GSM based Fire Sensing and Extinguishing Robot

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Abstract: *We design the fire detection system using four flame sensors in the Fire Sensing and Extinguishing Robot, and program for fire detection and extinguishing procedure using sensor based method. The fire fighting robot is equipped with four thermistors / flame sensors that continuously monitor the temperature. If the temperature increases beyond the predetermined threshold value, buzzer sounds to intimate the occurrence of fire accident A warning message will be sent to the respective personnel in the industry and to nearby fire station with the GSM module provided to it. Fire Sensing and Extinguishing Robot continuously monitors the temperature at four sensors and if fire accident is true, the robot moves to the direction to which the temperature is recorded to be the relatively maximum among the four sensors and extinguishes the fire with water pump provided to it. After extinguishing the fire Robot comes back to its initial position.*

Keywords: Microcontroller, Fire sensors, Fire Sensing, Fire Extinguisher, DC motors, GSM.

1. Introduction

A robot is an automatically guided machine, able to do tasks on its own. This project, which is our endeavor 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. 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 fire fighting 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 a 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 by the use of 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.

2. Description of Various Parts, Block Diagram, Circuit Diagram, Working

2.1 The brief descriptions of the parts are as follows:

2.1.1 Microcontroller

Microcontroller is a general purpose device, which integrates a number of the components of a microprocessor system on to single chip. It has inbuilt CPU, memory and peripherals to make it as a mini computer.

A microcontroller combines on to the same microchip:
1. Memory (both ROM and RAM)
2. Digital I/O lines
3. CPU

Microcontroller combines other devices such as:
1. A timer module to allow the microcontroller to perform tasks for certain time periods.
2. A serial I/O port to allow data to flow between the controller and other devices such as a PIC or another microcontroller.
3. An ADC to allow the microcontroller to accept analogue input data for processing.

Microcontrollers are:
1. Smaller in size
2. Consumes less power
3. Inexpensive

The Micro Controller having the internal memory to store the data or written program by the user and also having the control system to control the input and output data corresponding to the internal program written by the user. All the components like humidity sensor, temperature sensor, driver circuits and display will connect to the Micro Controller with the help of connecting tracks. Micro controller is a standalone unit, which can perform functions on its own without any requirement for additional hardware like I/O ports and external memory. The heart of the microcontroller is the CPU core AT89C51 is the 40 pins, 8 bit Microcontroller manufactured by Atmel group. It is the flash type reprogrammable memory. Advantage of this flash memory is we can erase the program within few minutes. It has 4kb on chip ROM and 128 bytes internal RAM and 32 I/O pin as arranged as port 0 to port 3 each has 8 bit bin .Port 0 contain 8 data line(D0-D7) as well as low order address line(AO-A7). Port 2 contain higher order address line (A8-A15). Port 3 contains special purpose register such as serial input receiver register SBUF, interrupt INT0,INT1 and timers T0 , T1 many of the pins have multi functions which can be used as general purpose I/O pins (or) Special purpose function can be decided by the programmer itself.

The specifications of microcontroller are as follows:

4K Bytes of In-System Reprogrammable Flash Memory, Endurance: 1,000 Write/Erase Cycles

1. Fully Static Operation: 0 Hz to 24 MHz
2. Three-Level Program Memory Lock
3.128 x 8-Bit Internal RAM
4. 32 Programmable I/O Lines
5. Two 16-Bit Timer/Counters
6. Six Interrupt Sources
7. Programmable Serial Channel
8. Low Power Idle and Power Down Modes

2.1.2 Electrical Components:

The uses 12V DC motors, Microcontroller, Fire extinguisher system will use a nominal voltage of 12.0V at most. The battery provides maximum power of 65 W and an average power of 7.8 Watts.

2.1.3 Features of the Fire Sensing and Extinguishing Robot:

1. The fire sensors are capable of detecting fire from 2 m away.
2. The fire extinguisher works for a continuous time till the water tank becomes empty.
3. The robot moves at 2.5 ft/sec on a flat surface, accelerate from 0 to 1 ft/sec in two seconds.
4. The robot turns within a 6" radius and utilizes circular or octagon design in order to minimize possible impact area.

