

Autonomous Fire Fighter

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Abstract—Fire accident at the industries would cause heavy loss and it is a major danger to human lives. Early stage fire detection and taking small steps of firefighting action may avoid huge loss and saves human lives. The proposed system is the idea of including the autonomous firefighting mobile robot in the traditional fire safety Internet of Things (IoT) system to perform early firefighting action. If the fire is detected, IOT system sends alerting message to fire safety department and initiates mobile robot to perform action. Firefighting robot reaches fire location by using path planning algorithm and performs firefighting action using the CO2 pump and sends the video stream of fire location to the control room. This early firefighting action stops the fire spreading and alerts the fire safety officers. In the meantime, fire safety officers can do better plan to handle the fire accident by watching the video sent by the firefighting robot. Industries which has lot of possibility of fire accident may use firefighting mobile robot with their existing fire alerting system.

Keywords—Alert system, autonomous firefighting robot, extinguisher, IoT system, sensors, video stream.

I. INTRODUCTION

Fire accidents are considered to be a big threat to human lives. Firefighters put their life at stake and try their level best to extinguish fire and save lives in a fire accident. But at the household level, it is found that if the fire can be extinguished at an early stage, many major accidents can be prevented. In certain situation firefighters may not arrive at the fire location on right time causing major danger to human life. This can be avoided by implementing a fire fighting robot which can automatically move to the fire location and start extinguishing the fire. There have been several technological advancements in the field of robotics that can replace humans in many situations. The robot can initiate the fire fighting job using a water or Co2 pump attached to its body. This robot can be implemented at household levels and in small scale industries to control fire at the initial stage itself. However, the fire fighting robot can perform the initial extinguishing measures that helps in avoiding the situation to get more complicated. Another innovative way is a flying drone to extinguish fire is still under study. Thus, the robotic system can be on demand for its usefulness.

II. LITERATURE SURVEY

Several researches are being carried out in the field of fire fighting robots to minimize the danger and prevent the damage caused by fires. Megha Kanwar has proposed the "IoT based firefighting robot" which is capable of extinguishing the fire through a water pump running on a servo motor. It can send an alert to the authorities and it can also be controlled manually. [1]

"Fighting tank Robot", Kristi Kokasih, is a robot capable of putting up fire built using iron, acrylic and plastic. Robot segments are servo engines, DC engines, compass sensors, ultrasonic sensors, fire locator, thermal sensor. The robot is initiated through DTMF transmitter and receiver. [2]

"An Autonomous Fire Fighting Robot", Ahmed Hassanein, Mohanad Elhawary, Nour Jaber, is a fire fighting robot that can extinguish fire by traversing the map to find the location of the fire and reach the location. [3]

"An Autonomous Fire Fighting Mobile Robot", H.P. Singh, is a research paper that proposes the idea of a mobile fire fighting robot made up of two optically isolated motors. There are five infrared sensors being used in the model, two for the motion control and other three for the flame sensor detection. The extinguisher is a water pump. The whole system is controlled by a microcontroller. [4]

"Fire Extinguishing System", Poonam Sonsale, is a paper that proposes of the calculation of fire location. It comprises of smoke sensor, flame sensor and temperature sensor for flame identification. It contains a framework for high security based on multisensory options. The system uses sprinkling system for extinguishing activity. [5]

"Android Phone controlled Robot", Arpit Sharma, is an android based manually controllable robotic system that is using Bluetooth. Accelerometer is used to detect the signals of the robot. The Bluetooth module is controlled by the microcontroller. It is a lightweight model compared to other models. [6]

III. PROPOSED SYSTEM

The proposed system is an autonomous firefighting robot that can move and perform extinguish operation without any manual

control. It is powered by the Arduino uno board. The working of the proposed system is based on WiFi that communicates with the flame sensors by sending and receiving data continuously. The robot is built using sensors namely flame sensor and ultrasonic sensor for obstacle detection. The robot runs on a servo motor. The proposed model is provided with an alert feature that will send an alert to the fire safety department once the fire has been detected. It also provides live video streaming of the fire location so that the fire department can know the region of fire spread and make necessary measures.

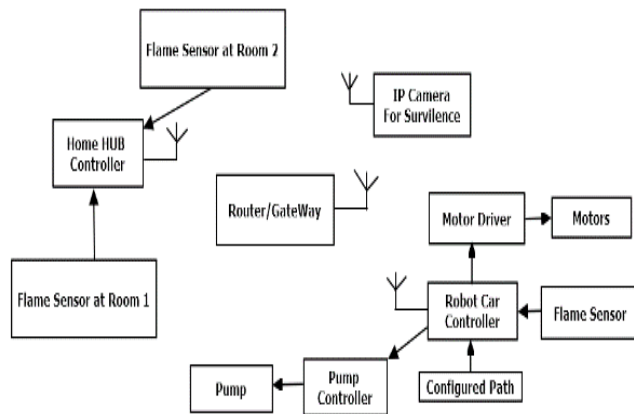


Fig. 1 System Architecture

The proposed model comprises of two main modules namely the sensing module and the control module. The sensors used in the robot are flame sensor to detect flame and ultrasonic sensor to detect obstacles and ensure free path navigation. A home hub controller coordinates the data from the flame sensor and sends to the microcontroller.

