodake et.al "360 Degree Automated Fire Fighting Robotic Platform" Robots are significant nowadays because they can dotasks that humans find difficult. The proposed projectis concerned with the concept of a 360-degree firefighting robotic vehicle with several modes of operation. We have incorporated two modes of operation: manual control and autonomous mode. The robotic vehicle may be operated manually and utilized to extinguish the fire using a wireless remotecontrol. The proposed device also incorporates a robotic arm to aid in fire extinguishment at various heights, it has the capacity to spin in 360 degrees to perform firefighting tasks. The vehicle also has a camera that can wirelessly stream live footage from the autonomous vehicle and aid in navigation using views from the camera.

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The vehicle also has an autonomous mode that will detect a fire using the sensors on the robotic vehicle, go to the area of the fire, and autonomously extinguish the fire in 360 degrees. To extinguish the fire, the Robotic Arm is attached on a rotating up and down movable robotic platform.

Shreyas B Jadhav, Shuchith Gowda G P et.al "FUNDAMENTALS OF 360° ROTATING AND SOUND WAVE FIREFIGHTING ROBOT" The project Design and fabrication of 360° rotating and Soundwave Firefighting Robot is associated with new technique of fire extinguisher. It deals with the firefighting operations with least amount of time spent. The main purpose of sound wave fire extinguisher is to put out the flames using sound waves with a specific range of frequency. It helps the fire fighter to fight the fire at early stage. The sound waves can extinguish all types of flames between the frequencies of 45 Hz to 55 Hz. The extinction of the fire must be done at an earliest stage and the flame does not need extra effort to be put out. The expected result from our project is to extinguish the fire in an earlier stage which will ensure worker's safety. Zero turn steering gives much better maneuverability and control on the car. We have developed a new idea for our four-wheel driving vehicle which will help us to turn the vehicle about its vertical axis. Zero degree turning capability is achieved by turning the frontadjacent wheels in opposite direction and by steering the rear adjacent wheels opposite to the front wheels which signifying reduces the turning radius of thevehicle to almost zero.

Shrirang Sandip Panat, Parth Patil et.al "Design and Development of a 360-degree Fire Extinguisher Robot using Microcontroller" Fire hazards are a common phenomenon in developing countries likeIndia causing loss of lives and property every year. Fire emergencies occur where either a human cannot reach on time or location of fire is hazardous and life threatening for humans to approach and douse the fire. 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 WIFImodule 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.

N.Parsuram, g.Marurhprsad et.al "ANALYSIS ON ASSOCIATION OF FUNDAMENTALS ON 360° ROTATING AND SOUND WAVE FIREFIGHTING ROBOT" The Endeavour The creation of a sound wave-powered, 360-degree rotating firefighting robot is related to a novel fire extinguisher approach. The least amount of time is spent on the firefighting operations. A sound wave fire extinguishers primary function is to extinguish flames by employing sound waves that fall inside a certain frequency range. The ability to tackle fires at an early stage aids firefighters. All forms of fires can be put out by sound waves between the frequenciesof 45 and 55 Hz. The fire must be put out as soon as possible, and more effort is not necessary to accomplish so. Our project's anticipated outcome is to put out the fire earlier, which will ensure worker's safety. Zero turn steering gives much better maneuverability and control on the car. We have developed a new idea for our four-wheel driving vehicle which will help us to turn the vehicle about its vertical axis. Zero degree turning capability is achieved by turning the front adjacent wheels in opposite direction and by steering the rear adjacent wheels opposite to the front wheels which signifying reduces the turning radius of the vehicle to almost zero.

