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An Innovative Approach to Extinguish Fire Using Android Application

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ABSTRACT: We have proposed here an innovative approach to extinguish fire as a part of advanced fire fighting system. The main goal of the project is to develop a vehicle which is remotely controlled with android application to extinguish the fire. Major fire accidents do occur in industries like nuclear power plants, petroleum refineries, gas tanks, chemical factories and other large-scale fire industries resulting in quite serious consequences. Thousands of people have lost their lives in such mishaps. In present fire extinguishing system, there is a big risk of life for fire fighters as they have to fight against fire from closer. Therefore, this project is enhanced to control fire through a robotic vehicle by using an Android application and save lives.

KEYWORDS: Robotic arm, fire extinguishing vehicle, Flame, android application, DOF.

I.INTRODUCTION

This system has two ends: 1) Transmitter end, 2) Receiver end. On receiver end, there is vehicle. It has microcontroller which is interfaced with input and output devices which are used to control vehicle. Vehicle is loaded with water tank with pump inside to spray water to control fire, this is done by robotic arm on the vehicle. On the transmitter end, there is a android phone with android application. Wireless signals are sent to transmitter side via Bluetooth module by android phone to control vehicle.

II.LITERATURE SURVEY

In present fire fighting system, fire fighters have to fight against fire from very closer. And lot of fire fighters lose their lives in such accidents. So there is necessary to update our present fire fighting system with advanced technology to make work of fire fighters easy and to save their lives. And for this purpose many technical persons had worked on it to improve it. They have used different techniques to implement this. Before deciding our method to implement innovative fire extinguishing vehicle, we have studied many research papers regarding to our topic. These paper includes different methods for the purpose of fire fighting. (1) The first one is" self operated fire fighting robot" is studied from paper of Swaranlata Bollavarapau and her co-authors (ref[4]). In this method, there are sensors connected on each and every side of vehicle to detect flame and according to that the vehicle navigates towards fire to extinguish it. But this method gives delayed output so takes more time to fulfil the task and has less accuracy. (2) The second method is "Voice Operated Fire Fighting Vehicle", which is studied from paper of Preeti Dhiman and her co-authors(ref[3]). It is implemented with the help of speech to text conversion module. But this system is affected by surrounding noise. This may result in error. Sometimes system doesn't follow the commands from operator due to noise or error. Other way is fire suppression using image processing. But it is quite complex system. Also many other papers are studied based on this topic which are mentioned in references. So we have decided to go through Android Technology which we are using in our day to day life. It is very fast and error free innovative system.

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III.BLOCK DIAGRAM

The system block diagram is shown in fig.1. The main block of system are described below.

