

Fire Fighting Robot

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ABSTRACT: Detecting fire and extinguishing it is a dangerous job that puts life of a fire fighter at risk. There are many fire accidents which fire fighters had to sacrifice their lives in the line of duty each year throughout the world. The research and development in the field of Artificial Intelligence has given rise to Robotics. Fire Fighter is a robot designed to use in such extreme conditions. It can be operated and controlled by remote user and has the ability to extinguish fire after locating the source of fire. It is equipped with a monitoring system and operates through a wireless communication system. The fire detection system is designed using the sensors mounted on the Fire Fighter Robot. The robot is controlled autonomously using Android application. Android mobile phone platform developed by Google has gained popularity among software developers due to its powerful capabilities and open platform. Therefore, Android is a great platform to control a Robotic system. Android provides many resources and already integrates lot of sensors. Through testing, it is possible to run in a realistic scene simulated in the lab and to detect and extinguishment the flame. Robot can transfer video to remote location. This concept helps to generate interest as well as innovation in field of robotics while working towards a practical and obtainable solution to save lives and mitigate the risk of property damage.

KEYWORDS: Fire sensors, Fire extinguishing, navigation, camera interfacing, fire robot.

I. INTRODUCTION

According to National Crime Records Bureau (NCRB), A total of 11,037 cases of fire accidents were reported in the country during 2019, showing a decrease of 15.7% as compared to 2018 (13,099 cases). 11,037 incidents of fire accidents caused injuries to 441 persons and 10,915 deaths during 2019. The cause-wise analysis of fire accidents revealed that 58.0% of total deaths (6,329 out of 10,915) were reported in residential/dwelling buildings during 2019. Though there are a lot of precautions taken for Fire accidents, these natural or man-made disasters do occur now and then. With the development in the field of Robotics, human intrusion has become less and robots are being widely used.

Fire incidents happen most commonly in family houses, processing plants, research centres, factory buildings and so on. In the absence of modern hardware and machines, firefighters need to risk their lives to save others' lives in a hazardous situation caused by fire. In short, there is an inherent danger for the firefighters whose primary duties are rescue people from fire and other hazardous situations. This is the main reason which motivated us to work on developing a firefighter robot. The main objective of this project is to build a Semi-Autonomous Robot which fights fire. The objective is to develop robot that navigates with the help of Android application through Wi-Fi, search certain area, find and extinguish the flame for different flame positions. It detects fire with the help of flame sensors and extinguishes fire by sprinkling the water. Robot will also be capable of live video

streaming of a disaster-prone area through Wi-Fi. This Robot reduces the risk of human lives at the disaster-prone area.

Paper is organized as follows. Section II describes the similar works which are made are inspired for making this project. The flow diagram represents the step of the algorithm. After detection of fire by the sensors, the water pump gets the required commands from the Arduino board and sprays water onto the fire, which can be monitored through the camera that is placed in the front, is given in Section III. Section IV presents experimental results showing the images of the bot obtained at its stages. Finally, Section V presents conclusion.

II. RELATED WORK

The Design of a Novel Multi - Purpose Fire Fighting Robot with Video Streaming Capability (2019), introduced a novel design of a multi-purpose fire-fighting robot which, with the help of a streaming video camera attached to it, transmits live video from its surroundings to a remote location from where the robot can be controlled. The robot can be mobilized and directed to the spot of the fire and throw water at the fire. It uses RF signal for communication and it is capable of performing three different functions related to firefighting operation.

Author Kristi Kokasih et al. has developed intelligent fire fighting tank robot. Tank robot is made from acrylic, plastic, aluminium and iron. Robot components are two servo motors, two DC motors, ultrasonic sensor, compass sensors, flame detector, thermal array sensor, white detector (IR and photo transistor) , sound activation circuit and micro switch sensor. The objective is to search certain area, find and extinguish the flame for different flame positions, room configuration with disturbance. Robot is activated through DTMF transmitter and receiver

Author SaravananP et al. has designed and developed an Integrated Semi-Autonomous Fire Fighting Mobile robot. The System controls four D.C. motors powered by Atmega2560 and controlled autonomously by navigation system. Navigation system comprises of integrated ultrasonic sensors and infrared sensors. The robot is fitted with wireless camera which captures the video and transmits it to the base station. The fire detection comprises of LDR and temperature sensor. If there is a fire the sensor detects it and the robot will be moved to the source and extinguishes it. The extinguishing system consists of a BLDC motor with water container. The SABOT can be operated manually for extreme conditions. It comprises of a GUI support through which robot can be controlled from the base station.

Design and Manufacture of Indoor Intelligent Fire Fighting Robot (2020) by Ligang Chen et al. The main purpose of this research design is to solve or improve real life problems. To lay

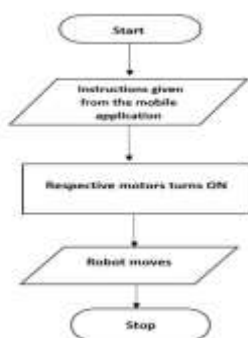
a solid foundation for the future research in the field of firefighting. Through this research design, provide certain experience and demonstration. Contribute to the convenience of people's life, this will also be an important part of the design. Using stm32f103zet6 MCU as the main control chip, MCU selection is suitable for low power consumption, powerful, convenient for later improvement and expansion. The traveling mode of the robot is selected as a structure of two wheel drive plus two universal wheels. Fire-fighting function. The robot is equipped with a portable fire extinguisher. After modification, with the corresponding mechanical structure, it can be controlled by a single chip microcomputer to extinguish the fire. Real time collection of surrounding environment data and return to the terminal, the robot needs to collect the environment in which it is in the process of traveling, including images, temperature, combustible gas, etc. Because the robot's head is equipped with a camera, so it can rotate freely, free rotation ensures that all directions of the robot are within the visual range, so that real time data collection and feedback to the terminal, finally the user can judge the next step

The work in this paper is divided in three stages. 1) Navigation 2) Fire sensing 3) Camera Live coverage. Navigation is done by making use of an android application developed using MIT inventor application. The robot is guided using wireless communication to the NodeMCU board that receives the inputs. Once the bot reaches the fire prone area and after the fire is detected by the sensors, water is sprayed onto the fire making use of a water pump. The live coverage of the situation is given to the user through the camera that is placed in the front of the bot by https live streaming.

