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Fire Accident Avoidance System in Trains Using Gsm Technology

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Abstract: *Now-a-days, fire accidents are occurring very frequently in public transport system which causes the loss of most valuable human lives and the government property. There are a number of methods to avoid fire accidents and to reduce the severity of loss in case of fire accidents in public transport system. But the damage is catastrophic as a rescue service could not reach at right time due to improper communication. So we can further reduce the loss caused by fire accidents in trains and buses if we are able to inform the respective authorities immediately after the accidents and open the emergency door automatically. The system which is proposed in this paper uses the modern technology to detect the fire accidents and also to inform the respective authorities with minimum delay. Three types of sensors fire, smoke and heat sensors are used to detect the fire accidents. The signals from these sensors will activate the microcontroller which in-turn activates the message transfer system, alarm system, water sprinkler system and the motor to automatically open the emergency door of the bogie in which the accident took place. The proposed system is designed by using GSM technology and AT89c52 microcontroller along with sensors.*
Keywords: *GSM, Microcontroller, Motor drivers, Sensors, Water sprinklers.*

I. Introduction

The railway system is an important transportation system in our country. Most of the trains in our country are the induction trains and hence there a chance of fire mishaps. Fire on a running train is more catastrophic than on a stationary one, since fanning by winds helps spread the fire to other coaches very soon after the accident. Moreover, passengers sometimes jump out of a running train on fire resulting in increased casualties. These fire accidents are causing serious threat to lives of people. Although there are sophisticated protection parameters in the existing system but the time taken by those systems to detect the accident and to inform the respective authorities is high. For avoiding the fire accident we can use an automatic fire accident avoiding system which senses the fire and alarms the passengers, driver and guard of the train. It also helps to put off the fire by using automatic water sprinklers and emergency door also gets opened. As soon as the fire is sensed a message is sent to relevant controlling authorities to take further action. For sending the message to relevant controlling authority GSM technology can be used.

The fire may occur in any form of activities such as short circuit in the electrical wires, prohibited activities of carrying explosive materials and smoking .The system can detect fire in three aspects: 1. Fire 2. Temperature increase (Heat) 3.Smoke. From the information collected from the sensors decisions of stopping the train, opening the emergency doors, automatic water sprinkling, and sending message to relevant authorities are made quickly by this system. It also gives message about the train in which the accident took place and what is detected i.e.; smoke or heat or fire.

II. Block Diagram Of The System

In this system microcontroller and the sensors are the main elements. Along with these there are a motor, a buzzer, an LCD display, water sprinklers and a GSM modem. The three sensors are placed in the bogie at the appropriate places to detect the fire. They are connected to the microcontroller by using connecting wires. The block diagram of the system is shown in the Figure 1.Fire accident if any occurs in the trains will result in smoke, fire and then a high degree of heat. So whenever a fire accident occurs in trains any one of the sensors or all the sensors will be activated and will give the signal to the microcontroller.

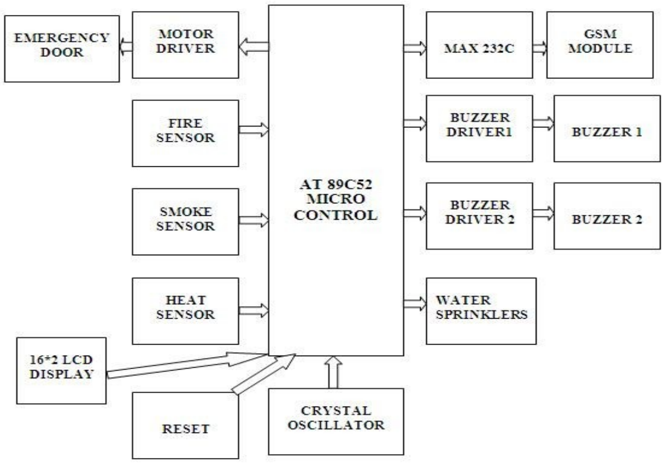

Figure 1: Block diagram of the system

Immediately the controller will activate the buzzer system to alert the passengers as well as the driver and the guard. Then it will turn ON the water sprinklers to extinguish the fire, motor to open the emergency door. The GSM system is also activated and sends an emergency message to the mobile numbers of the officials which are already stored in the memory. An LED display is also provided in the bogies to display the alert message and the condition of the GSM system. The maximum power needed to operate the circuit is +5V DC.

