A Design of a cost effective Fire Fighting Robot using Intelligent System

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Abstract: We usually read in newspapers about fire accidents and rising death toll rates because of fire related accidents. At times even firemen lose their lives while on rescue operations. We have proposed a model Fire Fighting Robot which has been designed for relief operations with main focus on rescue purposes. Use of robots is growing both on Earth and in space, in large part due to increased capacity for machine intelligence. Robotics defined as a mechanical design that is capable of performing human tasks or behaving in a human-like manner. The Robot is an electrically powered and remotely controlled unmanned vehicle. It is a battery-operated robot on wheels and its primary role is to detect the source of heat and put off flames.

Keywords: Autonomous, Fire Extinguishing, Obstacle detection etc.

1 INTRODUCTION

The Proposed firefighting robot is designed to detect the source of fire with its strong sensor technology integrated with it. We have read some past articles about firefighting robots but we have seen that cost has always been a neglected issue. We have proposed a micro-controller based firefighting robot (ATMEGA-32) [1] which is not only *cost-effective* but also *highly efficient* and *reliable* in its primary purposes. Robotics does not always need to be expensive and it should be designed for mass people. We have carefully chosen our materials surrounded beside us and we want to assemble different technologies for manipulating its main purposes. We have arranged the topics consequently in this paper to maintain the coherence among the discussed topics. Main features of this Robots are-

1. Heat and Smoke Sensor
2. Obstacle Detector
3. Traction System
4. Fire Extinguishing
5. Low battery sensor
6. Wireless Controlling System

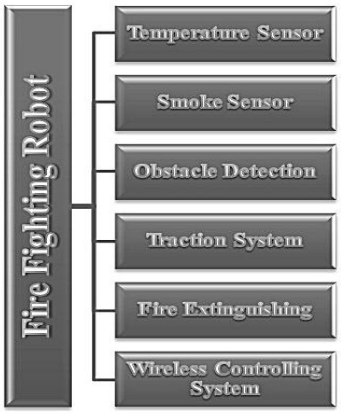

Fig1: Fire Fighting Robot Functions

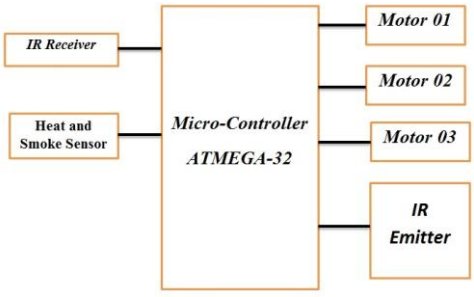

Fig2: Micro-Controller ATMEGA32 pin connection for some parts of the Robot

2 DESIGN

2.1 Heat and Smoke Sensor:

We have used CM-WTK55 as our heat and smoke sensor. The *photoelectric* type smoke part of detector is based on the photoelectric sensing principle [2]. When fire break out and smoke enters the light tight box, the particles of smoke scatter the infrared light, and this scattered light goes into the receiving element, there by emitting an electric current, and while the electric current is up to the fixed extent, the fire alarm will be activated. The fixed temperature heat detector part has stabilized performance, long-term durability and least -malfunction are ensured by employing a bimetal mechanism, which meets UL verification .Its temperature setting is 55°c**.** [3]

2.2 Obstacle Detection

As we have proposed that our robot is an *autonomous* one it has an efficient system to avoid the obstacles. To detect any kind of obstacles we have used *IR detection system*. We have used IR led for infrared emission .

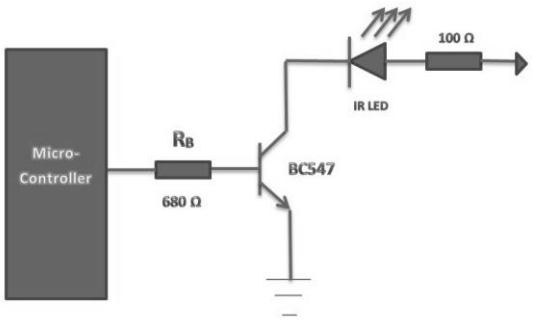

Fig 3: Block diagram of IR emitter

And we have also designed a receiver to receive the reflected IR so that our robot can move avoiding all the obstacles. We placed IR emitter and receiver on the robot in a manner so that it can sense objects and walls surrounding it.