Naveen Gupta, Aditya Raj Mehra, Harsh Gehlot et.al "Fire Fighting Robot"Fire incidents present significant challenges and risks to human lives and property. To address these challenges, the development of firefighting robots has emerged as a promising solution. This abstract provides a concise overview of firefighting robots, highlighting their design, capabilities, and contributions to fire suppression efforts. Firefighting robots are specialized machines equipped with advanced technologies and functionalities to combat firesautonomously or under remote human control. These robots are designed to navigate hazardous environments and access areas that may be difficult or dangerous for human fire fighters to reach. These robots employ various fire suppression mechanisms such as high-pressure water cannons, foam-based extinguishing systems, or even aerial water deployment through drones. By utilizing these capabilities, fire fighting robots can efficiently suppress fires, limittheir spreads, and prevent further damage.'

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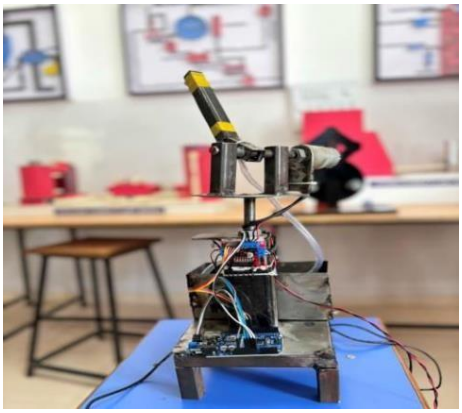
2.1 Automated Fire Protection System

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 and might even lead to massive loss of human life.

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 qty only at fire outbreak point tostop fire without ruining complete office furniture and electronics.
- This demo version is made to be remotecontrolled from few meters but future version will operate remotely from fire dept.

Fire monitors and sprayers 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



Automated Fire Protection System

While traditional fire monitors 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.

The system makes use of 2 x Motors coupled with a powerful sprayer motor with piping system and onboard wireless streaming camera to run this system.The 2 motors are used to control the nozzle direction movement.

The user may use a wireless remote to transmit movement commands. The receiver circuitry mounted on system receives users commands and operates the motors to achieve desired motion. Also the receiver operates the pump motor to start and stopthe spray.

The sprayer nozzle can also be adjusted to adjust the water spray outlet. The sprayer mechanism is built to operate in a 2 DOF operation to adjust position in x and Y directions and achieve a 360 Degree waterspray coverage

2.2 Components

- Pump Motor
- DC motors
- Controller Remote
- Receiver Circuitry
- Pipings and Nozzle
- Pipe Joints and Fittings
- Bearings
- Rotating Frame
- Base Frame

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- Supporting Frame
- Screws and Bolts

Applications:

- Useful for controlling indoor fires.
- Can provide a low cost fire protectionsystem with limited centralized fire protection.

Advantages:

- Targeted water spraying to avoid waterdamage in office
- Remote controlled operation ensuresoperator remains safe
- Adjustable Nozzle for Spray Tuning
- Powerful Long Distance Water Spray

III. RESULT

The robot was able to detect the fire through thesensors at a distance of about 900 mm and was able to take decisions to move towards the fire location at a speed of 0.5 m/s. Reaching towardsthe fire location, it was able to extinguish the fire through the water spray from the nozzle at a pressure of 110 psi. After extinguishing, the robot was able to return to its original position. Itsatisfied our objective which was to operate the robot in manual & autonomous

IV. CALCULATIONS

Torque required on a flat surface Normal force (Fn)
= m*g = 25*9.81 = 245.25N
Friction force (Ff) = Fnμ = 0.2*245.25 =49.05 N
Torque required = Ff*rw = 49.05*0.355 = 17.41 N-m
Total mass acting = 25kg = 25*9.8 = 245.25N
For Slope Surface consider maximum slope of 15degrees
Normal force acting (Fn) = mgcosΘ = 25*9.81*cos(15) = 236.89 N
Frictional force (Ff) = Fnμ = 0.2*236.89 = 47.37 N
Opposing force (Fo) = mgsinΘ = 25*9.81*sin (15)
= 63.4755.67 N
Torque required = (Ff + Fo) rw = (47.37+63.47)0.355

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