Intelligent Monitoring for Train with Renewable Power Source

[1.] S. Mahendran
Assistant Professor
ECE Department

[2.] D. Dinesh Shankar
IV Yr Student
ECE Department

[3.] N. Velmurugan
IV Yr Student
ECE Department

[4.] S. Valarmathi
IV Yr Student
ECE Department

[1,2,3,4.] Erode Builder Educational Trust's Group of Institutions, Kangayam, Tamil nadu, India.

***Abstract*— As there are many demands in train wagon monitoring systems, this paper continues to advancement of technology in train safety and reliability. Due to the lack of safety in railways, there are risks in train derailment, fire accidents, failure in brakes etc. Train wheels need to be kept safe operating margins by undertaking regular maintenances. By monitoring the various parameters in wagon train safety can be enhanced. Using WSN technology, a system would be designed which can monitor the train wagon condition like wheel irregularities, fire accidents etc. The aim of this project is to develop a wireless sensor network to collect information from sensor nodes which are placed inside the individual wagon. Different sensors present in the sensor node collect different information and will be sent to the locomotive for further precautionary actions.**

Keywords*— *Renewable power source, Train derailment, Railway wagon, wireless sensor network (WSN).

I. INTRODUCTION

monitoring systems, this paper continues to advancement of technology in train safety and reliability. Due to the lack of safety in railway, there are risks in train derailment, failure in brakes etc. The railway passenger wagon of individual or combined track irregularities can be monitored. Railway track irregularities need to be kept safe operating margins by undertaking regular maintenances. Wagon monitoring enhances train safety. Monitoring real time track measurement data has been published by various research institutions. Using WSN technology we can monitor the railway passenger wagon health condition like wheel irregularities. Our aim is to develop a wireless sensor network to collect information from sensors which are placed inside the train passenger wagon. This information will be sent to the locomotive for further precautionary actions. The renewable power supply is used as power source for the entire unit. There are many train accidents occur due to fire, derailment...etc as the statistic shown in Fig [1], so we have undertaken this project to reduce the train accidents.

II. LIST OF ABBREVATIONS

CPU Central processing unit, **MAC** Medium Access Control, **MCU** Microcontroller unit, **RISC** Reduced Instruction Set Computer, **RAM** Static Random Access Memory, **WSN** Wireless Sensor Networks, **XOSC** Crystal Oscillator.

III. EXISTING METHODS

Monitoring fire accidents at coaches and other abnormalities will be tracked and processed with single processor may give output with more delay as well as slow response. Detecting cracks at rails and checking track dimensions manually cannot provide excellent results although the modern trains have come up with latest technologies to run at high speed.

IV. OBJECTIVE

Our objective of this paper is to monitor individual sensor information present in the passenger wagon and sent the information to the control unit for precaution activities through wireless sensor network.

V. METHODOLOGY

In this paper each sensor node consists of following sensors:-

Statistics

Category	Class	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Consequential	Collision	2	---	1	---	1	---	---	---	---
	Derailment	13	6	9	5	5	12	3	5	5
	L-xing (M)	1	1	---	---	1	---	---	---	---
	L-xing (UM)	1	1	---	---	---	---	2	1	2
	Fire	2	1	---	---	---	---	----	---	2
	Misc.	1	---	1	---	2	1	---	---	---
Total		20	9	11	5	9	13	5	6	9