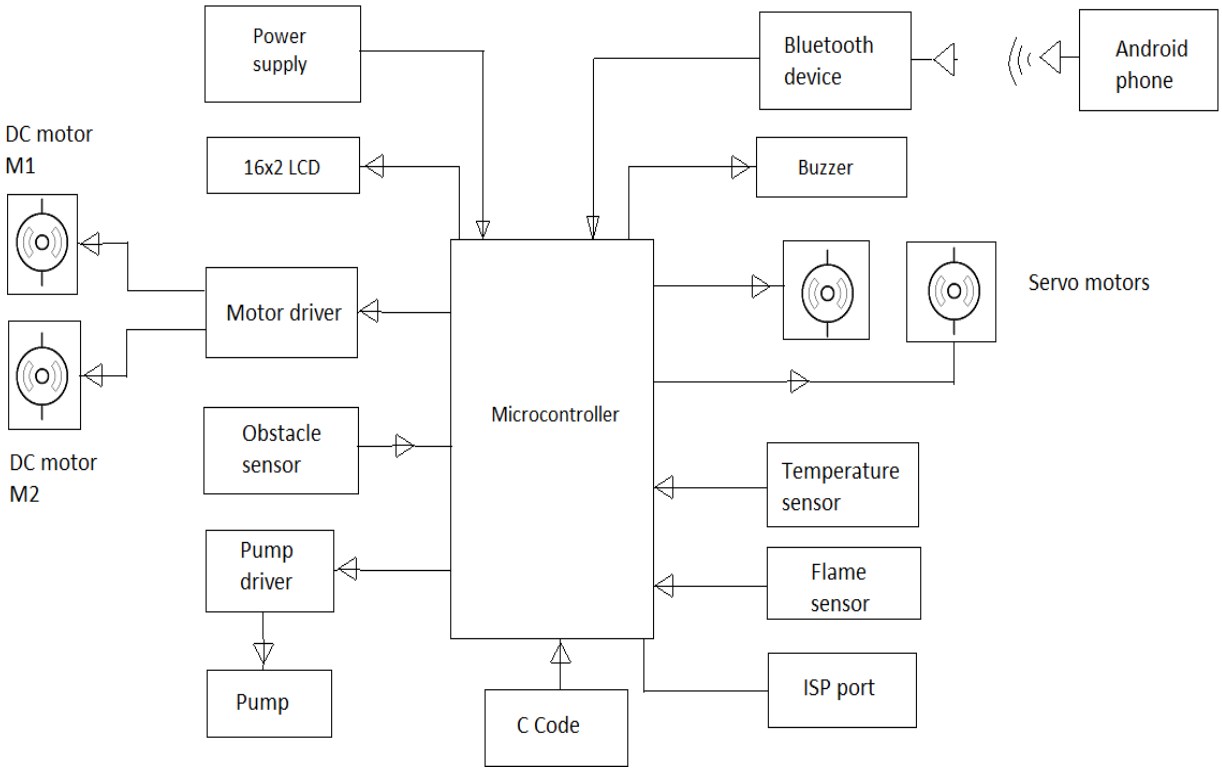

Figure 1: Block diagram

Power supply

Here 12V, 7AH battery is used as power supply. Regulated 5V,3A is necessary for some components like microcontroller, all sensors, servo motors etc. So it is designed with LM-1085. Other components like DC motors and pump are operate directly on 12V of battery.

Microcontroller

AVR ATMega-32 microcontroller is used. It is 40 pin IC and operates on 16MHz. Its operating voltage is 5V DC. It has 3 timers/counters. It has 10 bit, 8 channel on-chip ADC. It has 2KB SRAM, 1KB EEPROM, 32KB flash memory. It has four PWM channels.

DC Motors

There are two 200rpm, 12V DC gear motors used to control the motion of vehicle which are connected to two front wheels of vehicle. Other two wheels are free wheels. It is operating on 12V DC supply. It is interfaced with microcontroller through motor driver IC L293D.

Servo motors

There are two servo motors RKI-1204 used to control motion of robotic arm on vehicle which is used to spray water to fight against fire. The operating voltage is 5V. It is low speed, high torque motor with gear mechanism, so it is used in robotic arm. They are interfaced with microcontroller directly on two PWM channels.

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IR Obstacle sensor

It is infrared sensor. Its operating voltage is 5V. It is digital sensor. It is connected at front side of vehicle. If there is a obstacle detected, buzzer will give alert and vehicle will stop and doesn't accept commands from android. Sensor has one transmitting LED which emits infrared . These rays get reflected from obstacle and received by photodiode on sensor. Thus obstacle is sensed. Its sensitivity can also be changed by potentiometer connected to sensor module. Generally it is around 2 to 5 cm.

Figure 2 : Obstacle sensor

IR Flame sensor

It is digital infrared sensor. If flame touches to vehicle, this sensor senses it and alarm will alert operator. But there is a possibility of false alarm as there are many other sources of infrared which are detected by this sensor. To avoid this temperature sensor is used in conjunction with it. And output of both sensors are logically and , if it is high then only buzzer will alert operator.

Figure 3: flame sensor

Temperature sensor

Temperature sensor LM35 is used to measure temperature to protect vehicle from fire. It is analogue sensor. Its scaling factor is 10mV/˚C. Its operating voltage is 5V. It has 3 pins as shown in fig. 4. Formula to calculate temperature is as below:

$$\text{Temp}(^{o}\text{C}) = \text{Vout} * (100\ ^{o}\text{C/V})$$

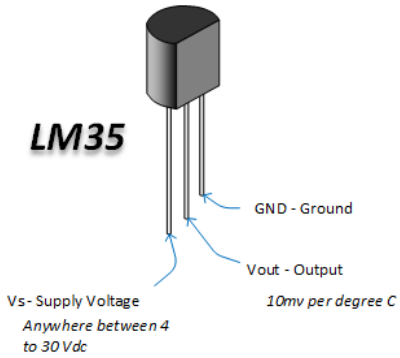

Figure 4 : Temperature sensor

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Bluetooth module

Here HC-05 Bluetooth module is used to receive wireless signals from android phone and sends it to microcontroller. It requires 5V DC to operate. Its normal baudrate is 9600 and operating range is around50fts. Its characteristics like name of Bluetooth, password etc can be changed by special AT commands. Bluetooth module is shown below figure.

Figure 5: HC-05 module

IV.ROBOTIC ARM DESIGN

Fire extinguishing vehicle has water tank with pump inside to extinguish fire with the help of robotic arm. *Degree of freedom*: Generally arms are described by their degree of freedom (DOF). This number typically refers to the number of single-axis rotational joints in the arm. Higher DOF indicates an increased flexibility .There are mainly 6 degrees of freedom per robotic arm which are shown in below figure 6. Six degrees of freedom (6DoF) refers to the freedom of movement of a rigid body in three-dimensional space. Specifically, the body is free to move forward/backward, up/down, left/right (translation in three perpendicular axes) combined with rotation about three perpendicular axes, often termed pitch, yaw, and roll which are shown in fig 6.

DOF = Number of joints in robotic arm

Robotic arm is designed with two servo motors, so there are two joints in arm, so we can say that it has 2 degree of freedom. Here the arm is designed with 2 DOF, which is sufficient for this application. And they are: forward-back, left-right. *Load calculation*: The length of arm is 9 inches i.e. 22.5 cm. And its weight is negligible. Robotic arm is loaded after calculating withstand able load on servo motors. According to datasheet of servo motor stall torque is 11 kg*cm for 4.8V(operating voltage) and 13.5 kg*cm for 6V. So around 11.5 kg*cm for 5V. So maximum load on motors should be 0.51kg (11.5 kg*cm/22.5 cm) for both motors approximately.

