

Wireless Sensor Network for Real Time Monitoring and Controlling of Railway

Accidents

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Abstract— Railway accidents and safety is crucial aspect in railway sector of all over the world. Actually accidents are often taking place due to breakage of track. It is a need to be identified breakage in track in real time before a train actually comes near to the broken track and get subjected to an accident. It is a complex and massive problem of railways for a life security and timely management of services. In proposed system a vibration sensor has been used for detecting cracks in the railway tracks and obstacles. In tunnel light will on and off when train entering and leaving the tunnel respectively with the help of load cell and switching circuitry for the energy consumption in tunnel and by using IR sensor, energy has been consumed in boogie.

Keywords: *Accelerometer; Real time Operation; Wireless Sensor Networks, Energy consumption, IR sensor.*

1. INTRODUCTION

The 1st railway train in India ran over a stretch of 21 miles from Bombay to Thane. The development of railways in India dates back to second decade of the nineteenth century. India railways system is an important lifeline in our country. Lights and fans can be on off by using special logic circuitry.

An accident happening due to track breakage has been a big problem in railway sector. It is also need to design system for detecting obstacles such as

cars, bicycles and human on the track in the range upto hundreds of meters ahead.

In the proposed system includes the several features which prevent the train accidents. It saves the human life and it saves the electrical energy. The system has been implemented for the detection and controlling of railways accidents using the PIC controller.

Nowadays, Energy resource, Telecommunication and Transport are the vital infrastructural prerequisite which acts as an indicator to the growth of any Economy. Transport includes road transport, air transport, water transport and rail transport. Transport gives useful relationship between production Centre, distribution areas and ultimate consumer. If we talk about inland transport mode, one major transport industry comes in mind: The Railways.

Actually the contribution of the Railways to the growth of the economy with its incredible services like mobility of various commodities and passengers has been ignored. It is impossible to imagine that Indian economy without Railways. We always feel proud and happy when thinking that our Indian Railway is Asia's first and world's second largest under the single management and astonished by knowing that the Indian Railway is world's largest employment provider organization. In India, Railway is the largest and cheapest mode of transport.

The country's vastness and diversity has been connected and coordinated by the largest and busiest rail networks in Asia, transporting over 18 million passengers and more than 2 million tons of freight daily. It is the world's largest commercial or utility employer, with more than 1.4 million employees. Indian Railways has become the lifeline for the country. There is no walk of life or sector of economy, which does not depend heavily on its existence of the Indian Railways. Passengers and goods with equal importance are carried everyday by Railways from one corner of the country to the other.

Recent accident in Uttar Pradesh has been happen on 14 Jan 2017 because of track breakage. In total, there are 168 railway stations and 235 railway platforms under Pune division. The series of railway accidents taking place across the country have again set off a debate on the issue of railway safety in our country.

Recent accident in Uttar Pradesh has been happen on 14 Jan 2017 because of track breakage as in fig.1 and on 18 Jan 2017, the train accident has been happen because of the 8 mm crack on the track in between pandabeshwar and Bukhara under Alanson division as shown in fig.2

These accidents can be controlled by detecting the crakes of the rail track. Hence for that vibration sensor can be used to detect the track breakage.



Fig 1: Accident occurred due to track breakaged.



Fig 2: Accident occurred due to obstacle

2. Literature Survey

The term accident envelopes a wide spectrum of occurrences with or without significant impact on the system. Consequential train accidents include mishaps with serious repercussion in terms of loss of human life or injury, damage to railway property or interruption to rail traffic in excess of laid down threshold levels and values. These consequential train accidents include collisions, derailments, fire in trains, road vehicles colliding with trains at level crossings, and certain specified types of miscellaneous train mishaps.

In [1] the many accidents happen due to the front obstacle of the train. For the way to detect the obstacle using IR sensor. It detects the object in the front of the train and gives the control signal to the controller to control the speed of the train. It is saves the human life.

In [2] the railway surveying in many accidents causes multiple damage of life and also our property. So that this project to implement in two way to save the train travel. For the one way is to determine the malicious in the train track incessantly, whether the track stipulation is good or not for use the vibration Sensor to check it. Next for them to avoid the obstacle crossing in train track, when the train is come. The main aspire in this project is to help our railway department to improve the automatic process. Also develop the requirement tools needed in that safe travel.