III. Microcontroller

Microprocessors and microcontrollers stem from the basic idea. The contrast between a microcontroller and a microprocessor is best exemplified by the fact that most microprocessors have many operational codes for moving data from external memory to the CPU; microcontrollers have one or two operational codes. The microprocessor is concerned with rapid movement of code and data from external addresses to the chip; the microcontroller is concerned with rapid movement of bits within the chip. The microcontroller can function as a computer with the addition of no external digital parts; the microprocessor must have additional parts to be operational.

In this system we are taking AT89C52 microcontroller where AT indicates Atmel company, 89 indicates Flash memory, C means CMOS technology, 52 is the microcontroller series that is used in this system. 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 pin out. 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.

Features Of At89c52 Microcontroller:

- Compatible with MCS-51™ Products
- 8K Bytes of In-System Reprogrammable Flash Memory
- Endurance: 1,000 Write/Erase Cycles
- Fully Static Operation: 0 Hz to 24 MHz
- Three-level Program Memory Lock
- 256 x 8-bit Internal RAM
- 32 Programmable I/O Lines
- Three 16-bit Timer/Counters
- Eight Interrupt Sources
- Programmable Serial Channel
- Low-power Idle and Power-down Modes.

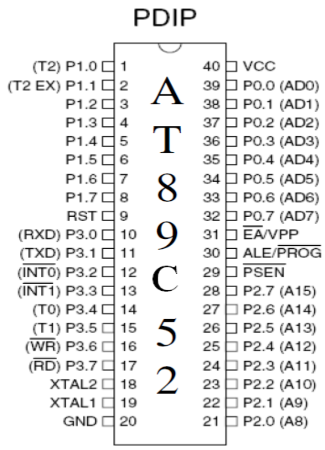

Figure 2: Pin Diagram of AT89C52

The AT89C52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port, and interrupt system to continue functioning. The Power-down mode saves the RAM contents but freezes the oscillator, disabling all other chip functions until the next hardware reset. The sensors are given to port 1 of the microcontroller, depending upon the inputs the outputs are formed at port 0(LCD display), port 2(buzzer, relays),port 3(GSM, MAX232).

IV. Sensors

HEAT SENSOR**:**

A thermistor is a type of resistor whose resistance varies significantly with temperature, more so than in standard resistors. The word is portmanteau of thermal and resistor. Thermistor is widely used as in rush current limiters, temperature sensors, self-resetting over current protectors, and self- regulating heating elements. Thermistor differs from resistance temperature detectors (RTD) in that the material used in a thermistor is generally a ceramic or polymer, While RTDs use pure metals. The temperature response is also different; RTDs are useful over larger temperature ranges, while Thermistor typically achieve a higher precision within a limited temperature range, typically −90 °C to 130 °C. Assuming, as a first-order approximation, that the relationship between resistance and temperature is linear, then:

$$\Delta R = k\Delta T \quad (1)$$

Where,

ΔR = change in resistance

ΔT = change in temperature

k = first - order temperature coefficient of resistance

Thermistors can be classified into two types, depending on the value of **k**. If **k** is positive, the resistance increases with increasing temperature, and the device is called a positive temperature coefficient (**PTC**) thermistor, or Posistor. If **k** is negative, the resistance decreases with increasing temperature, and the device is called a negative temperature coefficient (**NTC**) thermistor. Resistors that are not thermistors are designed to have a **k** as close to zero as possible, so that their resistance remains nearly constant over a wide temperature range.

Instead of the temperature coefficient k, sometimes the temperature coefficient of resistance α_T is used. It is defined as

$$\alpha_T = \frac{1}{R(T)}\frac{dR}{dT}. \quad (2)$$

NTC Thermistor:

Many NTC Thermistors are made from a pressed disc, rod, plate, bead or cast chip of a semiconductor such as a sintered metal oxide. They work because raising the temperature of a semiconductor increases the number of active charge carriers - it promotes them into the conduction band. The more charge carriers that are available, the more current a material can conduct. In certain materials like ferric oxide (Fe_2O_3) with titanium (Ti) doping a n-type semiconductor is formed and the charge carriers are electrons. In materials

such as nickel oxide (NiO) with lithium (Li) doping a p-type semiconductor is created where holes are the charge carriers.
This is described in the formula:

$$I = n \cdot A \cdot v \cdot e \qquad (3)$$

I = electric current (amperes)
n = density of charge carriers (count/cubic m)
A = cross sectional area of the material (sq m)
v = velocity of charge carriers (m/s)
e = charge of an electron (coulomb)

Over large changes in temperature, calibration is necessary. Over small changes in temperature, if the right semiconductor is used, the resistance of the material is linearly proportional to the temperature. There are many different semiconducting thermistors with a range from about 0.01 Kelvin to 2,000 Kelvin (−273.14 °C to 1,700 °C).

