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360 Degree Automated Fire Fighting Robotic Platform

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Abstract - *Robots are significant nowadays because they can do tasks that humans find difficult. The proposed project is 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 remote control. 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 fire fighting 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. 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.*

Key Words: **Robotic Vehicle, Fire Fighting, Camera, Wireless, Wireless, Autonomous, Sensors, Robotic Arm etc.**

1.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 is spotted, 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 amplify the signal and sends it to microcont1roller. The robotic vehicle's live video streaming system is used to extinguish the fire in many directions.

2.LITERATURE SURVEY

Ratnesh Malik and his colleagues have devised a strategy for building a fire fighting robot that is capable of extinguishing fires. The robot is completely self-sufficient and incorporates cutting-edge concepts such as environmental awareness and proportional motor control. Kristi Kokasih and colleagues have developed an intelligent tank robot for fire fighting purposes. The robot is designed to autonomously search a designated area, identify any fires present, and extinguish them even in intricate room configurations. H.P. Singh and colleagues have established a technique for managing an independent industrial fire-fighting robot. Swati Deshmukh and her team have advanced a wireless robot designed for firefighting, equipped with a fully automated platform capable of detecting and extinguishing fires from any angle . Robot with fire detection devices which can be operated with a phone was created by Lakshay Arora. The robot has a phone that it can use to command its actions when it is called.

3.COMPONENTS

1.IR Sensor: operating voltage4.5 V to5.5 V average current consumption 33 mama (typical) distance measuring range 20 cm to 150 cm (8 ″ to 60 ″) affair type analogue voltage affair voltage differential over distance range2.0 V(typical)

update period 38 ±10 ms package size29.5 ×13.0 ×21.5 mm(1.16 ″ ×0.5 ″ ×0.85″) weight4.8 g(0.17 oz)

Fig1: IR Sensor

2.Microcontroller Board :

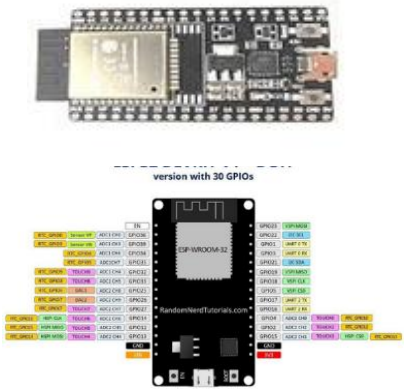

Fig2: Microcontroller Board

Node MCU grounded on ESP- WROOM- 32 module

1) Grounded on ESP32 DEVKIT DOIT
2) 30 GPIO Version
3) 520KByte RAM
4) 2.2 tp3.6 V Operating voltage range
5) In breadboard friendly rout
6) USB micro B for power and periodical communication, use to load program and periodical debugging too

3.Channel Relay Board: Coil rating: The voltage at which a relay coil gets fully activated. The most commonly available coil voltage ratings are 6V and 12V.Contact rating: The contact rating of a relay depends AC or DC current is passing. blue colored relay has a rating of 12A at 120V AC, 5A at 250V AC, and 10A at 24V DC.

Fig3: Channel Relay Board

4.Joystick : Joysticks are widely utilized in various industries, including aeronautics, gaming, heavy machinery, and mobile devices, to provide input to computers or machines. They are constructed to convert the physical movement of the plastic stick into electronic signals that can be comprehended and processed by a computer.

Fig4: Joystick

5. VNH2SP30:

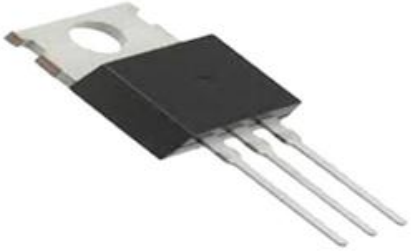

Fig5: VNH2SP30 Chip

1) Voltage Range : 5.5V - 16V
2) Maximum Current rating : 30A
3) Practical Continuous Current: 14 A
4) Current sense output proportional to motor current
5) MOSFET on-resistance: 19 mΩ (per leg)
6) Maximum PWM frequency: 20 kHz
7) Thermal Shutdown
8) Undervoltage and Overvoltage shutdown

6.H-Bridge Motor :

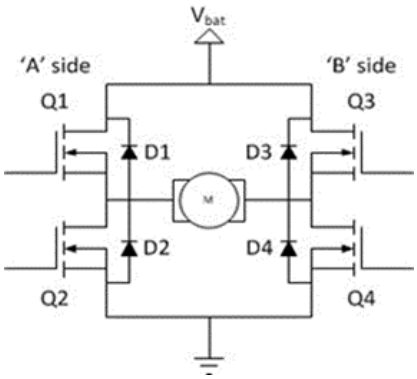

Fig6: H-Bridge Motor

H-bridge controls DC motor with 4 switching elements - bipolar/FET transistors, IGBTs & catch diodes. Used with DC/stepper motors, project has 2 H-bridges for robotic vehicle's base & arm. Base uses TIP 122/127 transistors.

4.METHODOLOGY

The Methodology to carry out the project is:

1) Material survey: The detailed material survey of various materials available in the market. The most suitable material for the project fabrication is chosen and the problem definition is outlined. A rough plan is devised which can handle all the defined objectives.

2) Fabrication of chassis: This phase involves the fabrication of chassis by choosing the proper material for the chassis. The chassis forms the integral part of the project as it is the frame which provides a base for mounting other components and mechanisms. The chassis is fabricated first and then other mechanisms are mounted over it.

3) The microcontroller and sensor interfacing: A microcontroller is a modest microcomputer that governs embedded systems in a variety of devices, including vending machines, robots, office equipment, sophisticated medical equipment, mobile radio transceivers, and home appliances. A processor, retention, and peripherals are common components of a microcontroller. This stage involves connecting the microcontroller of the robotic vehicle alongside the fire detection sensors. The microcontroller's response to both inputs and outputs is appropriately programmed.

4) The Robotic Arm fabrication: In this phase the robotic arm is fabricated which is incorporated onto the robotic vehicle. The robotic arm can be controlled wirelessly using the controller provided. The robotic arm helps to extinguish fire at different heights.

5) The Assembly: The project's final assembly is completed during this6 phase. All of the project's components must be put together during this phase, along with the power unit. The motor in the power unit is in charge of moving the robot and robotic arm. The components fabricated above are assembled and tested for performance and changes are made if required. Thus completing all the above phases we plan to complete the project. The project aims to solve the problems faced due to fire hazards which are noticed every day.

5.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 15 degrees
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

=69.90 N-m
Therefore;
While Selecting Motor, The motor Should be able to provide at least a torque of 69.90N-m i.e 70 N-m Considering Normal as well as slopy conditions.

6.RESULT

The robot was able to detect the fire through the sensors 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 towards the 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. It satisfied our objective which was to operate the robot in manual & autonomous mode.

7.CONCLUSION

In Conclusion, The project aims to address the issue of daily fire hazards, which often lead to the loss of many lives. Manual operations are often incapable of handling such situations due to the risk posed to workers' lives. Therefore, the pr4oposed project seeks to replace manual fire extinguishers with an autonomous system that can detect and extinguish fires using an onboard extinguisher. Additionally, the project can operate in dual mode: manual and autonomous. It can approach and put out fires in autonomous mode, and in manual operation, the operator may w1irelessly steer the robot towards the fire's spot and put it out. There is no danger to the operator's life because they can control the robot effortlessly from a distance.

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