Fire Fighting Robot

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Abstract- *The aim of this paper is to design a robot which acts as an fire fighter. It detects fire in the disaster prone area. With the help of the IOT we can also control our fire robot manually. We can switch between any the two modes i.e., automatic or manual in either way we want. We are using a camera to know what is happening in the area and NodeMCU to know the status of the robot. Here, the fire detection robot overcomes the problem of hitting the obstacle by sensing the obstacle and moving into the direction where it is obstacle free.*

Keywords- Camera, Flame sensor, NodeMCU, Fire Robot, IOT, GPS,SMS.

I. INTRODUCTION

Fire Fighters are being exposed to various hazardous situations. In most of the situations they may not know exact scenario of their working place.

As the situation is hazardous monitoring the data near from the operating location is putting life at risk.Without nearing the place, Scavengers and Fire Fighters can know about the hazardous situation by using the proposed system. They can arrange protective equipment, corrective measures accordingly.

With the advancement of technology, the people are motivated to use automation system. The automation system makes the task easy and reliable. Different people use the automation system for different purposes according to their comfort. Some of them use it for making their life more comfort like developing automatic door closer, automatic fan speed controller, home automatic system etc, and some of them make the use of automation for making the task easier such as automatic railway crossing gate controller or in metro, the automatic smart card detection system. But the operation of all these systems or devices is not possible without the use of internet of things (IOT).

The designs which are developed is based on GSM and GPRS innovation and Public subservience items for communication. It is a Gas or Fire battle Robot which can be used for either prevent our homes or industries, offices etc from fire or from harmful gases. The new and novel thought behind this research is that our robot will move in the area of suffocated fire or harmful gases in our homes or in buildings of other work area, where a normal person may feel lack of oxygen or need to wear a mask,or when nobody is at home and offices. This robot will find the presence of fire using flame sensor and gas sensor and when the flame or fire is observed by the robot, it will send the message in a form of signal to a server of IOT and battle with detected fire using fire extinguishers or sprinklers. These Gadgets can be used at various places where feasibility of human is very difficult. Wireless network has proclaimed its incoming on vast stage and thus the whole world goes dynamic. It is needed to regulate all the things without disturbing the ecosystem. This construction and design of fire or gas battle robot is remotely controlled by using GSM module embedded in NodeMCU. The employment of “Embedded System in Communication” gave rise to several attention-grabbing applications which assured comfort and safety to our life. The main object of this paper is to construct a SMS based Fire/Gas battle Robot tools that may replace conventional flame battle procedure. The tool detects the flame thereby sending message to landlord of the area, this device is made more efficient by SIM card installed in users phone for sending messages so that user got alert during fire.

II. LITERATURE SURVEY

A. Monitoring and Controlling of Fire Fighting Robot

It is designed by using a temperature sensor. Fire fighting is the act of extinguishing fires i.e., it sprinkles water on to the fire. Through this we can conclude that a robot can be used in place of humans reducing the risk of life of Fire fighters. We can use them in our Factories,Homes, Labs, Offices etc. They provide us greater efficiency to detect the flame. Hence, this robot can play a crucial role.

B. Fire fighting robot with vision camera and gas sensors.

WSN(Wireless Sensor Network) based Life Save System was designed.

C. IOT Based Fire Detection Robot.

This paper focus on improving the security of houses and industries against harmful Gas Leakage and fire flame. This device is very robust and help the user to notify about if there is any gas leakage or fire. It alerts the user when a person is not at home or offices directly from the Iot server. The designed robot can be easily controlled by sending the commands to the micro controller from anywhere from the world. These commands can be observed by using Attention commands and acceptable action is taken. The main aim of this paper is to design a semiautonomous electronic IoT based firefighting robot which can replace the traditional human firefighters and prevent them from the danger of firefighter. The robot sends message to controller and will take emergency precautions to eliminate the danger for firefighters. The device is made more efficient by sending the message via SIM card to user so that the user could be automatically alert when he/she is out of home or office.

III. EXISTING METHODOLOGY

It can be modified to a real extinguisher fire by replacing the water by a carbon-dioxide carrier and by making it to extinguishing fire of all the rooms using human controlling by IOT or a marked track for the drone to surveillance. This provides us the opportunity to pass on robots tasks that traditionally humans had to do but were inherently life threat. Fire-fighting is an obvious candidate for such automation. However, there has been research on many of these pieces in different contexts, e.g., coordination among mobile agents, techniques for detecting and avoiding obstacles, on-the-fly communication between humans and mobile agents, etc. It will be both interesting and challenging to put all together into a practical, autonomous fire-fighting service.