Fig [1] Statistics of train accidents

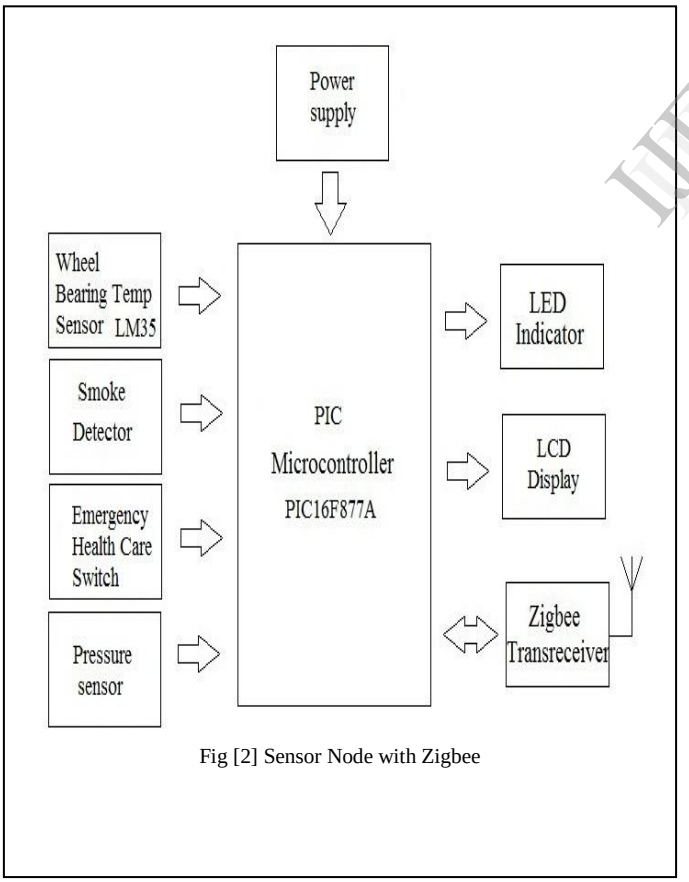

Fig [2] Sensor Node with Zigbee

VI. OBJECTIVE

Our objective of this paper is to monitor individual sensor information present in the passenger wagon and sent the information to the control unit for precaution activities through wireless sensor network.

VII. METHODOLOGY

In this paper each sensor node consists of following sensors:-

1. Wheel bearing temperature sensor
2. Pressure sensor
3. Temperature sensor
4. Smoke detector
5. Emergency switch for health care

The control unit will monitor the wheel bearing temperature, (inside passenger wagon) another temperature LM35 & smoke detector for fire alarm and a emergency switch for health care in individual passenger wagon for their medical purpose Fig [2].

This emergency switch can be used by any of the passengers to indicate the locomotive about the need of emergency health care. Fig [5] shows the renewable power source of block diagram which will be connected to the sensor nodes. Each sensor information is transmitted to the control unit in train locomotive through IEEE 802.15.4/Zigbee using WSN.

There will be a particular threshold temperature for wheel bearing and passenger wagon. If the temperature exceeds above the threshold temperature then the indicator or alarm will be triggered in the Engine Wagon Fig [3]. Pressure sensor is used to measure the pressure of wheel suspension at two wheels on same axis.