2.1.4 Programming Algorithm:

Before programming the AT89C51, the address, data and control signals should be set up according to the Flash programming mode table and Figures 3 and 4. To program the AT89C51, take the following steps.

1. Input the desired memory location on the address lines.
2. Input the appropriate data byte on the data lines.
3. Activate the correct combination of control signals.
4. Raise EA/VPP to 12V for the high-voltage programming mode.
5. Pulse ALE/PROG once to program a byte in the Flash array or the lock bits. The byte-write cycle is self-timed and typically takes no more than 1.5 m.

2.1.5 Programming Interface:

Every code byte in the Flash array can be written and the entire array can be erased by using the appropriate combination of control signals. The write operation cycle is self timed and once initiated, will automatically time itself to completion. All major programming vendors offer worldwide support for the Atmel microcontroller series. Please contact your local programming vendor for the appropriate software revision.

2.1.6 Fire sensors:

Using a UV sensor, a flame the size of a single candle can be seen Five meters away. The Trekker utilizes a Hamamatsu UV sensor that is mounted onto the Trekker sweeping sensor brackets. The Trekker scans the area and finds an open flame. The Hamamatsu UV TRON Flame Detector is lightweight, has low current consumption, and operates as high sensitivity UV Sensor.

Fire sensing is done in this way like, if fire accident occurs in a area temperature in that area increases anonymously. Thermistors can be used to detect the temperature. Thermistors have negative temperature coefficient i.e., when temperature increases resistance of thermistors decreases i.e., the output voltage from the thermistors decreases. Giving the output voltage of thermistor as one of the input to the comparator and other input of the comparator a threshold voltage value the occurrence of fire can be detected.

2.1.7 GSM Modem:

GSM modem is used to intimate the occurrence of fire accident via SMS. Using GSM modem a predetermined message can be send to required persons and also to fire station so that they get alerted and reach the place quickly where fire broken out.

2.1.8 Driver Circuit:

The driver circuit generally made of one transistor and one relay. The driver circuit was mainly operated by the Micro Controller. The Micro Controller was change the state of the output pin from the low to high (level to the 1 level). By using this sequence to control the base of the transistor. The transistor will act as a ON/OFF switch corresponding to the input of the base. If the base of the transistor will high the transistor will act as a ON switch otherwise it will act as OFF switch.

2.1.9 DC Motors:

DC motors are generally more powerful than servos in terms of speed and torque. Microcontroller could not accurately control DC motors without a motor controller. Therefore, motor Controllers are needed. An encoder used to get feedback from the DC motor.

2.1.10 Power Supply:

Rechargeable batteries were the power supply of choice for the robot. Combined with basic line regulation rechargeable batteries provide clean, reliable power, and allowed reuse of the batteries when depleted. The selection between different types of batteries was made based on size and power requirements.

2.1.11 Chassis:

Another word for chassis is base. All components of the robot are attached directly to the chassis; therefore a strong yet light chassis will be ideal. Chassis can be made from many different types of materials, some common types are aluminum, steel, acrylic, plastic, and high density polymer.

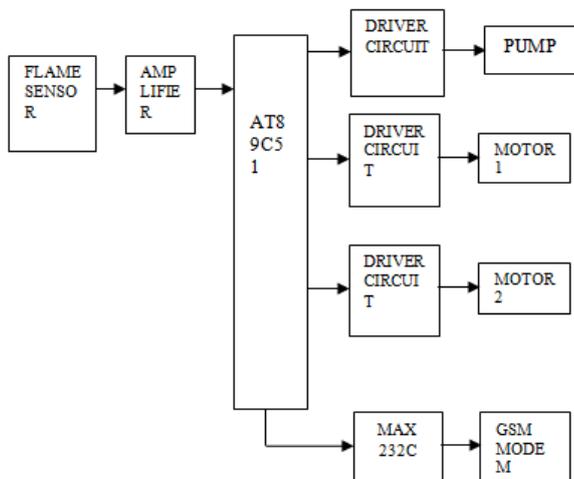### 2.2 Block Diagram and Circuit Diagram:

