Survey on Implementation Methods of Fire Fighting Robot

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Abstract - *Detecting the fire and extinguishing it is a dangerous job and that puts lives of fire fighters at risk. There are number of fire accidents in which fire fighter had to lose their lives in the line of duty each year throughout the world. Increase in the number fire accidents are due to expanding human population and growing industrialization. The physical limitations of humans to deal with these kinds of destructive fires make fire extinguishing an complicated task. The research and development in the field of Artificial Intelligence has given rise to Robotics. Robots are implemented in various areas like Manufacturing, Industries etc. Hence, Robotics can be used to assist fire fighters to perform the task of fire fighting and so reduces the risk of their lives. The use of fire fighting robots can reduce the errors and the limitations that are faced by human fire fighters. This paper contains various methods for implementation of fire fighting robots. Here we compare various design and construction of building a fire fighting robot.*

Key Words: **Fire, Robot, microcontroller, fighters, Android, implementation, etc...**

1. INTRODUCTION

Fire fighting and rescuing the human beings is a risky job. Fire Fighters have to face many dangerous situations while extinguishing the fire. Fire Fighters extinguish fires in buildings, drag heavy hoses, climb high ladders, carry victims from one building to another. They have to do their job for long and irregular working hours. Fire fighters also face unfriendly environment like high temperature, dust and low humidity etc. Besides these, they have to fight against life threatening situations like explosion and collapse buildings. Considering the challenges faced by a human fire-extinguishing team in arriving at the scene of fire accident, in the least possible time, and dealing with the fire with the few resources at their disposal, it is solved by designing a robotic Fire Extinguishing Vehicle, which can act more spontaneously to fires and makes its fire-fighting mechanism more efficiently and assist fire fighters. And there are various methods for implementation of fire fighting robot proposed by the authors, which are studied and mentioned in this paper.

2. METHODS OF IMPLEMENTATION

Below figure 1 shows different methods for implementation of fire fighting robot.
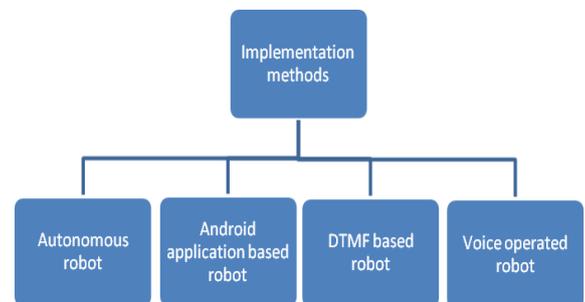
Fig-1 Hierarchy of implementation methods

2.1 Autonomous Robot

Authors Rohith Punuganti, Anusha Srinivas, Lakshmi F Savanoor, Divya Shreer had proposed their research paper on PIC BASED FIRE SENSING AND EXTINGUISHING ROBOT in Proceedings of IRF International Conference, 30th March-2014, Pune, India.

The robot presented by authors is a real time embedded system. The robot is implemented using a variety of hardware components and software built around C language. There are two modes of operation namely autonomous and manual controlled. The mode of operation is directed to the robot using the computer and Zigbee module making use of HyperTerminal.

Fig-2 Autonomous robot

In the autonomous mode of robot, the robot monitors its surroundings to perceive any fire hazard. IR Fire sensors are used on four sides of the robot and the electrical output at the sensor is amplified by simple transistor amplifier. The amplified signal is fed to the in pins of the microcontroller PIC18F4550. Metal detectors are placed on the front and back side of the robot which determine the presence of bombs in case of a battlefield. The output of the metal detector is amplified and fed to the microcontroller. Fire sensor input is assigned a higher priority against any other task. On detecting fire, the microcontroller directs motors and activates the actuators. A water reservoir is mounted on the board, which has 10 rpm DC pump motor. Depending on the direction of fire, the robot aligns itself, according which the motor pump is turned ON. The water reservoir is connected to the pipe whose end is mounted on the head of the robot and the water is sprayed on the fire, thus fight against fire. Above fig-2 shows robot designed by authors.

Advances and Limitations:
This system is intelligent as it operates in two modes. But in autonomous mode, it will take more time to find the exact location of fire and to reach their and extinguish it due to self alignment system of robot. So accuracy is less.

2.2 Voice operated robot

Authors Preeti Dhiman, Noble Tawra, Rakesh Nagar, Rishab Singh and Varun Kaushik have presented paper on VOICE OPERATED INTELLIGENT FIRE EXTINGUISHER VEHICLE in International Journal of Emerging Trends in Electrical and Electronics (IJETEE).

This paper demonstrates the design and implementation of voice operated fire extinguishing vehicle. The vehicle is controlled through speech input by operator. The language input allows a user to interact with the robotic vehicle. The speech recognition system is trained in such a way that it recognizes predefined commands and the robot navigates depending on the instruction through the voice Commands. The communication medium of interaction between humans

and computers is on the processing of voice. The whole system consists of three subsystems, the speech recognition system, transmitter section and the receiver section (on vehicle). Below fig-3 shows interfacing of PC and robot.
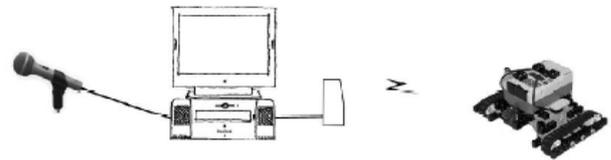

Fig-3 PC-Robot interface for voice operated robot

Transmission section:
Here, optocouplers are used, which provides an enable pulse to HT12E encoder. RF frequency modulated data signal is sent using antenna. It is necessary to encode signal generated at computer parallel port with Visual Basics.