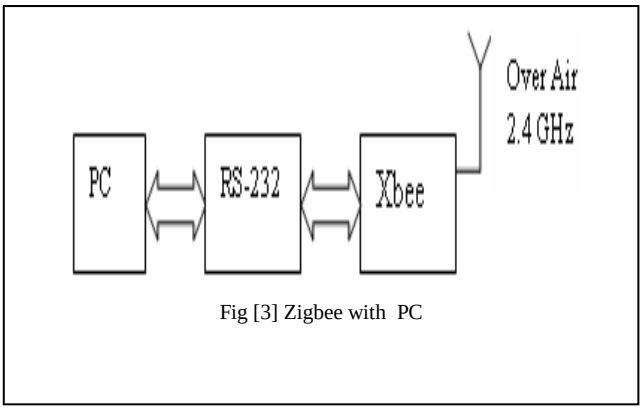

Fig [3] Zigbee with PC

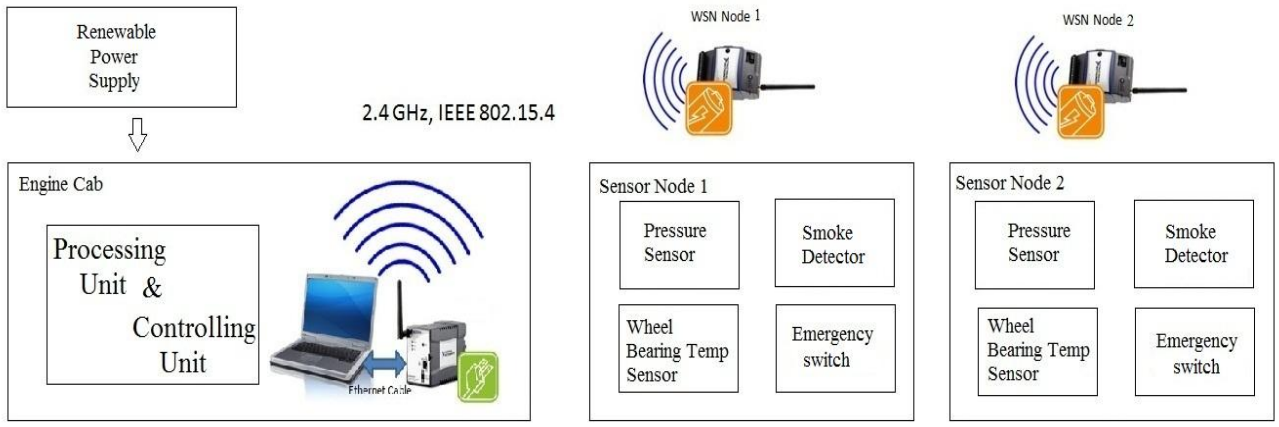

Fig [4] Overall Scenario

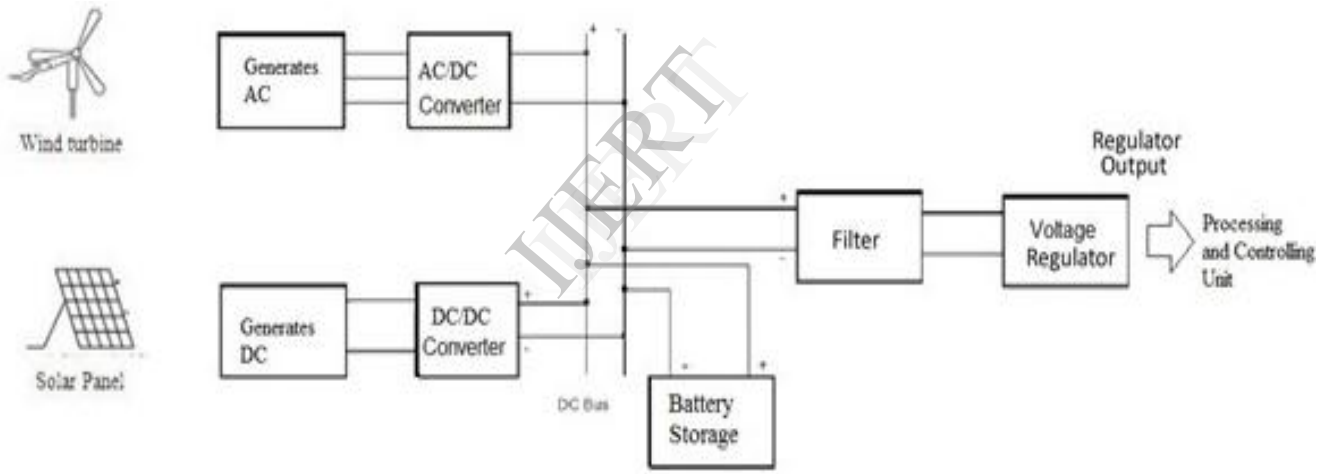

Fig [5] Renewable Power Source

A PIC controller based data acquisition system was used to display data in each wagon and sent data to the engine cab for precaution measures.

The main purpose of the data acquisition was to provide real data that represents the passenger wagon information. Data have been used to validate and demonstrate the effectiveness of signal analysis techniques and, finally to develop a model to monitor typical dynamic behavior of fire and wagon wheel irregularities.

VIII. TRAIN DERAILMENT

The train derailment is caused by primary mechanical failure of a track component broken rails, gauge spread due to sleeper, primary mechanical failure of a component of the running gear of a vehicle and also any fault in the geometry of the track components or the running gear that results in a quasi-static failure in running (for example rail climbing due to excessive wear of wheels or rails, earthworks slip) [4]. Some other factors are dynamic effect of the track-vehicle interaction (for example extreme hunting, vertical bounce, track shift under a train, excessive speed) also improper operation of points, or improper observance of signals

protecting them (signal errors)and as a secondary event following collision with other trains, road vehicles, or other obstructions (level crossing collisions, obstructions on the line).we can avoid train derailment by measuring temperature and pressure of the train wheels and maintaining the speed.

IX. WIRELESS SENSOR NETWORK

In early days, wireless modules of the sensor node were developed using Bluetooth IEEE 802.15.1 standard, which is now an outdated standard.

The data communication range of Bluetooth is only 10 m, which requires more of sensors per wagon for data communication with the locomotive. Fig [6] shows the entire scenario of communication between the sensor nodes and

control unit. The absence of energy-efficient features for data collection and communication from wagons to the locomotive makes this system less reliable. Instead of Bluetooth technology, we are considering the IEEE 802.15.4/Zigbee standard, which is an ultralow-power and low-data-rate radio standard.