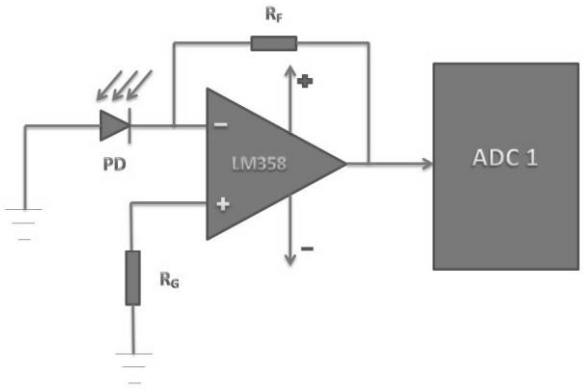

Fig 4: Block diagram of IR receiver

2.3 Traction System:

We have used two *permanent magnet dc motors*. Most of the work, power delivered to the shaft in the form of torque, is done by the permanent magnets. Because power is consumed for only a brief period of time upon each alignment of the permanent magnet and electromagnet, very little power is necessary to run the motor-generator, making it *highly efficient*. The benefits of using permanent magnet dc motors are-wide availability, cost effectiveness, Adequate Power Supply [4]. The movement of our proposed Robot models depends on the rotation of two wheels. If both of the wheels rotate clockwise our robot will move forward. The robot will move backward when both of the wheels rotate anti-clockwise. When the Right side wheel is off, the left side wheel is rotating clockwise, So the robot will turn right at that time and similarly the robot will turn left when the left wheel remains still.

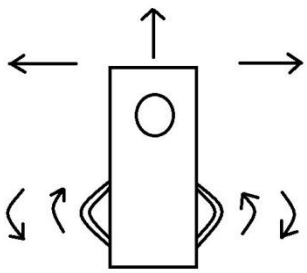

Fig 5: Traction system

2.3.1 Sample programming for traction system

```
Sub Forward

Cls

Lcd "FORWARD"

Pwm1b = 200

Portd.3 = 0

Pwm1a = 200

Portd.6 = 0

End Sub
```

2.4 Wireless Controlling System

We have followed the Manchester coding system for Wireless Controlling. We have modified according to our demand.

2.4.1 Manchester Coding

Manchester coding works on transitions from high to low (bit 0), or low to high (bit 1), the actual width of the pulses doesn't matter particularly (within reason).This is the way the bits are actually sent, a bit 1 is a transition from 0 to 1, and a bit 0 is a transition from 1 to 0 [5].For RF transmission there is a huge possibility in case of receiving a data. So we hane used a *packet system*, where a number of different pieces of information are transmitted after each other in the form of a 'packet', this consists of a number of different sections like header section , address byte, data and checksum.

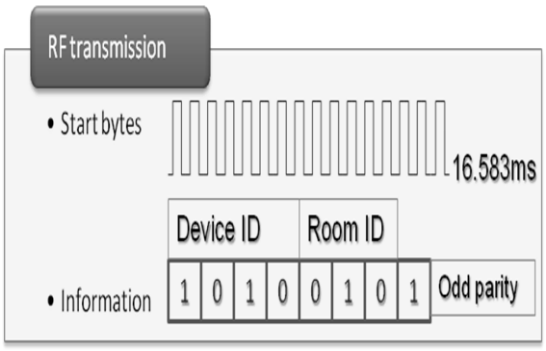

Fig 6: Manchester coding system

The *header* section consits of a row of 20 bit one's followed by a single bit zero.

The long sequence of 1's gives the receiver time to settle and the decoding software time to synchronise.

