Abstract

Railway safety is crucial aspect of rail operation over the world. Railway accidents are often taking place. There are different reasons of railway accident. Railways being cheapest mode of transportation are preferred over all other means. When we read newspaper, we come across many railways accidents. Therefore very big economic losses are to be faced. The objective of this project is to avoid railway accidents. This model is designed with the help of microcontroller to avoid accidents. If there is fire in any bogie due to some reason this system being activated and will give message or signal to nearest hospital, police station, fire brigade and as well as to each bogie. And also that particular shower is being activated which is placed in that particular bogie. And IR sensors are used to identify the front obstacle of the train. As we know it's impossible to stop the train immediately in critical situation or emergency arises. Train accident having series consequence in terms of loss of human life, injury damage to railway property. The concept of model is to control railway accident using sensor technique. Main purpose of the system is train is always connecting with the railway station. By using this system we control the railway traffic possible.
1. Introduction

The Indian Railways has the world's fourth largest railway network in the world, after that of the United States, Russia and China [3]. The railways traverse the length and breadth of the country and carry over 20 million passengers and 2 million tons of freight daily. It is one of the world's largest commercial or utility employers, with more than 1.6 million employees. About 15000 trains work every day. Unfortunately there have been many accidents involved in the railways. The trains are moderate vehicles used for transporting people and goods. Mostly, the people prefer the train journey for longer distance as it is cheaper. Since induction of train for public transportation, the fire accidents are not catered seriously by the Indian Railways. The notices showing "Do not smoke", "Do not carry inflammable material" are the only precautionary warnings about the fire in each compartment. However, because of failure in routine maintenance system or by the activities of illegal social elements, the fire accidents in train occur frequently. These fire accidents are among the most serious disasters to human lives and the property of government.

In recent days, the train fire accident occurred and mad several human loss. The prevention of train fire has become a serious concern in our country. Currently, Our Indian Railways doesn't use any sophisticated fire prevention methods. But it is realized to have an automatic system to monitor the fire in the coach giving alarm to the people, sending signal to the engine driver to stop the train and the fire is extinguished with the help of automatic sprinkler system. To have these all above in a single package a wireless sensor network based on RF Module is proposed. This system is used for monitoring, automatic fire sprinkling, cautioning and preventing of fire in running trains. The fire may occur in any form of activities such as short circuit in the electrical wires, prohibited activities of carrying diesel, petrol, gas stoves and smoking nearby them will cause fire accidents. To control these we do not have an intensive work force. To overcome this, a system of having automatic sensor monitoring, fire alarm warning and fire extinguishing are based on RF module network technology. This system can monitor real-time related parameters such as temperature and humidity in each coach. From the information collected by the system, decisions for firefighting, alarming, and automatic operation of the train braking system can be made more quickly by the system or engine driver. The engine driver will get the warning light and he stops the engine. Further he informs to the immediate concern authority for help.

2. Various Important Components Of Automated Railway Safety And Control System

These are the major components utilized in this system are ARM LPC 2138, IR sensors, GSM, GPS and RF module.

2.1 ARM controller-ARM 7 LPC 2138

The LPC2138 microcontroller are based on a 16 bit/32bit ARM7TDMI-S CPU with real time emulation and embedded trace support, that combine microcontroller with embedded high speed flash memory ranging from 32KB to 512KB.A 128 bit wide memory interface and unique accelerator architecture enable 32bit code execution at maximum clock rate. Various 32 bit timers, single or dual 10 bit ADC, 10bit DAC, PWM channels and 47 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers suitable for industrial control and medical system.

2.2 IR SENSORS

An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings by either emitting and/or detecting infrared radiation. It is also capable of measuring...
heat of an object and detecting motion. Infrared waves are not visible to the human eye. A typical system for detecting infrared radiation using infrared sensors includes the infrared source such as blackbody radiators, tungsten lamps, and silicon carbide. In case of active IR sensors, the sources are infrared lasers and LEDs of specific IR wavelengths. Next is the transmission medium used for infrared transmission, which includes vacuum, the atmosphere, optical fibers. Finally, the infrared detector completes the system for detecting infrared radiation. The output from the detector is usually very small, hence pre amplifiers coupled with circuitry are added to further process the received signals.

A version of the above reflective sensor is to use INFRARED LIGHT SENSOR, as there is much less interferences. IR is a kind of light that humans cannot see. This is god when we don’t want people to see our sensor and thus is useful in security system. This infrared sensors are of two types one is TR-X and RF-X here this sensors transmits and receive signal due to any obstacle in front of railway.

2.3 GSM

GSM (Global system for mobile communication) is the world’s first cellular system to specify digital; modulation and network level architectures and services. GSM module is used to send message to user. 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 dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves.

2.4 GPS

The Global Positioning System (GPS) is a space based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the earth where there is an unobstructed line of sight to four or more GPS satellites. The system provides critical capabilities to military, civil and commercial users around the world. It is maintain by the United States Government and is freely accessible to anyone with a GPS receiver.

2.5 RF MODULE

It consists of RF transreceiver. It is used to send the data to main station. The data consist of status of the bus. It will send the signal when the controller detects the BRT bus. RF transmitter is in the bus station and RF receiver is in the main station. RF transreceiver works at the frequency of 433.92MHz.

