

## Smart Railways with Better Security Using Embedded Systems

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**Abstract-** Nowadays Railway accidents quiet common in our daily routine life .So many innocent people lost their lives due to these accidents. For example, recently so many people dead in major fire accident happen in Tamilnadu express train in country India. We can stop like these disasters in future with present science and technology. This paper proposes a new system for preventing the accidents in railways using Sensor networks. It involves two parts of implementation. In the first part, the sensor nodes are used for collecting data such as temperature, concentration of smoke in air, intra and inter bogie temperatures automatically. These collected data are processed to monitor temperature and bogie temperature, if any mal detected exit door opens and water is pumped automatically in the compartment at the information is reached to locomotive engineer and the nearby station master. The second part implements the surveying system for the railway tracks which detects the cracks in the tracks using IR sensors and the derailment in train is detected using MEMS sensors. Hence the system performs both the data acquisition and the survey. The overall process is then controlled by the PIC micro controller which is 8 bit microcontroller and suits very well for the Data acquisition and the control system based application used largely in the industrial applications. In this project, PIC microcontroller gets the data's from sensor nodes, the survey sensors (Inclination using MEMS) manipulates and issues the control signals to the final control elements. Also, it uses GSM to send data's to the locomotive engineer. By implementing this project the Railway network will be safe and secure mode for transportation.

### I. INTRODUCTION

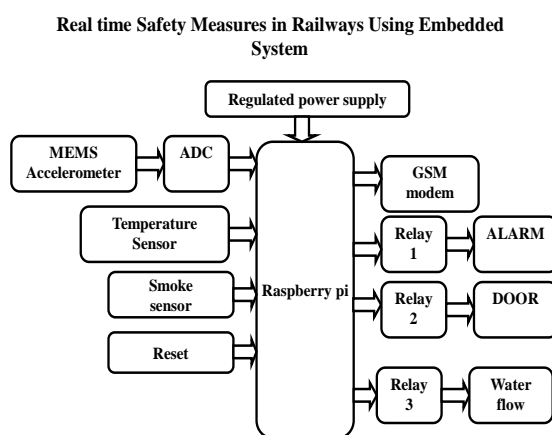
The Railways is the chief mode of transport for the people for the people across various strata in the society. In such situation there is a need for ultimate security to be implemented across the railway network. Conventional railway networks lack the necessary infrastructure to respond swiftly to the emergencies such as fire accidents. Now a days accidents have become part and parcel in our daily routine life not a single day passes without them [1,2]. Whether they are road-accidents or they are train accidents or air crashes, they definitely occur every day in various parts of the world. Also other problem created when the continuous need in monitoring and maintaining the railway tracks to ensure to free from cracks and inclination. Depending on recent developments in railway system, high speed trains are being extensively used, and rail transportation is being increased.

### II. LITERATURE SURVEY

The Railways is the chief mode of transport for the people for the people across various strata in the society. In such situation there is a need for ultimate security to be implemented across the railway network. Conventional railway networks lack the necessary infrastructure to respond swiftly to the emergencies such as fire accidents. Nowadays accidents have become part and parcel in our daily routine life not a single day passes without them. Whether they are road-accidents or they are train accidents or air crashes, they definitely occur every day in various parts of the world. Also other problem created when the continuous need in monitoring and maintaining the railway tracks to ensure to free from cracks and inclination.

Depending on recent developments in railway system, high speed trains are being extensively used, and rail transportation is being increased. Reasons for this increase are high speed, economical, environment friendly, safety and modern characteristics of railway systems. Depending on various factors, deformations may occur on the superstructure of railways. Determining these deformations on the time and taking precaution is very important for the safety of railway systems. The proposed project introduces a real time survey and real time data acquisition and results are analyzed at the real time. If any mal detected at the system then the alerts are given at the real time and necessary safety measure will be provided. Smoke and fire sensors are implemented at specific points of the carriage to monitor the temperature of the carriage if any flaws deduced in the temperature then alert are provided to insure safety. The sudden change in temperature may cause mal like fire accidents. This can prevent by automatic opening of the doors of the compartments and pumping out order to avoid the fire accidents and if any mal detected exist door opens and water is pumped out automatically in the compartment. MEMS accelerometer is used to senses the axis of train.