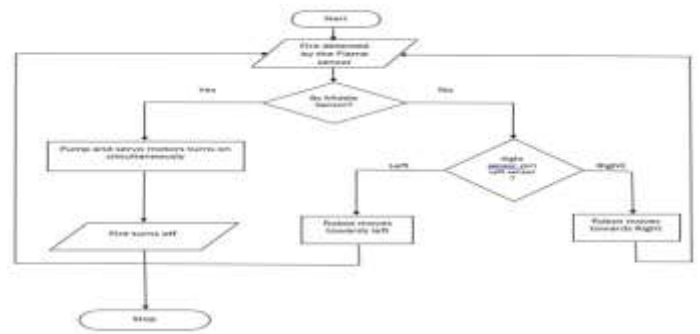
III. METHODOLOGY

Fire Fighting is an important job but it is very dangerous occupation. Due to that, Robots are designed to find a fire, before it rages out of control. It could be used to work with fire fighters to reduce the risk of injury to victims. Basically, sensors which play a very important role in our day to day life, play a important role in this project too. Digital communication of zeroes and ones is mainly focused on. The complete project is divided into 3 stages

1)Navigation: The method implemented for navigation is using driver module (L293D) having interfaced it with the nodeMCU ESP8266 and an android application developed on MIT app. inventor. The four motors drive the robot in the desired direction and controlled using the application on the user equipment.



2) Fire sensing: Robot uses Flame sensor and detects the fire and extinguishes it on its own. Here the flame sensors are interfaced with Arduino UNO. Flame sensors have IR Receiver which is used to detect the fire and communicates with Arduino. If fire is detected it automatically switches on the pump and sprinkles the water and put offs the fire.



3) Camera Live Coverage: This is achieved using ESP32-Camera which is interfaced with the FTDI (FT232RT). FTDI – FT232RT is one of the more commonly used to convert USB signals to UART signals. This allows to communicate with and upload code to ESP32-Camera this enables to live video stream from a disaster-prone area. It makes use of https live streaming technique.

IV. EXPERIMENTAL RESULTS

Figures shows the results of the improvisations made to the bot with the stages of operation as desired. Figure(a) shows the implementation of the navigation stage of the robot. Figure(b) shows the android application that is used to remotely control the robot movements through an android phone. Figure(c) shows the implementation of the second stage of the robot i.e., fire sensing. Figure(d) shows the implementation of last stage of the robot i.e., camera interfaced in the front of the robot.



FIGURE (A)



FIGURE (B)

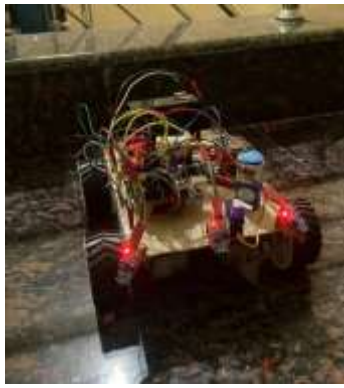


FIGURE (C)

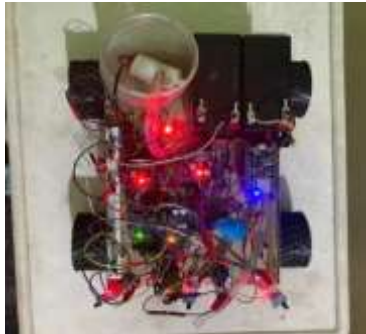


FIGURE (D)



FIGURE (E)

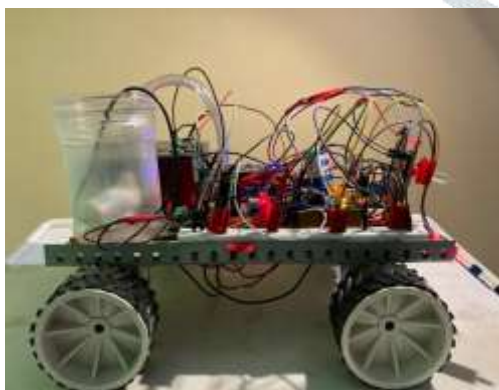


FIGURE (F)

Figure(e) shows the top look of the robot with all the stages implemented. Figure(f) shows the side view of the robot.

The developed robot navigates with the help of Android application through Wi-Fi, search certain area, find and extinguish the flame for different flame positions. It detects fire with the help of flame sensors and extinguishes fire by sprinkling the water. Robot will also be capable of live video streaming of a disaster-prone area through Wi-Fi. This Robot reduces the risk of human lives at the disaster-prone area.

V. CONCLUSION

We have implemented an automatic Fire Fighting Robot using sensors and wireless communication. Fire causes tremendous damage and loss of human life and property. It is sometimes impossible for the fire fighter personnel to access the sight of fire because of explosive materials, smoke and high temperature. Through this we can conclude that robot can be placed where human lives are at risk. The robot can operate in the environment which is out of human reach in very short time. In such environments, Fire Fighting robots can be useful for extinguishing fire. The robot accurately and efficiently finds the fire within minimum time after the fire is detected. This project presents the design and the implementation of a fire fighting robot that moves towards the fire and pump out water to extinguish the fire.

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