



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.699

Volume 14, Issue 5, May 2025

IoT Enabled Toxic Gas Detecting and Fire Extinguishing Robot

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ABSTRACT: In today's world sometimes when fire accidents occur it is difficult for the fireman to access the place of fire and extinguish it. In the event of a fire breakout, to rescue people and to put out the fire we are forced to use human resources which are not safe. By designing and implementing an autonomous robot capable of detecting and extinguishing flames, disasters can be avoided with minimal risk to human life. These robots have the capability to detect and extinguish fire automatically. These robots are based on IOT and has flame sensor to detect the fire and a sensor to detect toxic gas. Robotic technology has the potential to be a great relief for emergency response personnel-in their daily work as well as when facing extreme disasters robots can be employed to extinguish fires. In this project we are using the micro controller (NODE MCU (ESP 32)) to perform the action that continuously monitors the specified area whether there is any fire and automatically it goes near to the flame and extinguishes the fire. Here we are using a MQ7 gas sensor to detect the toxic gas like methane presence in that specified area.

KEYWORDS: IoT Enabled toxic gas detecting and fire extinguishing robot, ESP-32 Microcontroller, MQ7 gas detecting sensor, multi-functionality, fire extinguishing capabilities, toxic gas detection and mitigation, navigation and movement

I. INTRODUCTION

In current world scenario communication between everyday objects is done by the use of microcontrollers. Many smart devices assist human being in their day-to-day activities. These devices perform work cost effective and also efficiently. Now comes the use of robots which are used in dangerous places like bomb detection in aeronautical applications, chemical industries, etc., our aim of this paper to design such a robot which would detect and extinguish fire where human beings are not accessible.

The proposed of this robot can detect and extinguish fire on its own. If fire in a place is not detected in its early stage it would spread rapidly. The fireman who are normally involved in this process may lose their lives; Therefore, the purpose of firefighting robot is that it would sense the fire using flame sensor, extinguish it using water by means of the water spraying mechanism.

The Fire Fighting Robots are most popularly searched to prevent the fire injuries and to improve the effectiveness of the robot. In order to determine the lead of the fire to the robot, smoke, and fire (thermal) reflections can be clued. The project aims to design a robotic fire extinguishing vehicle that can be operated both wirelessly and manually. The main objective of the project is to automatically or manually design and implement a fire fighter robot to extinguish fire. The robot is equipped with sensors that help us detect fire, smoke, or any obstacles in its path. The proposed vehicle has a gas spray which, compared to water, can extinguish fire at a faster rate. The robot control system presented here can be used for various robotic applications.

The main and only work is to deploy the robot in a fire prone area and the robot will automatically work once it detects a fire breakout. This prototype helps in Rescue operations during fire accidents where the entry of service man is very difficult in the fire prone area. There are several existing types of vehicles for firefighting at home and extinguish forest fires. Our proposed robot is designed to be able to work on its own or be controlled remotely. By using such robots, fire identification and rescue activities can be done with higher security without placing fire fighters at high risk and dangerous conditions. In other words, robots can reduce the need for fire fighters to get into dangerous situations.

When we the field of firefighting has long been a dangerous one, and there have been numerous and devastating losses because of a lack in technological advancement. Additionally, the current methods applied in firefighting are inadequate and inefficient relying heavily on humans who are prone to error, no matter how extensively they have been trained. A recent trend that has become popular is to use robots instead of humans to handle fire hazards. This is mainly because they can be used in situations that are too dangerous for any individual to involve themselves in. Robot consist of the two sensors that are interfaced in the control circuitry. Sensors are used to detect fire prone area all directions and moves the robot to fire location. When the robot reaches fire zone then a pump extinguisher is attached on the robot comes into action to extinguish the fire.

II. LITERATURE SURVEY

In olden days, there is no automatic extinguishing of fire. The fire brigade should be called to the fire prone area which is operated by human whose lives are at greater risk. It takes time to arrive at the fire place and mostly water is used to put off fire. Later with the evolution of technology, fire extinguishers came into existence which is filled with CO₂ limitedly. In recent years around 2016, manually controlled fire extinguishing robot came into existence which is followed by pre trained robot for environment like smart homes fire detection and avoidance. It also sends alert to the user through Bluetooth which is capable for communication over some meters. The proposed robot uses Iot for streaming live pictures of the fire prone area and puts off all types of fire by fitting it with the corresponding fire extinguishing substances depending on the fire prone area.