### III. SYSTEM BLOCK DIAGRAM



### IV. WORKING OF SYSTEM

These are the components used in this project Raspberry pi processor, MEMS Accelerometer, Temperature sensor (LM 235), Smoke Sensor

(T9Q6), 12v relay switch and GSM. In this circuit we are using temperature sensor for to detect temperature level and smoke sensor for detecting Co<sub>2</sub> in the compartment. If the temperature is above the threshold level immediately the doors will open and water is pumped out automatically in the compartment and gives alarm. The message will be send to locomotive engineer through GSM automatically. The MEMS 3-axis accelerometer consists of a Mass at the centre of the sensor's chip, which is suspended by 4 Beams doped with Piezo-resistive material. When the sensor is subjected to acceleration in any direction, the movement of the Mass causes the 4 Beams to deform and so change the resistance in the piezo material. This enables the sensor to detect the acceleration motion.

### V. HARDWARE COMPONENTS

#### 1. RASPBERRY PI

The **Raspberry Pi** is a credit-card-sized single-board computer developed in the UK by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools. The Raspberry Pi is manufactured through licensed manufacturing deals with Newark element14 (Premier Farnell), RS Components and Egoman. All of these companies sell the Raspberry Pi online. Egoman produces a version for distribution solely in China and Taiwan, which can be distinguished from other Pis by their red coloring and lack of FCC/CE marks. The hardware is the same across all manufacturers. The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF-S 700 MHz processor (The firmware includes a number of "Turbo" modes so that the user can attempt over clocking, up to 1 GHz, without affecting the warranty), Video Core IV GPU, and was originally shipped with 256 megabytes of RAM, later upgraded to 512 MB. It does not include a built-in hard disk or solid-state drive, but uses an SD card for booting and long-term storage. The Foundation's goal was to offer two versions, priced at US\$25 and US\$35. They started accepting orders for the higher priced model B on 29 February 2012, and the lower cost model A on 4 February 2013.



Fig: RASPBERRY PI

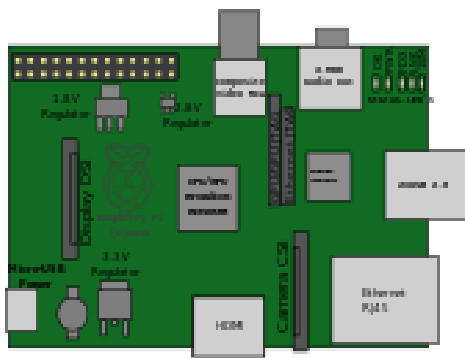


Fig: HARDWARE DESCRIPTION OF RASPBERRY PI

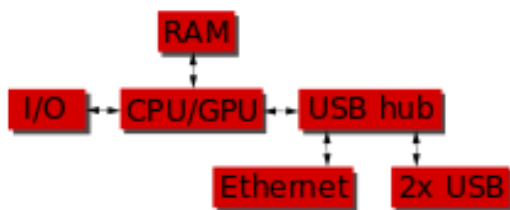


Fig: Block diagram of Raspberry pi



Fig: Pin description of Raspberry pi

## 2. Temperature Sensor:

The LM35 sensor series are precision integrated-circuit temperature sensors, whose output

voltage is linearly proportional to the Celsius (Centigrade) temperature.

To detect the heat produced during fire occurrence we use temperature sensor.

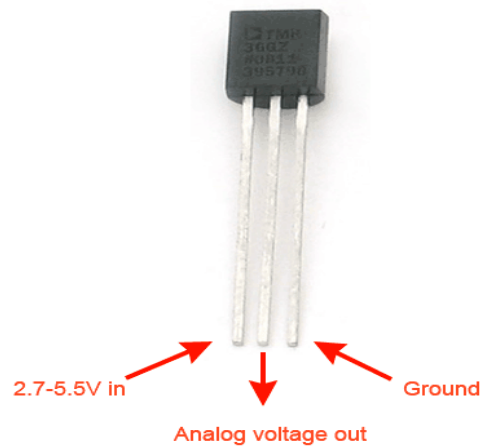


Fig: Temperature sensor pin description

The Temperature Sensor LM35 sensor series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.

3. MEMS- The MMA7260Q is 3-axis accelerometer. An accelerometer measures acceleration (change in speed) of anything that it's mounted on. Single axis accelerometers measure acceleration in only one direction. Dual-axis accelerometers are the most common measure acceleration in two directions, perpendicular to each other. Three-axis accelerometers measure acceleration in three directions. Accelerometers are very handy for measuring the orientation of an object relative to the earth, because gravity causes all objects to accelerate towards the earth. A two-axis accelerometer can be used to measure how level an object is.

