

A SURVEY ON FIRE DETECTOR AND EXTINGUISHER ROBOT CONTROLLED USING ANDROID APPLICATION – BLUCONTROL

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ABSTRACT

There are many possibilities a fire can start in an industry or in any remote area. For example, in cotton mills, garments, fuel storages, etc., electric leakages can lead to huge damage. Also, it's a worst-case scenario, causing heavy losses not only financially but also destroying areas surrounding it. Robotics is the emerging solution to protect human lives and their wealth and surroundings. The aim here is to design a FIRE DETECTOR AND EXTINGUISHER ROBOT using embedded system. A robot capable of fighting a simulated household fire will be designed and built. It must be able to autonomously navigate through a modelled floor plan while actively scanning for a flame. The robot can even act as a path guider in normal case and as a fire extinguisher in emergency. Robots designed to find a fire, before it rages out of control, can one day work with fire-fighters greatly reducing the risk of injury to victims. The project will help generate interests as well as innovations in the fields of robotics while working towards a practical and obtainable solution to save lives and mitigate the risk of property damage.

Keywords: *Android app- BluControl, Fire source detection, Fire extinguishing, Sensors, Wireless Video Camera.*

I. INTRODUCTION

Robotics is one of the fastest growing engineering fields of today. Robots are designed to remove the human factor from labour intensive or dangerous work and to act in inaccessible environment. The use of robots is more common today than ever before and it is no longer

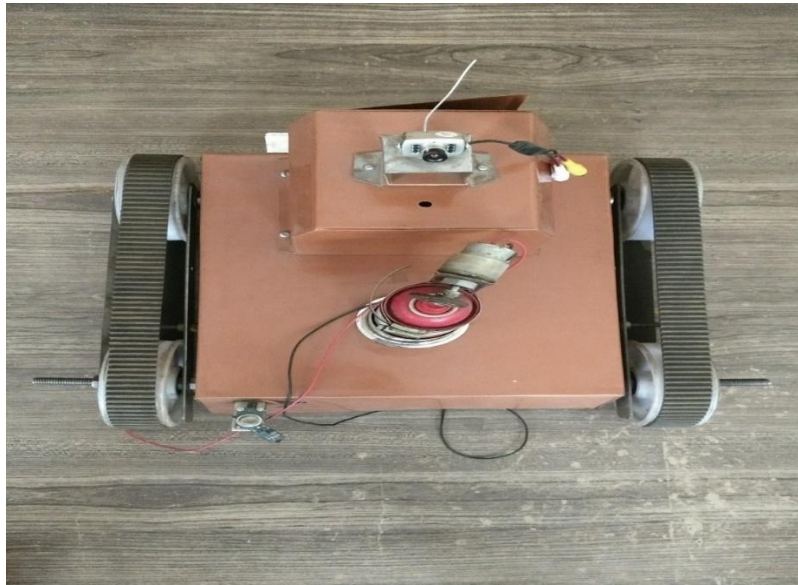


Fig: Fire Fighting Robot

Exclusively used by the heavy production industries [1], the need of fire extinguisher robot that can detect and extinguish a fire on its own is long past due. With the invention of such a device, people and property can be saved at a much higher rate with relatively minimal damage caused by the fire. Our task as engineers was to design and build a prototype system that could autonomously detect and manually extinguish a fire. Also aims at minimizing air pollution.

In this project, we have design a wireless controlled robot. 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 firefighting.

Robot is a mechanical device that is used for performing tasks that includes high risk like firefighting. There are many types of robots like fixed base robot, mobile robot, underwater robot, humanoid robot, space robot, medicines robot etc.



Fig: Fire Fighting Robot with Foam Extinguisher

Fixed base robot has limited workspace due to their structure. Workspace of the robot can be increased by using a mobile platform. These types of robots are called mobile robots. The main objective of this paper is to design a firefighting robot by using android application [2]. Mobile robots are used in mining, military, forestry, security etc. 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 equipment used in firefighting.

II. LITERATURE SURVEY

Author Kristi Kosasih et al. [3] Has developed the intelligent firefighting tank robot. Materials like acrylic, plastic, aluminium and iron are used to make the robot. The tank robot is consisting of components like two servo motors, thermal array sensor, two DC motors, flame detector, ultrasonic sensor, IR and photo transistors, sound activation circuit and micro switch sensor. The goal of paper is search the prescribed area find the fire and extinguish it. The robot is activated by using DTMF transmitter and receiver.