In [3] includes several features which prevents train accidents. It includes automatic speed controlling in curves, collision detection, Fire detection, detaching of couch automatically when fire is detected in it automatic railway gate control and track continuity. This system makes use of IR sensors, fire sensor, Zig Bee and other embedded systems.

In [4] the work on “Development of automatic person detection system to control electrical fan and lights” using Microcontroller is a reliable circuit that takes over the task of controlling the room lights in museums very accurately. When somebody enters into the Museum then the light in the museum will be switched ON and count also incremented by one when any one leaves the room then count will be decremented by one. If the total count will be zero, the light will be switch OFF. The implementation is made simpler by using sensor to detect person. The system includes IR sensor, microcontroller, LCD display and a 5V power is supplied to run the system. The system uses a compact circuitry built around PIC microcontroller programs are developed in Embedded automatically switched OFF. The microcontroller does the above job. It receives the signals from the sensors, and this signal is operated under the control of software which is stored in ROM. PIC Microcontroller 16F887A continuously monitor the sensors, A IR Sensor is which controls the switching on/off of the light.

In [5] this paper described a new and innovative medium for railways that are Wireless Sensor Network (WSN) based Railway Signalling System and conclude that Introduction of WSN in Railways will not only achieve economy but will also improve the level of safety and efficiency of train operations.

In [6] gap in the track is detected or when a running train is detected in front of the standing train, the sensors(vibration sensor and the gap detector) sounds an alarm which is fitted in the operating room in the engine. The microcontroller form the main unit of the

system .It receives input from the sensors and wirelessly sends information to other sensors in the network to sound an alarm thereby preventing any disaster from occurring. The sensors are capable of detecting the gap 800 to 900 meters away. They use this same module at a few places fitted below the engine. Thus zigbee is used to communicate with the other sensor modules. This helps the driver to stop the train immediately.

In [7], a new type of autonomous train is developed. The localization system is constructed with GPS and GSM device. Currently, three tasks, including collision detection and following, object detection, and obstacle avoidance, has been implemented on this platform. Developing on-board automotive driver assistance systems aiming to alert drivers about driving environments, and possible collision with other trains has attracted a lot of attention lately. In these systems, robust and reliable train detection is a critical step. It presents a review of recent vision-based on-track train detection systems.

In [8] a wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, and pressure to cooperatively pass their data through the network to a main location. It provides a bridge between the real physical and virtual worlds. The more modern networks are bi-directional, also enabling control of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control. The aim of the project is to design a system that will run the train autonomously without any human operators. This will avoid train to train collisions, over speeding problem, signalling errors and unmanned railway crossing incidents. Provide a way for a passenger to know the train location, speed and direction in real time from

anywhere in India through his mobile phone using GPS.

In [9] Railways are large infrastructures and are the prime mode of transportation in many countries. The railways have become a prime means of transportation owing to their capacity, speed, reliability; even a small improvement in performance of railways has significant economic benefits to rail industry. Thus a proper maintenance strategy is required to govern optimization of inspection frequency and improvement in skill and efficiency. Accidents happening due to track breaking have been a big problem for railways for life security and timely management of services. This breakage needs to be identified in real time before a train actually comes near to the broken tracks and get subjected to an accident. In this paper, different kinds of rail defects inspection and maintenance methods are described and a basic algorithm is readdressed that makes use of wireless acoustic sensors for detecting cracks and breakages in the railway tracks.

3. PROBLEM DEFINITION

Accident happening due to track breaking has been a big problem in railways sector. It is also need to designed system for detecting obstacles such as cars, bicycles, and human on the track in the range up to hundreds of mete ahead. Power consumption has to reduce in railway boogie as well as in tunnel.

4. OBJECTIVES

- To implement real time monitoring and automatic control of different parameters related to railway.
- To develop completely automated system with reducing the need of human involvement and to achieve energy

conservation.

