A Review on Fire Extinguishing Robot

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Abstract: *Fire is an unavoidable disaster that occurs suddenly or unintentionally in place or mostly in household residence. To observe continuously for accidental fire is not possible to appoint a person that's why one takes the help of robot. So in such cases these robots come in picture and will detect fire remotely. These kind of robots are mostly useful in industries where probability of occurrence of fire accidents is more. These robotic vehicles are able to detect the fire and extinguishing the fire automatically with the help of temperature and gas sensor. To control the movement of robot, it contains motor driver and gear motors. Normally, the relay detects the fire and also exchanges or shares information with microcontroller through Bluetooth module. Since, the robot contains a jet water spray to extinguish the fire. If robot comes across some obstacle then it will not collapse and prevent itself automatically because it detects obstacle with the help of ultrasonic sensors with limited range. The communication between mobile phone and robot will take place through Bluetooth which have graphical user interface to control the robotic movement. Some work has already been done in this field but significant scope is still left. Earlier, it has been observed that the robots operate with the limited range and also with microcontrollers with limited features. Now, we have planned to make our project in this field with improvements interms of range and performance therefore we have done review on this topic and find out problems. In our undergraduate project, we are going to make a performance improved fire extinguishing robot by using arduino controller and want to present or discuss this paper in the conference for getting more inputs from the experts or participants if any.*

Keywords: *Fire, Fire Sensor, Mini Pump, Arduino, Robot, Programming & Prototype*

I. INTRODUCTION

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 fighter had to loose 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. Robots are implemented in various areas like Industries, Manufacturing, Medicines etc. Hence, Robotics can be used to assist fire fighters to perform this task of fire fighting and thus reduce the risk of their lives. 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.

Firefighting and rescuing the victims is a risky task. Fire Fighters have to face dangerous situations while extinguishing the fire. Fire Fighters extinguish fires in tall buildings, drag heavy hoses, climb high ladders, carry victims from one building to another. In addition to long and irregular working hours, fire fighters also face unfriendly environment like high temperature, dust and low humidity. Besides, they also have to face life threatening situations like explosion and collapse buildings. According to the report of IAFF in the year 2000, 1.9 fire fighters per 100,000 structure fires have lost their lives per year in USA. However, this rate was increasing to 3 per 100,000 structure fires. The different causes of Line of Duty Deaths (LODD) are smoke inhalation, burns, crushing injuries and related trauma. Statistics shows that the deaths of fire fighters are constant every year. This results in need of firefighting machines to assist the fire fighters to avoid deaths by handling the dangerous situations. So if a robot is used instead, which can be controlled from a distance or which can perform actions intelligently by itself, which will reduce the risk of this task of fire fighting. Robot is a mechanical device that is used for performing tasks that includes high risk like fire fighting. There are many types of robots like fixed base robot, mobile robot, underwater robot, humanoid robot, space robot, medicines robot etc. Fixed base robot has limited workspace due to their structure. Workspace of the robot can be increased by using a mobile platform. These type of robots are called mobile robots. Mobile robots are used in mining, military, forestry, security etc. Mobile robots can also be used for extinguishing fire in tunnels, industries, hospitals, laboratory and in homes A fire fighting robot will decrease the need of fire fighters to get into dangerous situations. Further the robot will reduce the load of fire fighters. It is impossible to extinguish fire and rescue many victims at a time of huge disaster. Robot technology can be very efficiently used in such cases to rescue much more victims. Thus robotics makes human life easier and safe as well as save a lot of time. The rapid development in technology improves the tools and equipments used in firefighting. These advance tools and equipments can be more effective and efficient. Moreover, it reduces minimum risk level. This will also reduce the damages caused due to an fire incident. Android is based on Java programming language and is platform independent. Therefore it can be used in student projects. Android application is a program that can run on Android operating system and provide the required functionality to the user. The Android platform includes support for Wifi communication. Using the Wifi APIs, an Android application can scan for Wifi devices, connect to other devices, transfer data to and from other devices.

The advanced industrialized societies in the metropolitan areas consisted with dense apartment blocks, factories, complex offices and building. The gas stations and oil reservoir are also found in these areas and both are highly

flammable. In these situations, fire fighting robots are extremely necessary because due to smoke, high temperature and possible chances if explosions. The robot extinguishing fire fighters are used on which place where human cannot reach and not able to work. Hence, in these situations fire fighting robot may be operated through the remote control with fixed distance and can save large revenue for any individual or organizations and most importantly also saving human life from unexpected danger. The remote control based fire fighting robot is shown in Fig.1. But, in the present time due to advancement in the technologies one can make more efficient robot for this purpose. In this present paper, a literature review has been done for fire extinguishing robot. In future one can make multitasking robot in the emergency situations.

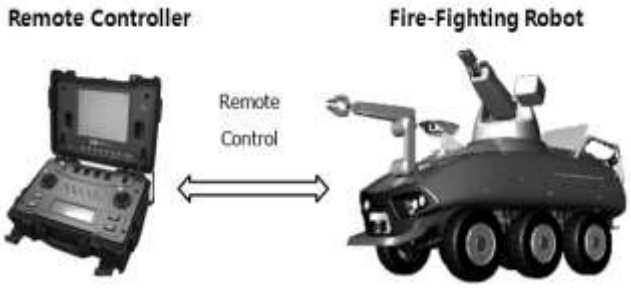

Fig.1. Fire-Fighting Robot and Remote Controller

II. Literature Review

A literature review on fire extinguishing robot has been discussed as follows:

H. Amano in [1] has discussed present status and problems of fire fighting robots. He reported that some fire departments have already developed and deployed fire fighting and rescue robots but with low performance. In this paper, author has examined robots in two points of view one is size and weight and second is cost and performance. He discussed some ways to save and rescue much more human lives. Author has considered on monitor nozzle vehicle, under water searching robot, Reconnaissance robot, Rescue robot.