Specification of RF Transmitter:
1) Operating Voltage 3V to 12 V.
2) Operating Current Max = 40mA (12V), Min = 9mA (3V).
3) Oscillator SAW (Surface Acoustic Wave).
4) Frequency: 433.92MHz.
5) Transmitting Power: 25mW (315MHz@12V).

Specification of RF Receiver:
1) Operating Voltage 5.0V ± 0.5V.
2) Operating Current= 5.5mA @5.0V.
3) Operating Principle Monolithic super heterodyne receiving.
4) Bandwidth: 2MHz.
5) Transfer Rate < 9.6Kbps.
3. Hardware Implementation

- **Figure 3.1: Train control unit**

- **Figure 3.2: Train control unit**

- **ARM 7 LPC 2138**: ARM 7 LPC 2138 is the heart of this system. It is used for monitoring the overall activities such as fire sensor, IR sensor, shower, display, recorder, dc motor, RF transceiver, GSM and GPS.

- **IR obstacle sensor**: This sensor is fitted in front of train engine to detect any obstacle present on track with in the line of sight. It sense appropriate signal to train control unit, which in-turn stops train immediately if an obstacle is detected.

- **GPS (Global Positioning System)**: The Global Positioning System (GPS) is a space based satellite navigation system that provides location and time information in all weather conditions. Here it is used for finding the location of train.
GSM: GSM (Global system for mobile communication). Here it is used for the purpose of sending the message to police station, railway station, fire brigade, hospital, etc. when fire is detected.

Fire Sensor: When any bogie fired due to some reasons, then fire sensor will detect fire and send signal to ARM 7 LPC 2138. This fire sensor is used for the purpose of fire detection.

Shower: As the shower is interfaced with the ARM 7 LPC 2138. Once the fire is detected, the shower interfaced will be switched ON.

Buzzer: Buzzer is used to give an alert in the case of fire detected. As the fire sensor is interfaced with the ARM 7 LPC 2138, it will detect the fire around it. Once the fire is deducted, it will start buzzing.

Display: Display is interfaced with the ARM 7 LPC 2138. Once the fire is detected, it will display message and it will also display safety instructions on it.

Recorder IC: Recorder IC is interfaced with the ARM 7 LPC 2138. Once the fire is detected, it will sound safety instructions in the fired bogie.

DC Motor: As the DC motor is interfaced with the ARM 7 LPC 2138, dc motor is used to control the speed of train; it will stop the train if fire is detected.

RF Transceiver: The RF Transceiver uses RF modules for high speed data transmission. Here it is used for wireless communication between Train control unit and Fire Control unit.

Power supply: Power supply IS used to provide the power to each block such as ARM 7 LPC 2138, fire sensor, display, recorder, RF transceiver, IR sensor, etc.

4. Working of Fire Control System & Fire Control Unit

4.1 Train Control unit

This system performs four major following function, fire detection, shower ON display safety message, and activated recorder and signal send to train control unit with the help of RF transmitter control of train. We have fire sensor, which is fitted in each bogie. When fire is detected through fire sensor, it will give signal to ARM 7 LPC2138, then the shower will be activated or ON as well as safety message will be display on LCD screen and announcing the safety message in fired bogie through recorder IC. Therefore RF transmitter transmit signal towards the train control unit for next helping process.

4.2 Fire Control Unit

Train control unit has received signal from fire control unit with the help of RF transceiver, therefore, train control unit stop the train immediately, i.e. both dc motors are OFF as well as ARM 7 lpc2138 send the message to the nearest hospital, railway station, fire brigade, police station etc for helping purpose. IR sensor fitted in front of train which acts as obstacle sensor and other fitted to left side of train to behave as curve detecting sensor. These two sensors are connected to train control unit of train. The IR obstacle sensor fitted in front of train continually senses the track in line of sight, if an Obstacle of large size which may derail train is detected then signals is sent to control block which immediately stops train using dc motors. Similar to LCD connected to track control system. The messages related to all the operations that occur in both train and fire control unit are displayed on LCD screen connected to the ARM7 LPC2138 present in train control unit.
5. Implementation Methodology

5.1 Algorithm For Fire Control Unit

1. Start
2. Initialize all ports, LCD
3. Sense the fire, if no goes to step 3, otherwise step 6
4. Send message to train control unit
5. Receive message from train control unit if no go to 6. step 5
7. Shower on
8. Buzzer/Recorder/speaker on
9. Display message
10. Recorder activated
11. End

5.2 Algorithm For Train Control Unit

1. Start
2. Initialize all ports, GSM module, GPS
3. Sense the obstacle, if obstacles detected go to step 6
4. Receive message from fire control unit
5. Send message to hospital, police station, railway station etc.
6. Train stop
7. End

**Hardware:** In this we are using ARM7 LPC2138

**Software:** For programming ARM7 LPC2138 we use KEIL software, and for circuit implementation and testing we use MULTISIM and PROTEUS.

6. Conclusion

This paper introduced a low cost, low-power embedded system for railway accidents control system. In this paper, we discuss the design of proposed safety system for railway, using ARM LPC 2138 Microcontroller of Atmel as hardware platform, and combines with RF as a communications platform of wireless area network. Introduced RF wireless communication will assemble Ad-hoc network among stations and trains and work in phase with each other. RF is designed for low cost and low power consumption. The result shows that this new innovative technology will increase the reliability of safety systems in railway transport. By implementing these features in real time application railways can avoid accidents up to approximately 50%.

7. References