5. SYTEM ARCHITECTURE

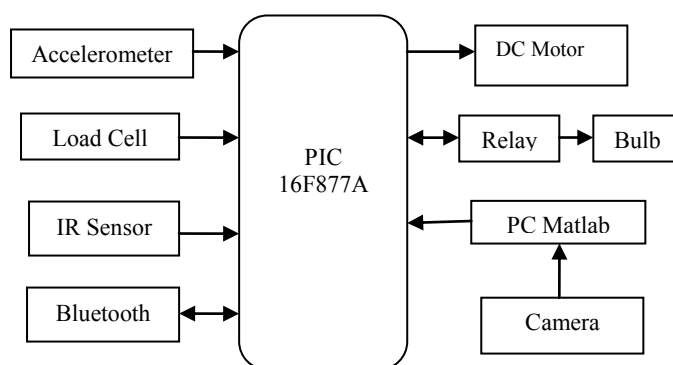


Fig 3: System architecture of implemented system.

The system architecture consists of PIC16F877A microcontroller. Accelerometer, Load cell, PC (Matlab), Camera and IR sensor.

Accelerometer is used to measure the vibrations. It is used to checking the breaking of train track. It is placed on the railway track to continuously monitoring the track and measuring the vibrations if the track is break it sends the signal to the controller to control the speed of the train and avoiding the accident. Camera is used to capture the image it is placed on the front of the train it captures the image on the track and sends to the PC (Matlab) through the RS232. PC (Matlab) is used to detect the person is present in front of the train. If the person is present then sends the signal to the controller to control the speed of train. By using load cell and switching circuitry, energy conservation in railway tunnel has been achieved. Lights in tunnel is switch on only during the train has passed over the load cell and entered in the tunnel.

5.1. Microcontroller : The PIC16F877A features 256 bytes of EEPROM data memory, self programming, 2 comparators, 8 channels of 10 bit analog to digital(A/D) converter. All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer

applications.

5.2 IR Sensor: An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings by either emitting 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 sensor, the source are infrared lasers and LEDs of specific IR wavelengths.

5.3 Accelerometer: It is used ADXL335 accelerometer. It is used for vibration measurement. The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range.

5.4 Load Cell: load cell of capacity 20kg. Load cell is used for measurement weight of the railway engine. Load cell is one type of strain gauge it is used to convert the force or pressure into electrical signal.

5.5 DC Motor: DC motor is used for controlling the speed of train, when curve or obstacle is detected.

5.6 LCD Display: It is used to display the measuring vibrations, weight measured by the load cell, detected objects etc.

5.7 Power Supply: The standard 5v DC power supply is used for controlling all blocks of the system.

5.8 Camera: It is placed on the front of the railway. It is used to capture image of the object placed on the train track and sends signal to the PC (MATLAB) regarding person detection.

5.9 Bluetooth: It is used to exchange the data regarding person present in front of railway over a 20 m distance for demo purpose. For actual use, zigbee module or GSM module can be used. Once it is paired to a master Bluetooth device, its operation becomes transparent to the user.

6. Simulation Result:

6.1 Train has enter in Tunnel.

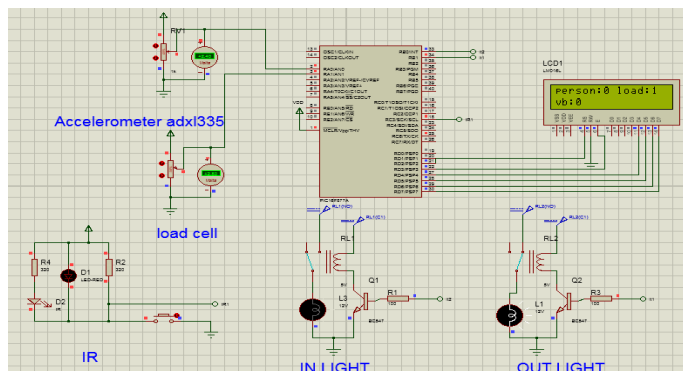


Fig 4: Load cell measured weight of railway engine

Before entering in tunnel, the train has passed over the load cell AD620. As train passed over the load cell and entered in the tunnel the tunnel, then light will glow on and when train leaving the tunnel the light will glow off. For demonstration purpose, the threshold value of weight detection is 20 gms. The output of the load cell is very low that means hardly 2mV to 5mV. So by using differential instrumentation amplifire the gain will increase. That means it amplifies the signal and gives to the controller.