Author Sahil .S.Shah et al. [4] Have developed the firefighting robot. The firefighting robot is integrated with embedded system. Prototype system is designed to detect and extinguish fire. It aims to reduce air pollution caused due to fire. The robot is designed to detect fire in small floor plan. The task of extinguishing fire is divided into smaller tasks. Each task is carried out in most appropriate way. The robot navigates in every room step by step, finds the fire in a room, approaches fire from fixed distance and then extinguishes fire.

Authors Prof. Dr. S.N. Kini, Rutuja Wadekar, Shweta Khatade, Sayali Dugane and Rutuja Jadkar [2] proposed a firefighting robot which included a project that aims to promote technology innovation to achieve a reliable and efficient outcome. The movement of the robot is controlled by the sensors which are fixed on the mobile platform. is to provide security of home, laboratory, office, factory and building is important to human life. They also developed an intelligent multisensory based security system that contains a fire fighting system in our daily life. It included the design of the fire detection system using sensors in the system, and program the fire detection and fighting procedure using sensor based method.

III. METHODOLOGY

A robot is an automatically guided machine, able to do tasks on its own. This project, which is our endeavour to design a Fire Fighting Robot, comprises of a machine which not only has the basic features of a robot, but also has the ability to detect fire and extinguish it [4] This robot processes information from its various sensors and key hardware elements through microcontroller. It uses thermistors or ultraviolet or visible sensors to detect the fire accident. A robot capable of extinguishing a simulated tunnel fire, industry fire and military applications are designed and built. Ultraviolet sensors/thermistors/flame sensors will be used for initial detection of the flame. Once the flame is detected, the robot sounds the alarm with the help of buzzer provided to it, the robot actuates an electronic valve releasing sprinkles of water on the flame. The project helps to generate interests as well as innovations in the fields of robotics while working towards a practical and obtainable solution to save lives and mitigate the risk of property damage. Fire fighters face risky situations when extinguishing fires and rescuing victims, it is an inevitable part of being a fire fighter. In contrast, a robot can function by itself or be controlled from a distance, which means that firefighting and rescue activities could be executed without putting fire fighters at risk by using robot technology instead. In other words, robots decrease the need for fire fighters to get into dangerous situations. This robot provides fire protection when there is fire in a tunnel or in an industry by using automatic control of robot by the use of microcontroller in order to reduced loss of life and property damage. This robot uses dc motors, castor wheel, microcontroller, sensors, pump and sprinkler. Microcontroller

is the heart of the project. Microcontroller controls all the parts of the robot using programming. In this robot as the fire sensor senses the fire, it sends the signal to microcontroller; since the signal of the sensor is very weak the amplifier is used so that it can amplify the signal and sends it to microcontroller. As soon as microcontroller receives the signal a buzzer sounds, the buzzer sound is to intimate the occurrence of fire accident. After the sounding of the buzzer microcontroller actuates the driver circuit and it drives the robot towards fire place, as the robot reaches near the fire microcontroller actuates the relay and pump switch is made ON and water is sprinkled on the fire through the sprinkler.

IV. OVERALL DESIGN

After some discussions within the team and with some analysis of previous robots, we decided on a robot with the following design:

Using 6 panels of sensors, capable of detecting flame sources in a 360 degrees' fashion [5]. A lot of the older projects seem sluggish, in that they must stop, spin around to find the flame, and continue in that direction for a small amount of time, stop and spin around again.

The project also has a modular design as illustrated where all the tasks to be performed by our robot are split into following:

1. Proximity, this involves the interfacing of a number of proximity sensors to detect the presence of objects
2. Motor, this involves the making of a motor controller that can interpret commands sent to it, and perform corresponding motor actions
3. Flame Tracking, this involves the interfacing of sensors in such a way that we can reliably detect flame sources in a 360 degrees' fashion
4. Firefighting, this involves finding a suitable way to put out a fire
5. Core unit, a core unit will be present to co-ordinate the actions of all the sub units listed above.