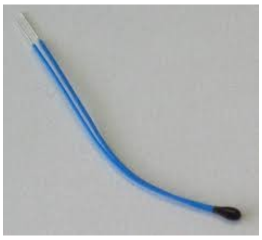

Figure 3: NTC Thermistor

FIRE SENSOR:

LDR can be used as fire sensor. The light-sensitive part of the LDR is a wavy track of cadmium sulfide. Light energy triggers the release of extra charge carriers in this material, so that its resistance falls as the level of illumination increases.

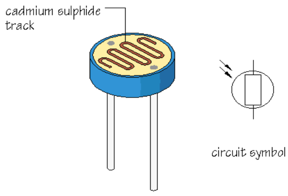

Figure 4: LDR as Fire Sensor

The essential circuit of a voltage divider, also called a potential divider, is:

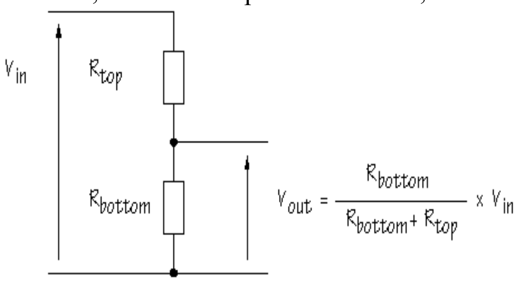

Figure 5: Voltage Divider Circuit

As you can see, two resistors are connected in series. with V_{in} , which is often the power supply voltage, connected above R_{top} .

SMOKE SENSOR:

Photoelectric diode can be used as a smoke detector. The light from the light source on the left shoots straight across and misses the sensor. When smoke enters the chamber, however, the smoke particles scatter the light and some amount of light hits the sensor:

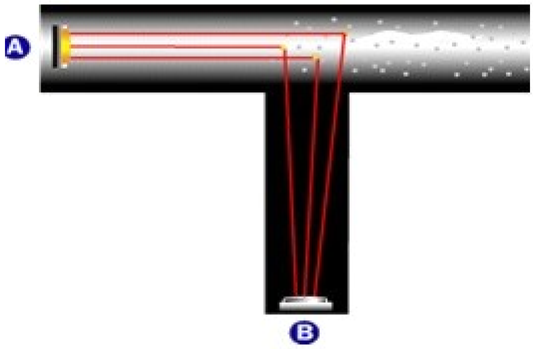

Figure 6: Smoke Sensor

The sensor then sets off the horn in the smoke detector. Photoelectric detectors are better at sensing smoky fires, such as a smoldering mattress.

V. Gsm Technology

Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz. A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves.

Definition:

GSM (Global System for Mobile communications) is an open, digital cellular technology used for transmitting mobile voice and data services. GSM differs from first generation wireless systems in that it uses digital technology and time division multiple access transmission methods. GSM is a circuit-switched system that divides each 200kHz channel into eight 25kHz time-slots. GSM operates in the 900MHz and 1.8GHz bands in Europe and the 1.9GHz and 850MHz bands in the US. The 850MHz band is also used for GSM and 3GSM in Australia, Canada and many South American countries. GSM supports data transfer speeds 9.6 kbit/s, allowing the transmission of basic data services such as SMS (Short Message Service). GSM satellite roaming has also extended service access to areas where terrestrial coverage is not available. The transmission power in the handset is limited to a maximum of 2 watts in GSM850/900 and 1 watt in GSM1800/1900.

GSM has used a variety of voice codec's to squeeze 3.1 kHz audio into between 5.6 and 13 Kbit/s. Originally, two codes named after the types of data channel they were allocated, were used, called Half Rate (5.6 Kbit/s) and Full Rate (13 Kbit/s). These used a system based upon linear predictive coding (LPC). In addition to being efficient with bitrates, these codes also made it easier to identify more important parts of the audio, allowing the air interface layer to prioritize and better protect these parts of the signal.