6.2 Human detection

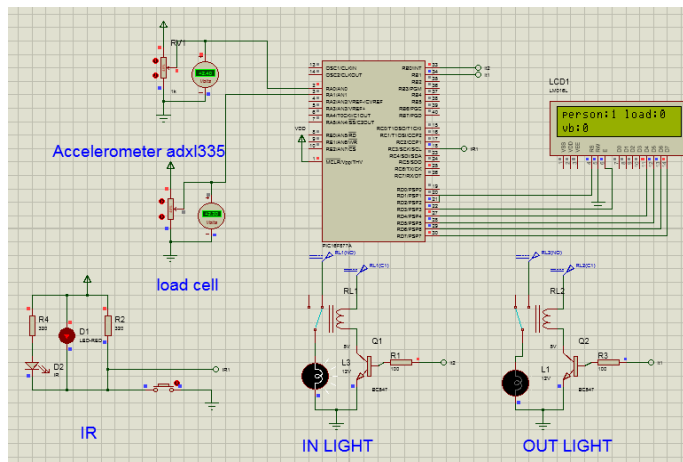


Fig 5: Human Detection in Boogie.

For the person detection IR sensor is used. Infrared sensor is placed in the upper part of the seat, it sense the person is present or not. If person is present then the lights will be turn on otherwise it will be turned off. This function is followed by the Relay.

6.3 Track Breakage.

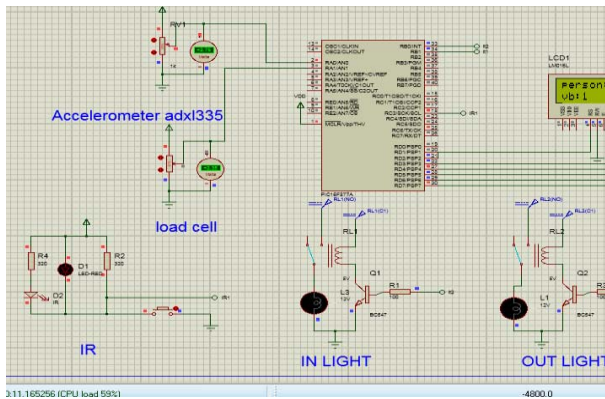


Fig 6: Action will be taken at the time of track breakage

When vibration becomes high the breakage of track will detect. For that vibration detection accelerometer adxl335 is used. The output of the accelerometer is in analog form. It has 3 axes like X, Y and Z. When axis are varies vibrations are detected and accelerometer gives the output in the form of voltage.

6.5 Obstacle detection

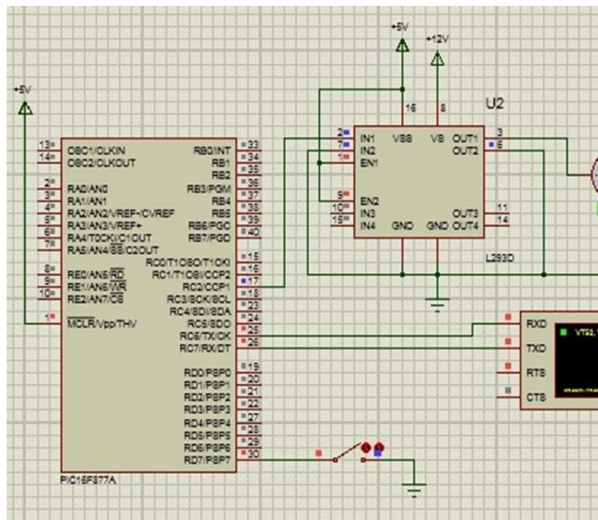


Fig 7: Speed control during obstacle detection

For the DC motor driver L293D IC is used. In this IC there are two Vcc supply. That is Vcc1 and Vcc2. Vcc1 having 5V from the power supply and the supply of Vcc2 will decide according to the DC motor used. For drive the DC motor, requires 500mA current. When obstacle is present in front of train, that image is captured by the camera. That captured image is process by viola-jones algorithm. Controller gives

the voice message to system and then speed of train becomes slow.