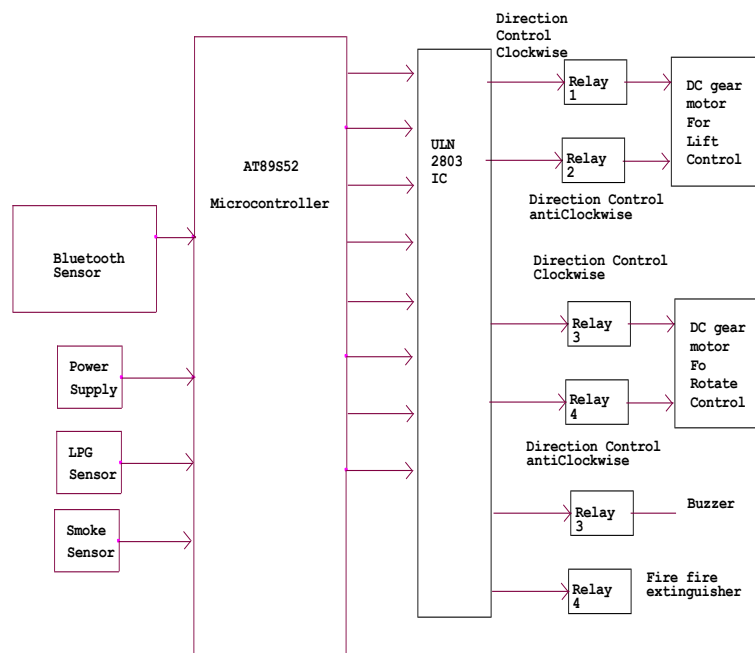


Fig: Block Diagram of Fire detector and Extinguisher Robot

4.1 Master Control

As the master controller part mainly requires programming and calibration from other parts, the first two sections are ignored.

4.2 Hardware

Circuitry wise, the main board is the least complex as the main board's purpose was to take in messages from the sub modules, and output correct fan and motor control messages, all that was required hardware wise was the use of connectors, and parts required to make a PIC function. List shows the parts used for the main board:

4.3 Micro-controller 89c52

The AT89C52 is a low-power, high-performance CMOS 8-bit microcomputer with 8K bytes of Flash programmable and erasable read only memory (PEROM). The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard 80C51 and 80C52 instruction set and pinout. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C52 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications.

4.4 DC motor

12V 55Rpm DC Wiper Motor - ZKE1032 – Right [6] is commonly used as wiper motor for cars, but it can also be used in the field vehicles and projects that require high power.



Fig: Wiper Motor

The motor speed is 55rpm and because of the bearing used it has no problem with longer operation times. The motor has 6mm screw holes for mounting and its gear is designed to be on right side of the motor.

We use that wiper motor for giving a power to the back wheel through a shaft which is revolve by wiper motor.

4.5 LED buzzer

LED is used in firefighting robot. If any fire is detected in industry or in any other area LED get on and after that buzzer get start so that operator gets signal about the fire.

4.6 Step down Transformer (230v input/12-0-12v output 1A)

Transformer is an electrical device that takes electricity of one voltage and changes it into another voltage. In AC circuits, AC voltage, current and waveform can be transformed with the help of Transformers. Transformer

plays an important role in electronic equipment. AC and DC voltage in Power supply equipment are almost achieved by transformer's transformation and commutation.

4.7 Diodes

The most common function of a diode is to allow an electric current to pass in one direction (called the diode's forward direction), while blocking current in the opposite direction (the reverse direction). Thus, the diode can be viewed as an electronic version of a check valve.

4.8 Transistors

A transistor is a semiconductor device used to amplify or switch electronic signals and electrical power. It is composed of semiconductor material usually with at least three terminals for connection to an external circuit.

4.9 Resistors

Devices called resistors let us introduce precisely controlled amounts of resistance into electrical circuits typical resistor used in an electronic circuit. It works by converting electrical energy into heat, which is dissipated into the air.

4.10 Crystal

A crystal oscillator is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a precise frequency

4.11 PCB Board

A printed circuit board (PCB) mechanically supports and electrically connects electronic components using conductive tracks, pads and other features etched from copper sheets laminated onto a non-conductive substrate. ... In multi-layer boards multiple layers of material are laminated together.

4.12 Sensor

Robotic sensors are used to estimate a robot's condition and environment. These signals are passed to a controller to enable appropriate behavior. Sensors in robots are based on the functions of human sensory organs. Robots require extensive information about their environment in order to function effectively.

Following sensors are used in firefighting robot.