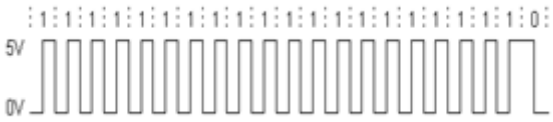

Fig 7: Header

The *address section* consists of the 8 bits of data in the byte, followed by a single bit one, and a single bit zero.

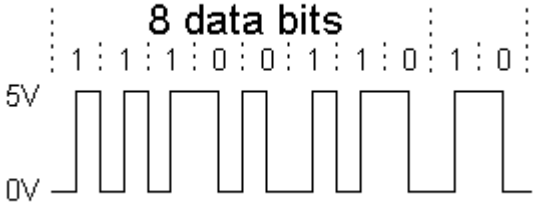

Fig 8: Address byte

Data and checksum are same as address 8 bits.

2.5 Materials

For the robot designing, we used *Aluminium* because it is very strong, light, resistant to corrosion, and affordable. To slow down the heat flow between the outer and inner shells, the gap is filled with rock wool and ceramic paper as insulation material. Most importantly, it is very easy to cut, shape, drill, and bend. Aluminum has a much higher strength to weight ratio. This means that for a mass of aluminum and an equal mass of steel, aluminum would be much stronger. Another important thing about aluminum is that it is resistant to rust. In actuality, aluminum does rust, but it quickly forms an oxidized layer which acts as a protective coating against any further rust. Aluminum has a very high thermal conductivity. We have chosen worm gearing as our gearing because it available, cost effective.

2.6 Low battery sensor

A low battery sensor measures current, voltage from battery, if battery contains lesser voltage or current than standard this circuit will work. A warning alarm will be triggered when battery voltage is lower than the voltage or current level set by the user. As we used 9.6V battery we set the voltage level at 7V, which means this circuit

will trigger alarm when the battery voltage is lesser than 7V [6].

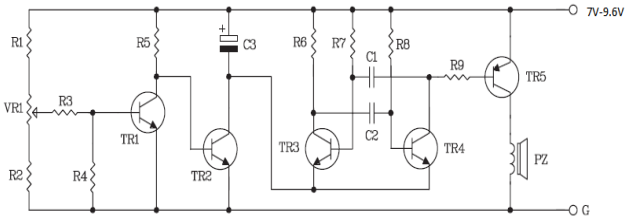

Fig 9: Circuit diagram of low battery sensor

2.7 Power Supply

The power of the robot is supplied by two 9.6 V rechargeable NiCd batteries. The Transmitter battery pack contains NiCd (Nickel-Cadmium chemical composition) rechargeable that provide significantly more energy than comparable AA NiCd batteries. The Battery Pack's cells will provide a constant reliable voltage until they are exhausted. Contrary to popular belief, NiCd batteries do not suffer from any sort of permanent "memory effect". Rechargeable NiCd batteries can be used over and over again for hundreds of battery cycles if properly maintained [7]. However, all batteries will eventually wear out over time.

2.8 Fire Extinguishing

A fire extinguisher or extinguisher is an active fire protection device used to extinguish or control small fires, often in emergency situations**.** For *extinguishing fire* we used *CO_2 and water* [8]. We have placed rotating nozzles in all corner parts of the robot so that it can cover every possible part of a room. Both the extinguishing system will be activated when temperature reaches the set value and smoke is sensed by the sensor. To spray water we used Zodi Outback Gear Zodi 6 Volt which can Pump [9] about 1/2 gallon per minute and weighs only 1lbs.

3 CONCLUSION

Our proposed low cost robot model can move avoiding obstacles and detect fire source without any kind of false alarm. Depending upon the fire intensity it will use the extinguishers attached to it. Our robot can be autonomous and we can also control it by RF transmission. We are currently working on image processing and video feedback system so that we can learn about the inner situation of the room. We are also working on machine learning so that our robot can remember the mistakes and take certain intelligent decision by him. We are trying to make our robot even more cost effective. Our main concern is to make the robot effective in very high temperature. The main deficiency of our proposed robot model is that it is not able decide what kind of extinguisher it would use. We are working on that problem.

4 REFERENCES

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