7. DEMONSTRATION RESULT

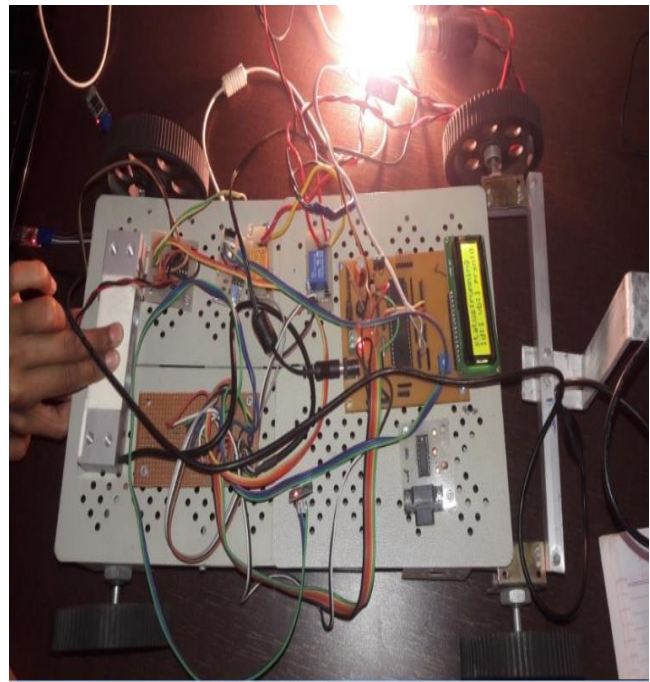


Fig 8: State of load cell, when train enters in tunnel

As soon as the train has been entered in the tunnel, with the help of AD620 load cell, lights in the tunnel have been in ON state and when train leaving the tunnel the train light will glows off

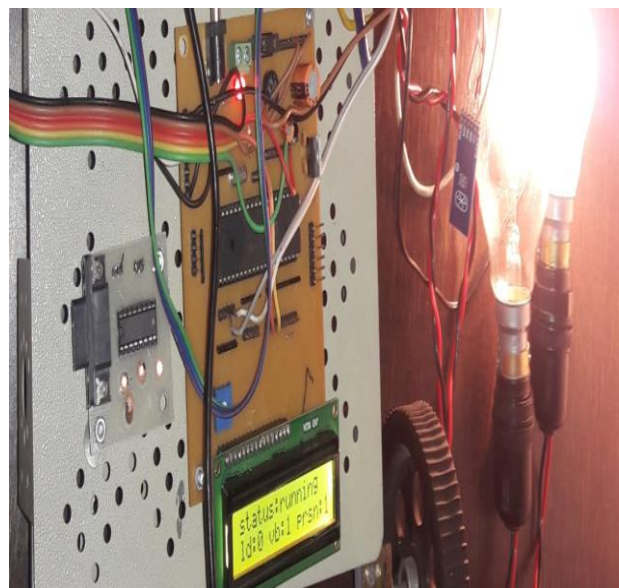


Fig 9: The state of IR sensor, In the boggie presence of person

When person is present in boggie then only

the light will be turn on this is sensed by IR sensor.
This function is followed by thw relay.

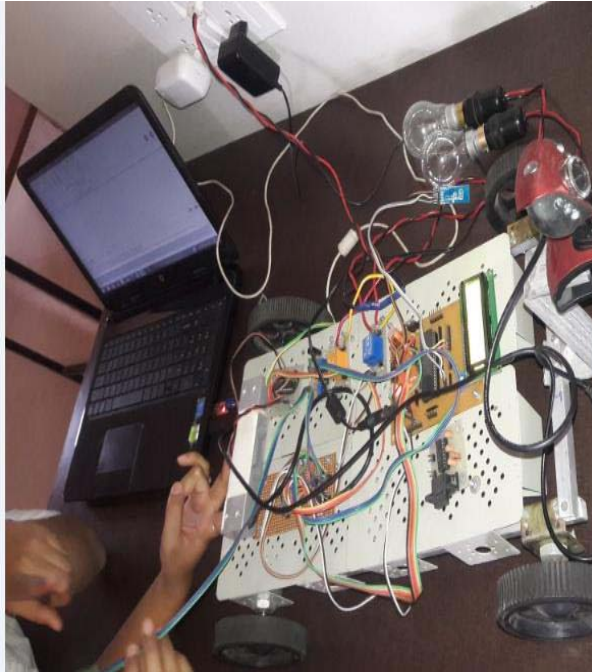


Fig 10: Hardware of complete railway accident control system.