A fire extinguisher robot designed with the look and function of a robot assembled with the intention to extinguish the fire by using a water pump as actuators. The movement of the fire extinguisher robot is controlled using Android smart phones via Wi-Fi networks utilizing Wi-Fi module contained in the robot. User commands are sent to the microcontroller on the robot and then translated into robotic movement. The robot was equipped with cameras and ultrasonic sensors. The camera played role in giving feedback to user and in finding the source of fire. Feedback provided by camera on the robot is displayed on a screen of the smart phone.

The requirement of this proposed work is to create a robot that could fully governing itself. When the robot is kicked off by the user, the robot could maneuver itself, poke into, and quench the fire on its own without any backing. The designed robot indicates the fire through alarm. It is preprogrammed with the environment. The robot can only be used in a pre-trained area like home, and not for general purpose.

The robot has multiple modes of operation; the first mode of operation is to regulate the movement wirelessly using a Node MCU module, paired with a smart phone application. The second mode of operation is consummated by linking the interfacing IR sensors with Node MCU for obstacle detection and temperature sensing using temperature sensing LM35 IC. The quenching mechanism used in the different modes of operation is a water pump. The robot proposed is trained to do the functionality of the fire brigade.

The goal of the proposed work is achieved by training the robot as a fire fighter which is controlled automatically. The robot has a water tanker unit and a pump

III. METHODOLOGY

In the indoor of an industrial organization, the robot is placed at the place where fire accidents can happen. A micro-controller and sensors are used to operate this robot. If there exist any fire signal, the sensors will send the information to the central coordinator unit. The coordinator unit is the brain of the robot. It makes decisions based upon the sensor signals.

The whole system includes a sensor, a Micro controller unit, and motors. The sensors' data is sent continuously to the NodeMCU. It Collects the data from sensors and then process the data depending upon the program. If the data are analog value, then the data are converted to a digital value using ADC conversion and sent to the server and the android app. The flame sensor value is used to decide to switch on the water pump automatically. By using flame sensors find

the exact position of the fire. The module must relate to a Wi-Fi router or mobile hotspot to transfer the feedback data from the robot to the server and Android App.

When the robot goes into autonomous mode it started searching for fire. The robot moves round in a circular way from right to left. This movement is the default movement for the autonomous part. There are 3 flame sensors. Flame sensors cover up to 0 to 60 degrees searching for the higher wavelength flame. We put 2 flame sensors in the front of our robot to cover up a significant amount of range to search fire. The 2 flame sensors on the lower part search for fire, if the left flame sensor sense fire, then the robot moves left, if the right flame sensor sense fire, then the robot moves right, and if the middle flame sensor sense fire, then the robot goes forward. The robot moves forward in that direction only when middle sensor senses fire. When it moves forward it follows a straight line towards the fire so it takes minimal time to reach for the fire. Then the pump starts and the fire extinguisher is ready to spray.

A servo motor was attached to the fire extinguisher spray. The servo that is attached to the fire extinguisher spray creates a TENSION on the cap of the spray to release water from the water pump. Another Sensor called MQ7 is placed in this project which is used to detect the methane and some harmful gases. When the MQ7 sensor senses any harmful gas, it provides information to the NODEMCU which is connected to the Blynk app. Then the NODEMCU sends an alert message to our android regarding presence of harmful gas.