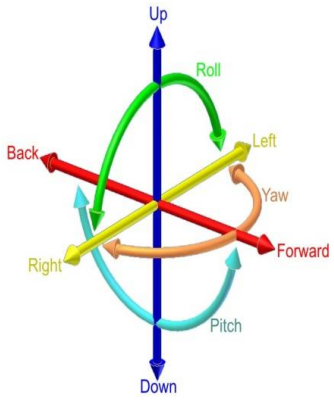

Figure 6 : Six DOF

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V.VEHICLE DESIGN

This smart fire extinguishing vehicle is designed by plywood sheets. The prototype design of vehicle is shown in below figure 7. Vehicle follows commands from android and run towards fire, after it reaches to fire , command of water spray is given by operator and thus fire is extinguished by spraying water with the help of robotic arm on vehicle from water tank.

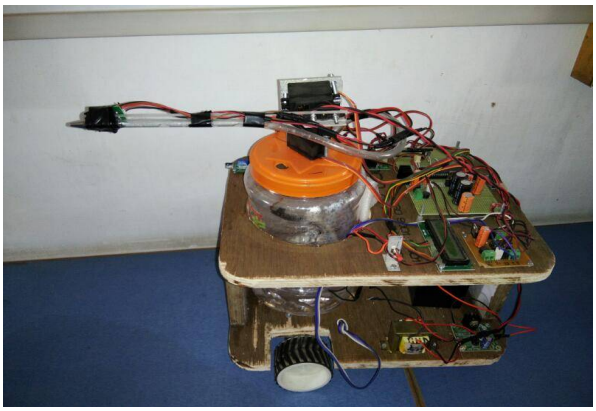

Figure 7: fire extinguishing vehicle

VI. ANDROID APPLICATION

This vehicle is guided by a operator with android phone. Wireless signals are sent from android and are received by HC-05 bluetooth module to the microcontroller AVR ATMega 32. This is the dataflow of the system. For this purpose an android application is developed with the help of Android Studio software. The screen designed for controlling the vehicle is shown in below fig. Designing is done in XML and functioning is done in JAVA. It is a snapshot of Android Studio software.

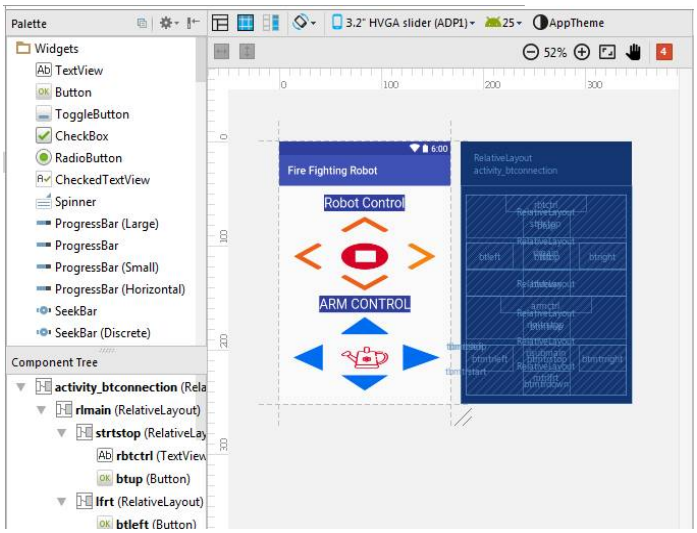

Figure 8 : Vehicle controlling screen of application

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VII.ADVANTAGES

Use of this vehicle can save number of lives. This vehicle is based on android phone. But there are many other ways to control it. It can be controlled with voice but chances of noise interference increases which results in errors. Other technique is self operated by using sensors but it may result in delayed output and accuracy is also less. So android control technique is superior.

VIII.RESULTS

We have implemented innovative fire extinguishing vehicle which is shown in fig. 7. And also android application is designed to control the vehicle remotely with the help of Android Studio software and snapshot of it is shown in fig. 8. Thus the prototype of this vehicle is designed and it is also working properly. It detect flames with the help of temperature sensor and IR flame sensor and buzzer rings to give alert. Also obstacle detection is successfully implemented by IR obstacle sensor. Vehicle is controlled by android phone. The relation between input from android phone and corresponding outputs are shown in below table.

Sr no.	Button pressed in Android application(Input)	Vehicle movement(Output)
1		Forward
2		Reverse
3		Turns Right
4		Turns left
5		Robotic arm moves in forward
6		Robotic arm moves in backward
7		Robotic arm moves in right
8		Robotic arm moves in Left
9		Stop
10		Water spray on

Table 1 Result of system

IX.CONCLUSION

Here we have proposed a smart vehicle for extinguishing fire as a part of advanced fire extinguishing system to save several lives which are losing in fire accidents. Vehicle is protected from fire and obstacles by sensors but one can use wireless camera for this purpose.

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