Table I :Flow of Sensor operation..

State no.	Activated sensor or othe element	Output
1	IR Sensor (Person Detection)	“Person is Present in Boggie” Person is prent= Light on Person is absen=Light off
2	Accelerometer (Track Breackage)	“Breackege of Track” Vibration Present=Speed Slow Vibration absent=Ok
3	Load Cell	“Tunnel Light” Load Present=Light on Load absent=Light Off
4	Camera	“Person is present in front of train” Person Present=Speed slow Person absent=Ok
5	DC Motor	DC Motor starts When state 2 and 3 send messege OK.
6	Bluetooth	Wireless connection for transfer data.

In state 1 when Person is Present then the boggie light will goes on otherwise it is in off state.In state 2 if the vibration is occres then system sends the voice messege to driver and he speed of train goes decreasing otherwise train will not stop.In step 3 if the load of train is present then only the tunnel light will goes on otherwise it will off.In 4 state if the person is present in front of train then it will send the message to system and the speed of the train will goes decreasing.State 4 Bluetooth is used to send these data wirelessly to the system.

CONCLUSION

The design and implementation of Low-power real time embedded system for railway accident monitoring, controlling and energy consumption has been tested successfully. Wireless sensor network and switching circuitry are the key elements of the system. The implemented system can be used for smart india , digital india scheme.

REFERANCE

- [1] Kalpana Sharma, Jagadish Kumawat, Saurabh Maheshwari, Neeti Jail"Railway security system based on wireless sensor networks : State of the art.", International Journal of Computer Applications , Vol. 96-No.25, June 2014.ISSN:0975-8887.
- [2] S. Bhuvaneshwari, M. Hariprabhu, R. Deepika "Automatic Railway System Using Wireless Sensor", International Journal for Research in Applied science and Engineering, Vol.3, Issue 11, November 2015.ISSN:2321-9653.
- [3] M.D. Anil, Sangeetha.S, Divya. B, Niranjana .B, Shruthi.K.S. "Advanced Railway Accident Prevention System Using Sensor Networks", International journal of advanced research in computer and communication engineering, vol.3, issue5,May-2014, ISSN no: 2319-5940.
- [3] International Journal Of Informative and Research. "Automatic Railway Safety and Control using RF module". Vol.2, Issue 5, January 2015.ISSN(Online):2347-1697.
- [4] Rahul Mishra, ShahidRaza , Zulquarnain , RachnaArya, Prashant Kumar, "Development Of Automatic Person Detection System To Control Ac Fan & Room Lights." Vol. 2, Issue 3, March 2013 ISSN: 2319-8753
- [5] Jitender Grover, Anjali "Wireless Sensor Network in Railway Signalling System", IEEE Fifth International conference on communication system and network technologies, 2015, ISBN no: 978-1-4799-1797-6/15. DOI: 10.1109/CSNT.2015.28
- [6] G.Anjali bissa, S.Jayasudh, R.Narmatha and B.Rajmohan, "Train Collision Avoidance System Using Vibration Sensors And Zigbee Technology", International journal of research in engineering and advanced technology, Vol.1, Issue.1, March 2013, ISSN no: 2320-8791.
- [7] Nisha S.Punekar, Archana A. Raut, "Improving Railway safety with obstacle Detection and Tracking System Using GPS-GSM Model" International journal of science and engineering research, vol.4, issue.8, Aug-2013, ISSN no: 2229-5518.
- [8] R Karthik, Aby. K. Thomas,"Automated Train Control System with Real Time Train Tracking Facility Based On GPS and Onboard Disaster Prevention Network" , International journal of science and research, vol.3, Issue.4, April-2014, ISSN no: 2319-7064.
- [9] Emad Aboelela, William Edberg, Christors Papakonstantinou and Vinod Vokkarane. "Wireless Sensor Network Based Model for Secure Railway Operations", IEEE conference-2006, ISBN no:1-4244-0198-4/06.