2.2.1 BLOCKDIAGRAM:

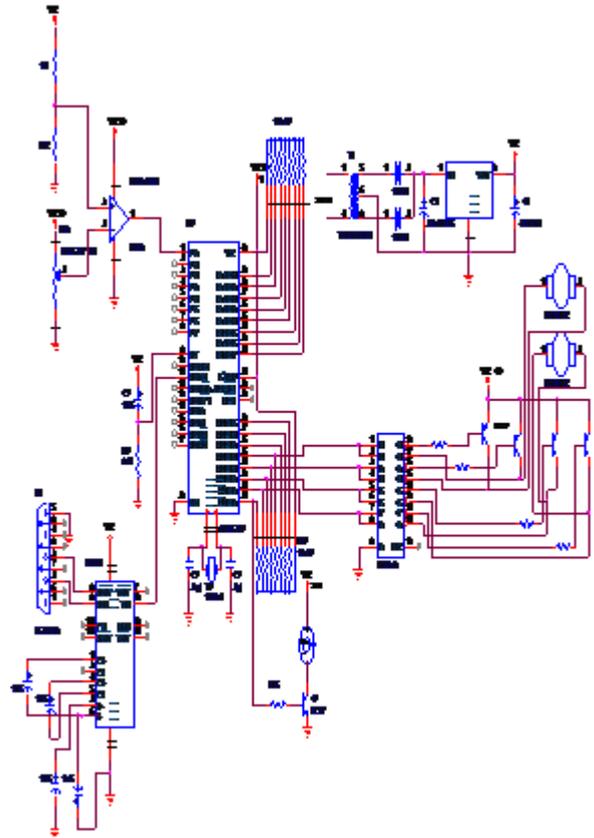**Figure 1:** Block Diagram

2.2.2 Circuit Diagram:

Figure 2: Circuit Diagram

2.3 Working of GSM Based Fire Sensing and Extinguishing Robot:

Robot uses microcontroller to drive four flame sensors, and transmit distance range to main controller of the fire fighting robot through series interface. To drive the all the components 5v dc and 12 v dc are required. The mains give the 230v ac so first we step down the 230v ac in to 12v ac by using step down transformer. Then the output is given to the full wave rectifier. The rectifier eliminates the negative peek voltage of the input voltage .The output of the rectifier is the pulsating dc. The error pulses are eliminating by using capacitor filter. Then the output at the parallel of the capacitor is the 12v dc. But the Micro Controller works on 5v dc .To convert the 12v dc into 5v dc a regulator (7805) is used. The output of the regulator is constant irrespective of the input voltage. The Micro Controller requires the preset logic circuit for protection of the internal program and internal clock in case of power failure. A sudden change in the power may cause data error resulting in the corruption of the internal program. The reset logic circuit contains one capacitor and a resistor. The driver circuit generally made by using one transistor and one relay. The driver circuit is mainly operated by the Micro Controller. The Micro controller changes the state of the output pin from the low to high, i.e. from O level to the 1 level. The transistor will act as an ON/OFF switch corresponding to the input of the base. If the base current of the transistor is high the transistor is under ON condition else it is in OFF state. These conditions will be used to control the relay. The thermal sensors sense the heat within the room. First sensors will give information to the micro controller if it senses heat. The micro controller pin bit

will goes high when the fire is present. The micro controller will always scan the input signal of sensors. If the sensors give the data about fire to the micro controller, it then finds the movement to reach the fire by calculating the input data.

A predetermined warning message will be sent to respective personals to intimate the occurrence of fire accident. The buzzer provided to the circuit sounds. The micro controller drives two motors. One motor is used to provide movement to the Robot to move in forward direction to reach the destination point and the other is used to sprinkle the water on fire. After extinguishing fire the robot will go back to the original position.

3. Advantages, Disadvantages

3.1 Advantages:

1. Prevention from dangerous incidents
2. Minimization of
–ecological consequences
–financial loss
–a threat to a human life

3.2 Disadvantages:

1. Doesn't predict nor interfere with operators thoughts.
2. Cannot force directly the operator to work.

4. Conclusion

This paper 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.

5. Future Scope

In the present condition it can extinguish fire only in the way and not in all the rooms. It can be extended to a real fire extinguisher by replacing the water carrier by a carbon-di-oxide carrier and by making it to extinguish fires of the entire room using microcontroller programming. Also the robot could not be run through the batteries because at some conditions the current requirement for the circuit rises to about .8A which is very high and cannot be obtained using batteries.

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