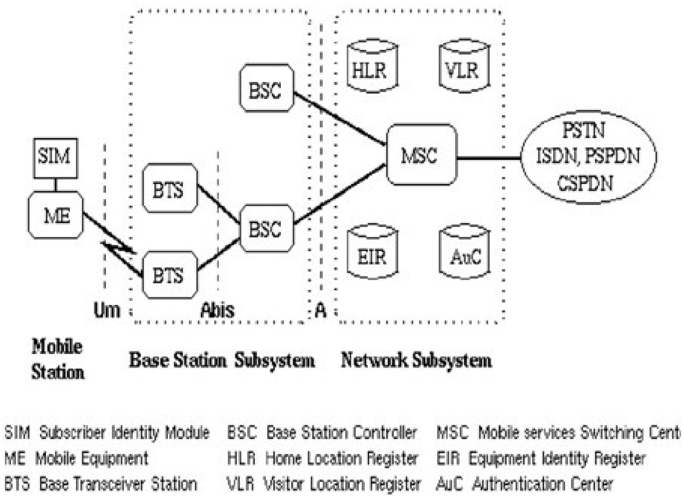

Figure 7: Architecture of GSM

Gsm Characteristics:
- TDMA over radio carriers (200 KHz carrier spacing).
- 8 full rate or 16 half rate TDMA channels per carrier.
- User or terminal authentication for fraud control.
- Encryption of speech and data transmission over the radio path.
- Low speed data services (up to 9.6 Kb/s).
- Support of short message service (SMS).

Advantages Of Gsm:
- Capacity increases.
- Reduced RF transmission power and longer battery life.
- International roaming capability.
- Better security against fraud.
- Encryption capability for information security and privacy.
- Compatibility with ISDN, leading to wider range of services.

VI. Buzzer And Water Sprinklers

Buzzer And Its Driver:

A buzzer or beeper is a signaling device, usually electronic, typically used in automobiles, household appliances such as a microwave oven. It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a preset time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound.

Figure 8: Buzzer

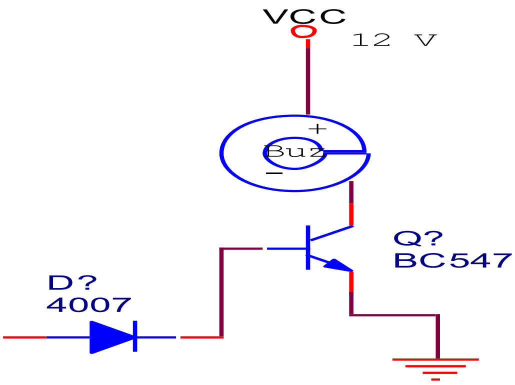

Figure 9: Buzzer driver

Buzzer Drive: `

The circuit is designed to control the buzzer. The buzzer ON and OFF is controlled by the pair of switching transistors (BC 547). The buzzer is connected in the Q2 transistor collector terminal. When high pulse signal is given to base of the Q1 transistors, the transistor is conducting and closes the collector and emitter terminal .So zero signals is given to base of the Q2 transistor. Hence Q2 transistor and buzzer is turned OFF state. When low pulse is given to base of transistorQ1, the transistor is turned OFF. Now 12V is given to base of Q2 transistor so the transistor is conducting and buzzer is energized and produces the sound signal

Water Sprinklers:

The main function of the water sprinkler is for sprinkling the water. In this system when the sensors get activated it produces power to the motor and the water is released through the water sprinklers. Some of the models of the water sprinklers that are used in the train bogies are as follows:

Figure 10: Water sprinklers

VII. Result

Figure 11: Target board

Figure 12: Initialization

Figure 13: After Detection

Figure 14: Sends SMS using GSM technology

Figure 15: Fire sensor ON

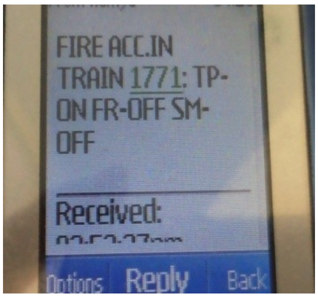

Figure 16: Temperature sensor ON

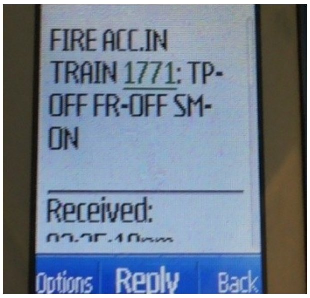

Figure 17: Smoke sensor ON

VIII. Conclusion

Human lives which are the most valuable and priceless thing in the world are getting affected due to the delay in the systems used for detection in case of fire accidents that are occuring in trains. So, we have proposed a system which uses the modern technologies such as sensor technology and the familiar technology such as GSM to reduce the delay in detection of fire accidents and alerting the respective authorities. The proposed system needs a much less power for its operation and is also cheap. So we can reduce the loss caused by fire accidents in trains. In future with advent of the wireless sensor technology the system can be made further faster and reliable.

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