IV. EXPERIMENTAL RESULTS

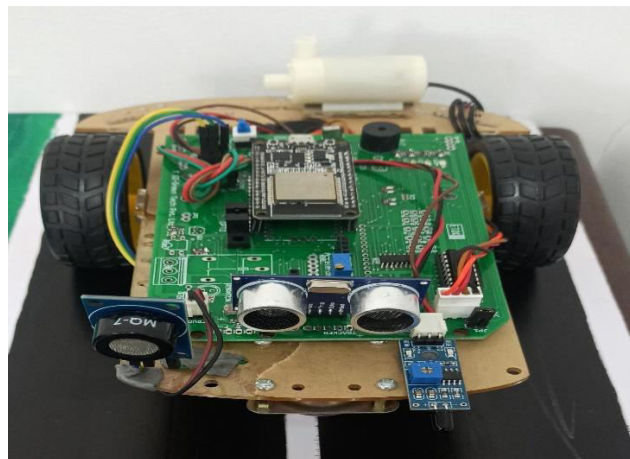
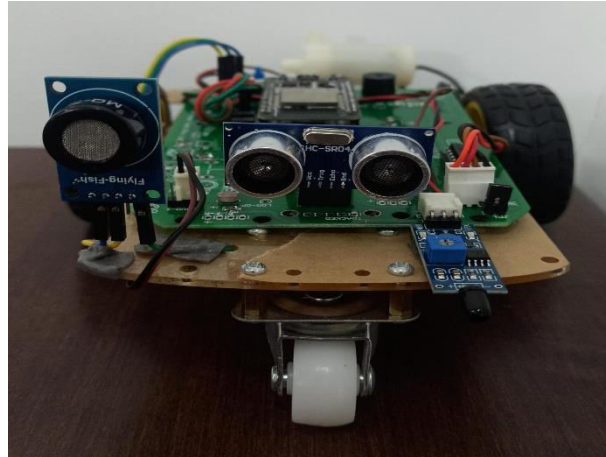
Design and Implementation: The control circuit is installed within the walled compartment of the structure. A total of 6Volt and 10 AH battery has been used for powering the control circuit. The rechargeable Liion batteries are connected in series to drive two motors. Each motor drives only one wheel so that sufficient torque is available for the robot to climb steep paths. The IR- flame sensor is located above the structure of the robot to detect the flame. A pipe is put in front of the robot to extinguish the fire.

Flame detection: A large amount of infrared radiation is emitted along with a sparse amount of UV rays and visible rays during a fire. The human eye captures the radiation as visible yellow red flames. However, some fire occurrences, such as hot charcoal, may not emit visible light, but it does emit infrared. Thus, a flame sensor is used in this robot that detects infrared rays and sends a signal upon the fire detection to assure the occurrence of fire.

Gas Detection: Gas sensor module MQ7 is used in this robot which detects the presence of combustible gases detecting LPG, natural gas, town gas, avoid the noise of alcohol and cooking fumes and cigarette smoke. MQ-7 is used in gas leakage detecting equipment in consumer and industry applications, this sensor is suitable for detecting LPG, natural gas, coal gas. Avoid the noise of alcohol, cooking fumes, and cigarette smoke. The sensitivity can be adjusted by the potentiometer. The sensor is highly sensitive and provides a speedy response. It provides additional safety on the occurrence of fire to detect the places where combustible gases may congregate due to leakage from a gas pipe or any other sources. The gas sensor sends a signal to the developed app based on its detection of gases. If combustible gases are found, the app displays "GAS: HIGH" notation and "GAS: LOW" notation when no combustible gases are detected.

NodeMCU: Module Data between the robot and the app is communicated through the NodeMCUESP32(Node Micro-controller Unit) module. Node MCU is an open-source Lua based firmware. Adoptable prototyping is possible using the NodeMCU-ESP32 module, which is implemented in C programming. This module has both the Dual-Mode Wi-Fi and Bluetooth. The system communicates via Wi-Fi to remotely monitoring data.

Android Application: The robot transfers all the information to the android app named Blynk App. Blynk app is the easiest way to build a mobile app that supports hardware platforms such as Arduino, and a similar micro-controller, which can be used to create required project. This app can control the robot via Wi-Fi and it indicates the presence of gas leakage and sends an alert message to the respective mobile phone.



V. CONCLUSION

This fire extinguishing robot using IoT is introduced to help fire men to avoid the risk situations. This proposed work presents an outline about the fire extinguishing robot using IoT and also gives objectives and advantages of the proposed system. It provides better features that make it a more practically usable robot in real time. It has advantageous features such as ability to detect location of fire automatically and poisonous gases like methane, carbon monoxide besides having a compact body and lightweight structure.

From the beginning till the end, from the scratch of building this robot to the final stage of this robot, we keep in mind that we want to make our robot real-life implementable. We make every step perfectly before moving to other steps we test every step before implementing it on the larger chassis. Firstly, we made a demo version of our robot to check the Arduino codes. After the completion and test of every component, we make the bigger chassis-based robot. The robot can be used at a place that has a small entrance or in small spaces because it has a compact structure. The system can potentially be useful to accompany fire fighters and prevent an outbreak. By introducing this system in industries and other factories, fire accident rates can be decreased.

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