A Motorola manufactured micro-controller with expanded memory autonomous robot has been discussed in [2]. This fire fighting robot was introduced with some advanced features such as environmental sensing and awareness, proportional motor control based upon environmental factors, digital speed decoding through programmable logic, differential drive control, and isolation of low and high power systems.

An advanced robot for fire-fighting and disaster preclusion are described and has been discussed in [3]. The robot was used in the disaster-fighting personnel to seize disaster status. In this fire extinguisher robot, the thermal protection technology, gas pressure servo actuator, vibration repressing control for flexible manipulators, locomotion mechanism, medium range laser visual sensor and short range ultrasonic visual sensor have used to make the robot efficient.

The firefighting robots control systems have been presented in [4]. In this paper authors have discussed the variety of different firefighting robots with their advantages and imperfections.

A computer vision based algorithm for fire detection and for directing the robot towards the detected fire has been reported in [5]. Authors have used color segmentation for initial detection and for extraction of non-static property of fire correlation was used. UV-TRON sensor used to corroborate the existence of fire along with depth mapping.

A Modular design based on proximity, vision and IR sensors based fire-fighting model has been reported in [6]. For extinguishing flame, the robot will spray water from manipulator. The obstacle avoidance, flame detection, motion control with integrated tracking has been done by the software. Here, robot also can transfer vedio to remote location.

A single longitudinal arm suspension structure for fire-fighting robot is proposed and reported in [7]. Authors said that the proposed technique has good adaptability to the ground. The ground performance has also been verified experimentally.

A fire fighting robot with streaming vedio camera has been reported in [8]. This fire fighting robot can transmits live vedio from its surroundings to remote location. The RF signal is used for signal communication purpose. For removing of smoke suction vacuum fan and cylinder was also connected with this robot. Authors emphasized that the design of the robot is cost effective and it makes it attractive for deployment in developing countries.

A dynamic modeling of a tracked mobile robot for fire-fighting is reported in [9]. The authors have considered jet velocity and pitch and tilt angles for fire monitoring purpose. Some main issues have been discussed such as slipping and tipping over of the robot under working of fire extinguishing. A voice commands based touch screen has been reported in [10]. Authors emphasize that by this robot communication can be done in the group.

III. Objective of the Work

The main objective of the work is to make an effective fire extinguishing robot with better performance and with competitive pricing. In our final year project, we will build up and an Arduino based quencher robot that have a double favorable position which can detect the fire and can put it off before the fire gains out of power. In this project, we will construct a robot utilizing Arduino that could move towards the fire and siphon out water to quench the fire. The framework can be isolated into three distinct modules sensor module, Arduino module and the apparatus module.

IV. Methodology of the Work

In our proposed final year project, we will use Arduino Uno to control and guide the Robot. We will use Four Servo Motors and small Ply Board and also motor will be connected through the Connecting wires. So, we can fix the four wheels at the edge of the ply board and connect all the following material like Flame Sensor, Arduino, Motor Driver, Servomotors, and Mini Water Pump and complete the whole circuit as shown in the Fig.2. After completion of the project, the robot will move in the room and will detect the fire. If the Temperature at certain place is more than the threshold value, then water pump will start. The main advantage of this work is that the robot is completely

autonomous and it will detect any obstacle through the android application. In this project the speed and range will also be extended. In our work Bluetooth technology will be used in the efficient way.

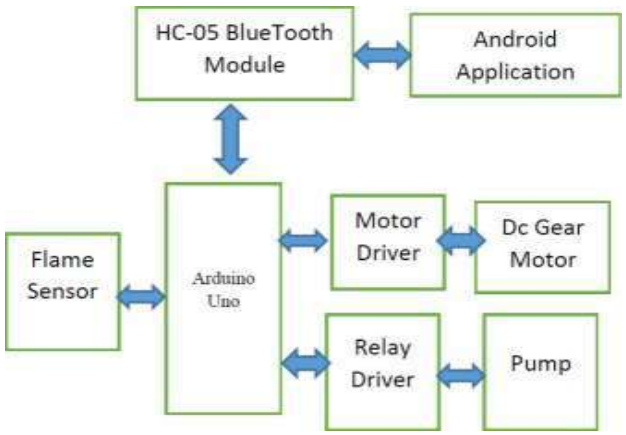

Fig.2. Block Diagram Proposed Fire Extinguishing Robot

A. Advantages of the Proposed Fire Extinguishing Robot

1. The robot will be utilized at places where it is hazardous for people to enter.
2. It can move naturally inside the room with no oversight.
3. It assists with identifying the specific bearing of the fire source.
4. It has the capacity of detecting precisely with expanded adaptability.
5. Low expense over the long haul.
6. It is dependable and prudent

B. Applications of the Proposed Fire Extinguishing Robot

1. Firefighting product has their end users in sectors such as defense, fire department, medicine, health monitoring etc.
2. Disaster area monitoring and rescue.
3. Extinguishes fire where probability of explosion is high.
4. Usable in power plant control rooms, captain bridges, flight control centers.

Conclusions

This research paper presents the plan and the execution of a putting out fires robot that moves towards the fire and siphon out water to stifle the fire. The venture disclosed how to interface different segments to Arduino. The framework can possibly be helpful to go with firemen and forestall an episode. A framework fit for exploring towards fire and afterward smothering it by siphoning water has made. Study on various segment and their interfacing strategies has been accomplished.

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