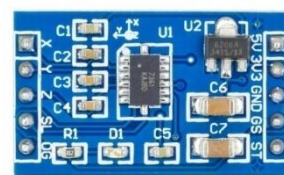


Fig: Picture of MEMS sensor

**4. Smoke Sensor-** Sensitive material of MQ-2 smoke sensor is SnO<sub>2</sub>, which with lower conductivity in clean air. When the target combustible smoke exist, the sensor's conductivity is higher along with the smoke concentration rising. Please use simple electro circuit, Convert change of conductivity to correspond output signal of smoke concentration. MQ-2 smoke sensor has high sensitive to LPG, Propane and Hydrogen, also could be used to Methane and other combustible steam, it is with low cost and suitable for different application.

This semiconductor gas sensor detects the presence of combustible gas and smoke at concentrations from 300 to 10,000 ppm. The sensor's simple analog voltage interface requires only one analog input pin from your microcontroller. This flammable gas and smoke sensor detects the concentrations of combustible gas in the air and outputs its reading as an analog voltage. The sensor can measure concentrations of flammable gas of 300 to 10,000 ppm. The sensor can operate at temperatures from -20 to 50°C and consumes less than 150 mA at 5 V.

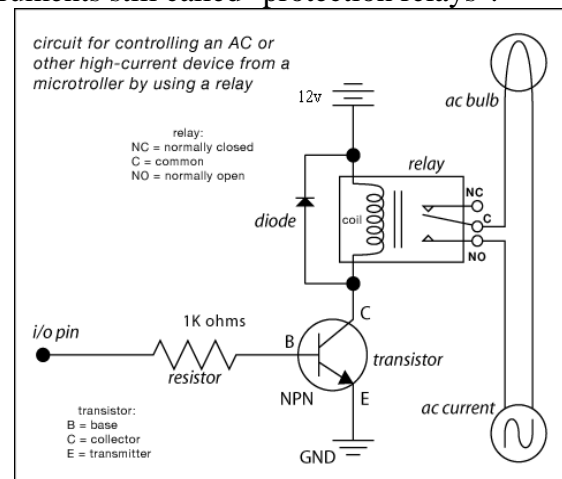


www.pololu.com

**Fig: Smoke Sensor**

**5. Relay-** A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism, but other operating principles are also used. Relays find applications where it is necessary to control a circuit by a low-power signal, or where several circuits must be controlled by one

signal. The first relays were used in long distance telegraph circuits, repeating the signal coming in from one circuit and re-transmitting it to another. Relays found extensive use in telephone exchanges and early computers to perform logical operations. A type of relay that can handle the high power required to directly drive an electric motor is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device triggered by light to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protection relays".



**Fig: Circuit for controlling an AC or other High current device**

**GSM-** GSM SIM 300 is used. GSM receives coordinates from microcontroller and sends message to mobile number store in our system.



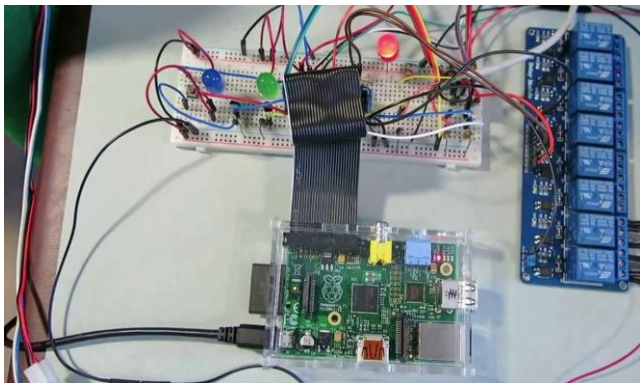
**Fig: Picture of GSM module**

**BUZZER-** A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke.



**Fig: picture of buzzer**

## V. RESULTS



**Fig.: A complete hardware kit**



**Fig.: Prototype design**

## VII. ADVANTAGES & APPLICATIONS

### Advantages:

1. The system is low in cost.
2. Highly securable.
3. Monitors and controls the parameters like smoke, Temperature
4. Advanced automatic system.

5. Sends Alerting messages.

### Applications:

1. Applicable in Trains to Prevent Accidents

## REFERENCES

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