The robot car controller is attached to a motor driver is responsible to control the movement of the robot. The car controller is provided with four motors for the four wheels respectively. The pump is controlled by the pump controller. The pump is attached to a Co2 cylinder.

IV. IMPLEMENTATION AND RESULTS

The implementation of the proposed model can be visualized as following:

A. Detection of flame

The flame sensor placed in each room of the house is connected to a central hub called the Home HUB Controller. The home hub controller communicates with the robot

through the WiFi module. The WiFi module on the microcontroller acts as a sender and sends request to the receiver module present in the home hub controller for every two seconds. If there is any flame the flame sensor responds to the request.

B.Alert to the fire station

Once the flame has been detected, the IoT system on the microcontroller board sends an alert to the nearby fire station about the fire.

C. Initiation and control of the robot movement

Once the flame has been detected, the robot will start to move to the flame location. The movement of the robot is controlled by the motors attached to the four wheels of the robot car. The robot can move in a straight line in all four directions namely forward, backward, right and left. The microcontroller is fed with the configured path for the movement of the robot car. The motors run on 12v voltage which cannot be handled by the microcontroller since it can withstand only 5v. This is resolved by placing a motor driver that can control the power of the motor and bring it down to 5v.

D. Obstacle detection

The robot moves in the configured path until there is any obstacle on the path of the robot. During the movement, any obstacle on the path can be detected by the ultrasonic sensor placed on the robot car. The ultrasonic sensor sends reflective signals. If the signals fall on any surface it gets reflected back using which the obstacle is detected. In such case, the robot stops and changes its direction and starts moving using the path planning algorithm.

E. Surveillance

An IP Camera is attached to the robot which starts the live video streaming once the robot senses the flame. The video is streamed to the fire safety department in order to make them aware of the prevailing situation.

F. Extinguishing the fire

The robot after reaching the fire location, the flame sensor on the robot car detects the flame and initiates the pump controller. The pump controller activates the pump

attached to the Co2 cylinder and starts to extinguish the fire.

The results of the proposed work are obtained as follows:

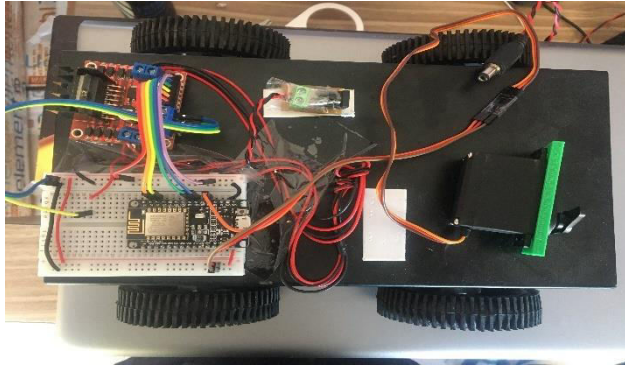


Fig. 2 The robot car

The robot car controller consists of motors for the four wheels which are controlled by the motor driver, Arduino nano board, Pump controller.

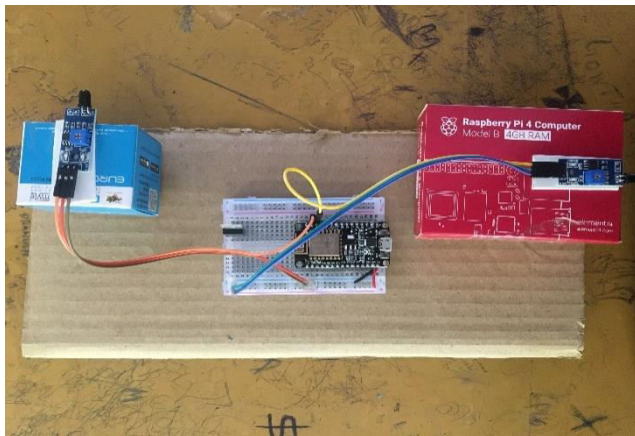


Fig. 3 Flame sensors and the home controller

Two flame sensors are connected to the Arduino nano board which acts as the home controller.

V. CONCLUSION

The proposed system mainly aims to perform primary firefighting action. The Robot has designed in such a form that it would extinguish fire by automatically moving to that particular location and alert the fire station. The flame sensor will help in finding the location and Co2 pump is used to extinguish the fire. The additional feature that proposed system has carried is live video streaming that would help the people to understand the intensity of fire and they can act corresponding to it. Thus, the proposed robotic system will can minimize the life loss in a fire accident.

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