Receiver section:
HT12D receives and decode encoded data transmitted by HT12E.

Speech recognize system:
Speech command is received by microphone and processed on PC. When command is recognized, Pc sends it to robot using RF signal. And according to command received by AT89S52 controller, it controls DC motor. There are also flame sensor and obstacle sensor used by author to make the system more intelligent.

Advances and Limitations:
The advantages of voice operated robots are fast data input and hands-free operations. Speech has difficulties to be recognized by an application. Because speech is different for every speaker. It may be fast, slow, or varying in speed. Also may have high pitch, low pitch, or be whispered. Have widely-varying types of environmental noise. The system is affected by surrounding noise and so noise interference is big problem. It leads to error in the results.

2.3 Android controlled robot

Authors MD AZHAR and Dr. K. SUDHAKAR REDDY have presented paper on ANDROID BLUE TOOTH BASE CONTROL FIRE FIGHTING ROBOT in (IJITR) International Journal of Innovative Technology and Research.
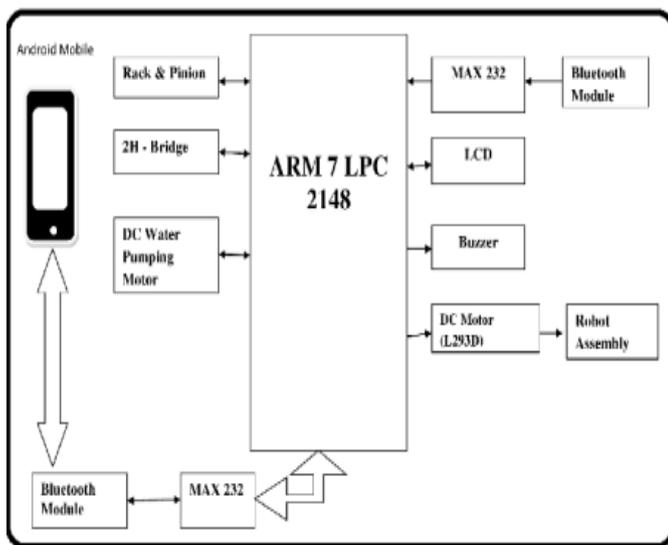
Fig-4 Android controlled robot
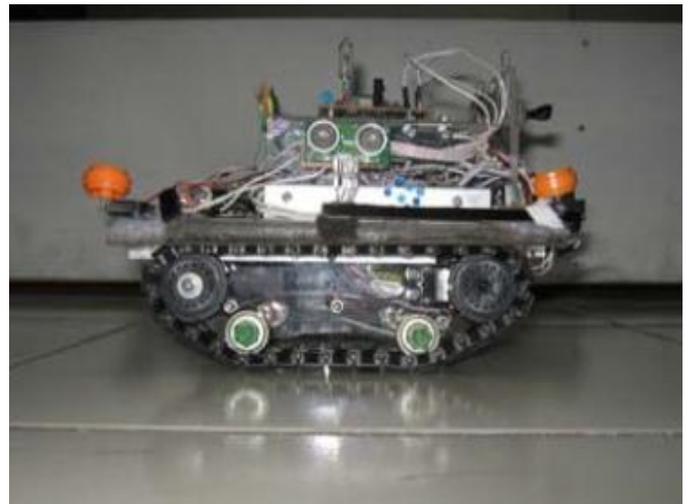
Android is open source software, manufacturers can modify the operating system to suit their respective needs and phones. This becomes a cheap and feasible alternative for the manufacturer. Android OS is Very customizable. It is open source operating system is easily changed, hacked, manipulated, and molded to fit whatever functionality you had in mind. Found on all platforms for all prices depending on what hardware and software version you are interested in.

Author had used ARM7LPC2148 microcontroller to control robot. It is shown in fig-4. Android Bluetooth control application is used as a transmitter. And receiver is a robot. Wireless commands are sent by android phone and it is received through Bluetooth module on the robot. It receives the data serially and send it to ARM controller via MAX232 IC for decoding the command .For movement of vehicle DC motors are interfaced to controller.

Advances and Limitations:
In our day to day life use of Android OS is increasing rapidly. It is a intelligent system controlled by android application. More accurate results are achieved in this project. There is also no error occurrence in the results. The only limitation is range of Bluetooth module which is around 50fts.

2.4 DTMF based robot

Authors Kristi kosasih, Merry Sartika, M. Jimmy Hasugian, Dan Muliady have presented paper on AN INTELLIGENT FIRE FIGHTING TANK ROBOT in Electrical Engineering Journal.

Fig-5 DTMF based robot

Author purposed a intelligent robot with a sound activation using DTMF technology with two servo motors for robotic arm, two DC motors for movement of robot ,two fans for extinguishing fire, ultrasonic sensor, compass sensor, flame detector, thermal array sensor . Tank robot is activated by sound, so it is designed with DTMF (Dual Tone Multi Frequency) transmitter and receiver. Above figure 5 shows DTMF based robot.

Advances and Limitations:
DTMF technology is complex for controlling the robot. It is cost effective. But it require DTMF transmitter and receiver.

3. CONCLUSION

In this paper, we have discussed many implementation methods of fire fighting vehicle. Among which, Android based robot is superior. Autonomous robot gives delayed output and voice operated robot is affected due to noise interference and voice recognize is also quit complicated task. DTMF based robot requires DTMF transmitter and receiver and is a sound activated so it is very complex system. Whereas android controlled robot is a smart system with more accurate and error free results. Thus based on comparative analysis of different implementation systems, we found that android application based implementation method is the most efficient and preferable.

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