- i. Proximity Sensors- A proximity sensor often emits an electromagnetic field or a beam of electromagnetic radiation (infrared, for instance), and looks for changes in the field or return signal. The object being sensed is often referred to as the proximity sensor's target.
- ii. Flame Sensors- A flame detector is a sensor designed to detect and respond to the presence of a flame or fire. 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

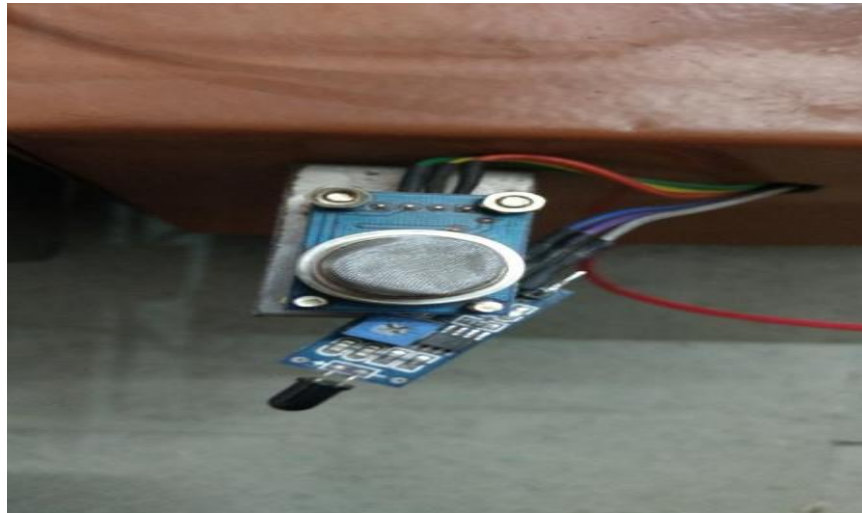


Fig: Fire and Smoke Sensor

Gas Sensors- This change in resistance is used to calculate the gas concentration. Semiconductor sensors are commonly used to detect hydrogen, oxygen, alcohol vapor, and harmful gases such as carbon monoxide. One of the most common uses for semiconductor sensors is in carbon monoxide sensors. They are also used in breathalysers.

4.13 Android application

Android application is used for controlling the robot. And operating the cam mechanism of the robot.



Fig : Android Application Interface on Mobile

V. FUTURE SCOPE

In future, we can implement following factors:

6.1 Use of Co2 Gas Cylinders

Due to its physical and chemical properties, Co₂ is the most commonly used gas on-board ships in order to extinguish fire during accidents. Co₂ is used in a number of ways, mainly depending on the intensity of fire. If the intensity of fire is less, it can be extinguished by using a small CO₂ extinguisher which are often portable. But in case the intensity of fire is high then a fixed firefighting system with higher capability is used

6.2 Use of Dry Chemical Powder

- i. Dry Chemical Powder is discharged by pressure of nitrogen gas stored in bottles without other power source.
- ii. The system is remotely activated from Navigation Bridge.
- iii. Fire-fighting operation can be performed with both monitor nozzles and hand hoses concurrently.
- iv. Shock-absorbers are fitted on hand hose storing boxes to prevent unnecessary load worked on hand hoses laid down during cargo operation.
- v. Dry Chemical Powder is not electrically conductive and therefore it can be used to electric equipment.

6.3 Use of Foam

Foam has been used as a fire-extinguishing medium for flammable and combustible liquids. FOAM: A firefighting foam is simply a stable mass of small air-filled bubbles, which have a lower density than oil, gasoline or water. Foam is made up of three ingredients - water, foam concentrate and air.

6.4 Can use Higher Resolution Zooming Camera:

By using higher resolution zooming camera we can detect the fire from the long distance.

6.5 Increasing the range of Wireless Remote:

By increasing range of Bluetooth module, we can operate robot from long distance.

VI. ADVANTAGES

- i. Less cause of accident cases. Even Working is carried out automatic mode.
- ii. Human control required is less.
- iii. Maintenance cost is less.
- iv. Easily repairable.
- v. Improved safety.
- vi. Protection of property from loss.
- vii. Simple in construction

VII. CONCLUSION

This project gives a detailed mechanism about the robot that continuously monitors, intimates the respective personnel and extinguishes the fire. In the industry if any fire accident occurs, there is a need of person to monitor continuously and rectify it. In this process if any time delay takes place irreparable loss occurs since it is a cotton industry.

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