IV. LIMITATIONS OF EXISTING SYSTEM

This study focuses on creating a prototype fire fighter robot and being able to implement to real time with trial and error ,to undergo testing the robot to various situations. The sensors are limited, specifically for flame. A mini pump or a small fire extinguisher is added to the prototype. It is also powered by an energy source which is exclusive for home safety and the motion of the robot depends on the distance from any flammable materials.

V. PROPOSED METHODOLOGY

The framework to be comprised of ultrasonic sensor, gas sensor and temperature sensors. A temperature sensor to be installed on the prototype so as to formulate the ultrasonic sensor readings accordingly, since readings of the ultrasonic sensor depends on the temperature. Boundary constraints must be taken into consideration in the source code. For a newly installed prototype, sample readings of the area to be taken to calculate the obstacles for its movement in that particular area. This prototype keeps patrolling around , sensing any kind of gas leakage or raise in temperature. A threshold is set on which, if the sensors detect the raise in the value, a signal is to be sent. While, there is a gas leakage the sensor sends a message to its corresponding user. Else,if there is a fire outbreak, the prototype is given command of sprikling the water or using a fire extinguisher in the particular region.If the temperature does not decrease within the time of its first detection, it is made to send another message to the user else a no-distress signal is sent stating the situation is under control.
More, constraints can be added , for example the gas sensing is to be done only in the kitchen, where there is more chances of a leakage , and also eliminating the fire extinguisher to function in particular region of the kitchen as there is a usage of stove whose temperature is usually very high. The hardware setup must use Wi-Fi Manager modules to connect to internet through L4 redirection and upload data to cloud storage such as Firebase. Mobile or web application derives data from the cloud and notifies the corporation accordingly. This here is a model in order to sense/detect the hazard, with the installation of sprinkler or a fire extinguisher one would also be able to hit the extinguisher through the prototype or sprinkle water by which the area on fire would be drastically reduce the temperature and the further cause of spreading of fire.

Inorder, to keep the user updated of the region where there is a fire , a camera is installed which sends the user, images of where there is fire. With pre programmed set of protocols where the camera should be held only near a limited distance between the flame and the prototype, so as to not cause as damage to the robot nor its components

Fig 1: Proposed Methodology Design

VI. SYSTEM ARCHITECTURE

Fig 2: System Architecture Design

This system is combination of both hardware components and software components. Google cloud service namely Firebase is used along with the setup for storage and retrieval of data.

a)Software used – Arduino IDE

The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third party cores, other vendor development boards. We make use of Wi-Fi Manager module and firebase module for our system.

Firebase module enables nodemcu to communicate with google cloud firebase and utilize its services. It ensures secured communication of data over the internet since Asymmetric encryption method is followed. The data to be sent is encrypted at client side before transmission using its encryption mechanism making using of unique client id or key. Data transmission is fast and well secured. The data stored at cloud is encrypted again using google's own security mechanism.

Wi-Fi Manager ensures reliable network connectivity to wireless network. When the setup is installed for the first time, the board activates access point mode, connecting to which leads us to a captive portal via L4 redirection on a mobile or pc connected to same Access Point (AP). The captive portal should be password protected for enhanced security. In the captive portal, one or more WiFi credentials can be added to which user might want to connect in future. Once done, the board changes its state to default mode attempting to connect to WiFi. If a WiFi is down, it will automatically attempt to connect to other WiFi station using credentials fed via captive portal.The credentials entered is not hard coded onto the board via software code, instead it gets stored in RAM and firmware which isn't accessible to users. This ensures reliable and secured connectivity to the internet.

b)Cloud services used: Firebase

Firebase is a Backend-as-a-Service (BaaS) app development platform that provides hosted backend services such as a realtime database, cloud storage, authentication, crash reporting, machine learning, remote configuration, and hosting for your static files.Database is stored under the format of JSON and to be synchronized with clients in realtime. The cross-platform client is the fundamental platform of this database which all clients share the same resource from Firebase server and it will automatically update when any data is stored of changed. Firebase uses NoSQL type for its database that removes the constraints when interacting with tables, fields. This helps user freely create and decorate database easier. It provides numerous features such as user authentication.

The sensor readings captured from the sensors (ultrasonic sensor, gas sensor, temperature sensor etc) by nodemcu are sent to firebase. The mobile or desktop web applications can fetch the data from the cloud after user authentication check and it can be shown to the end users for monitoring. The user can send appropriate control signal as when required which gets stored in firebase directly. The control commands are read by IoT board and changes can be reflected by sending required control signals to the sensors or devices attached to it.

c) Hardware used

1)Board: NodeMCU

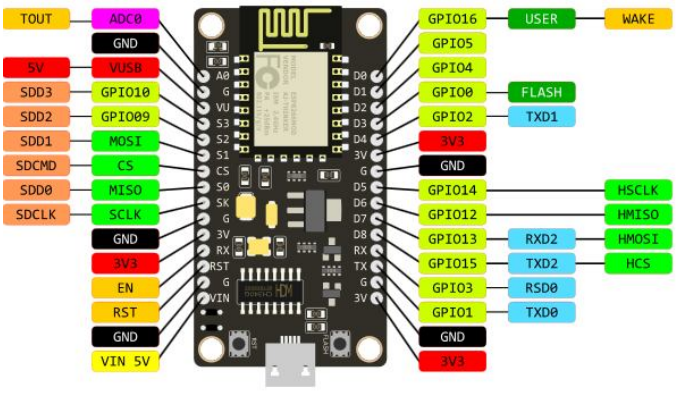

Fig 3: NodeMCU

NodeMCU is an open-source firmware and development kit that helps you to prototype or build IoT product. It includes firmware which runs on the ESP8266

WiFi SoC from espressif Systems, and hardware which is based on the ESP-12 module. The firmware uses the Lua scripting language. It is based on the elua project, and built on the Espressif Non-OS SDK for ESP8266. The sensors are attached to its pin. Analog and digital sensors are attached to analog and digital pins respectively. The board can be programmed using software Arduino IDE in C/C++ to control pins. Data can be written to or read from the pins.

2) Ultrasonic sensor

A special sonic transducer is used for the ultrasonic proximity sensors, which allows for alternate transmission and reception of sound waves. The sonic waves emitted by the transducer are reflected by an object and received back in the transducer. After having emitted the sound waves, the ultrasonic sensor will switch to receive mode. The time elapsed between emitting and receiving is proportional to the distance of the object from the sensor.

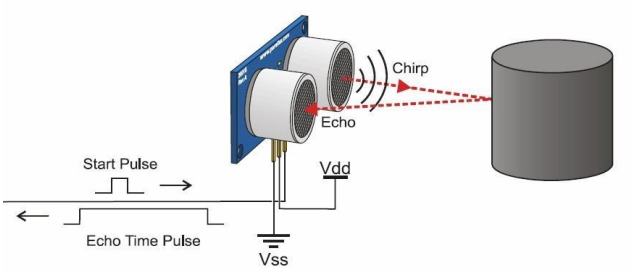

Fig 4: Ultrasonic sensor

Ultrasonic sensors generate high-frequency sound waves and evaluate the echo which is received back by the sensor, measuring the time interval between sending the signal and receiving the echo to determine the distance to an object.

3) Flame Sensor

A flame detector is a sensor designed to detect and respond to the presence of a flame or fire, allowing flame detection. Responses to a detected flame depend on the installation, but can include sounding an alarm, deactivating a fuel line (such as a propane or a natural gas line), and activating a fire suppression system. When used in applications such as industrial furnaces, their role is to provide confirmation that the furnace is working properly; in these cases they take no direct action beyond notifying the operator or control system. A flame detector can often respond faster and more accurately than a smoke or heat detector due to the mechanisms it uses to detect the flame.

Fig 5: Flame Sensor

VII. CONCLUSION

Fire fighting is the act of extinguishing fires i.e., it sprinkles water or carbon dioxide on to the fire. Through this we can conclude that a robot can be used in place of humans reducing the risk of life of Fire fighters. We can use them in our Homes, Labs, Offices etc. They provide us greater efficiency to detect the gases and fire. Hence, this robot can play a crucial role. IoT based fire fighting robot designed to detect fire or harmful gas in a certain area and send a signal to the operator. To implement this function, we need to integrate different sensors and systems together. This robot is accessed from a remote location using an IoT server. To enable the communication between the all the component and the IoT server programming is required. Hence the proposed system is more efficient and cost effective, serving a great help to humans by reaching places where it is difficult for humans to reach.

VIII. FUTURE ENHANCEMENT

The network reliability can be improvised by providing provision to connect to internet via ethernet as well. More sensors can be implemented and integrated to get further beneficial information out of the system and its environment like GPS for anti-theft. Local storage of data can be maintained for buffering the data from the sensors temporarily in case of network failure. Also by including face recognition system, intruder images can be captured.

Instead of Making the robot on Wheels,which is just moving in a floor , we could be able to give it a platform such that it is able to commute from a floor to another.

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