Due to its simplicity and low cost, Zigbee is the most suitable standard to date for railway applications. The IEEE 802.15.4/Zigbee has communication range of 10 to100m and it is easy to communicate the sensor information to the control unit at the engine locomotive. the maximum length of the railway wagon is approx 20 m. However, Zigbee 802.15.4 is wise to be considering a cover range of approx 40 m that covers two wagons. Hence, the transmission range of the receiver is expected to be sufficient for the railway wagon as it covers 40m of wireless range [1].

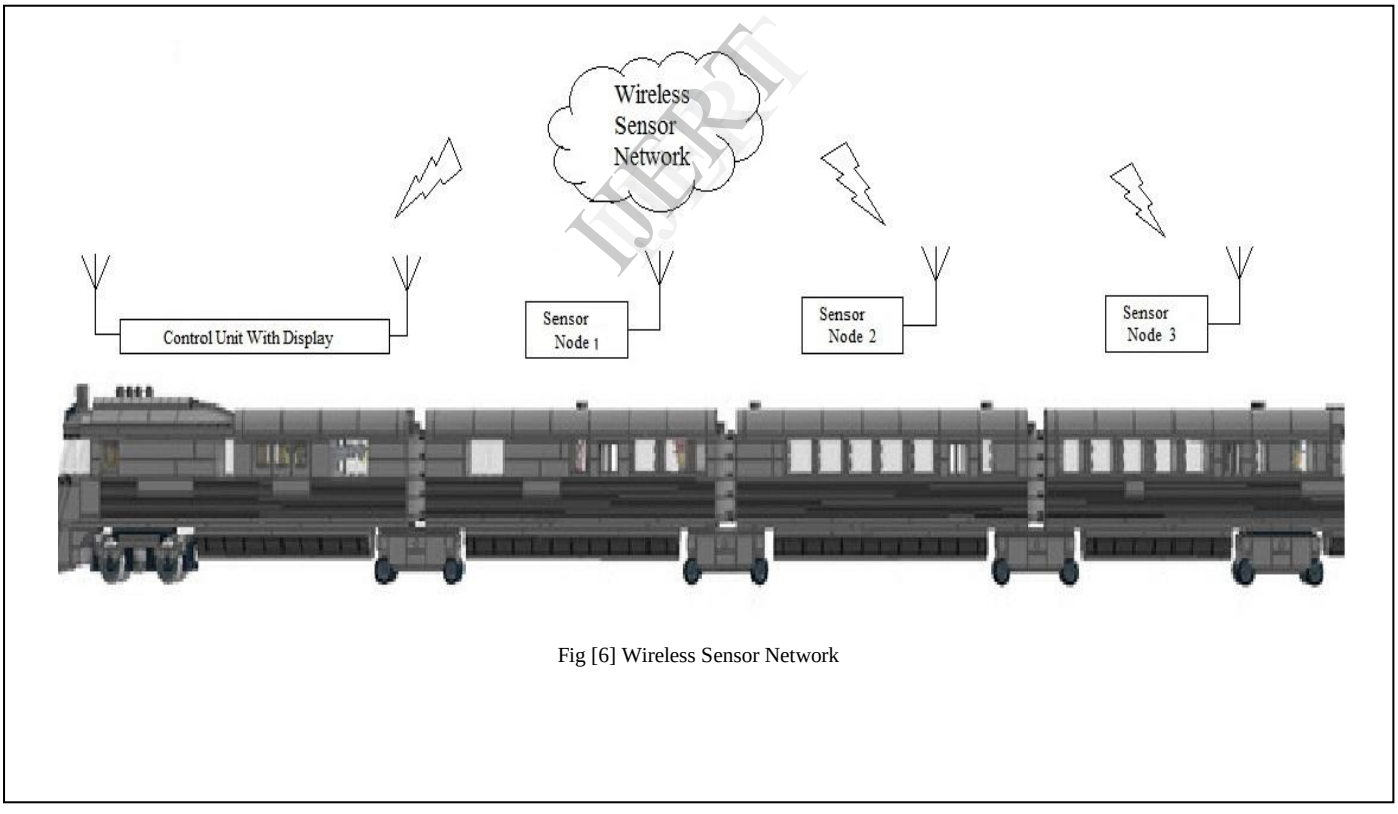

Fig [6] Wireless Sensor Network

X. CIRCUIT DESIGN

Fig [7] and Fig [8] shows the circuit diagram of single sensor node (transmitter) and pc with Zigbee(receiver).

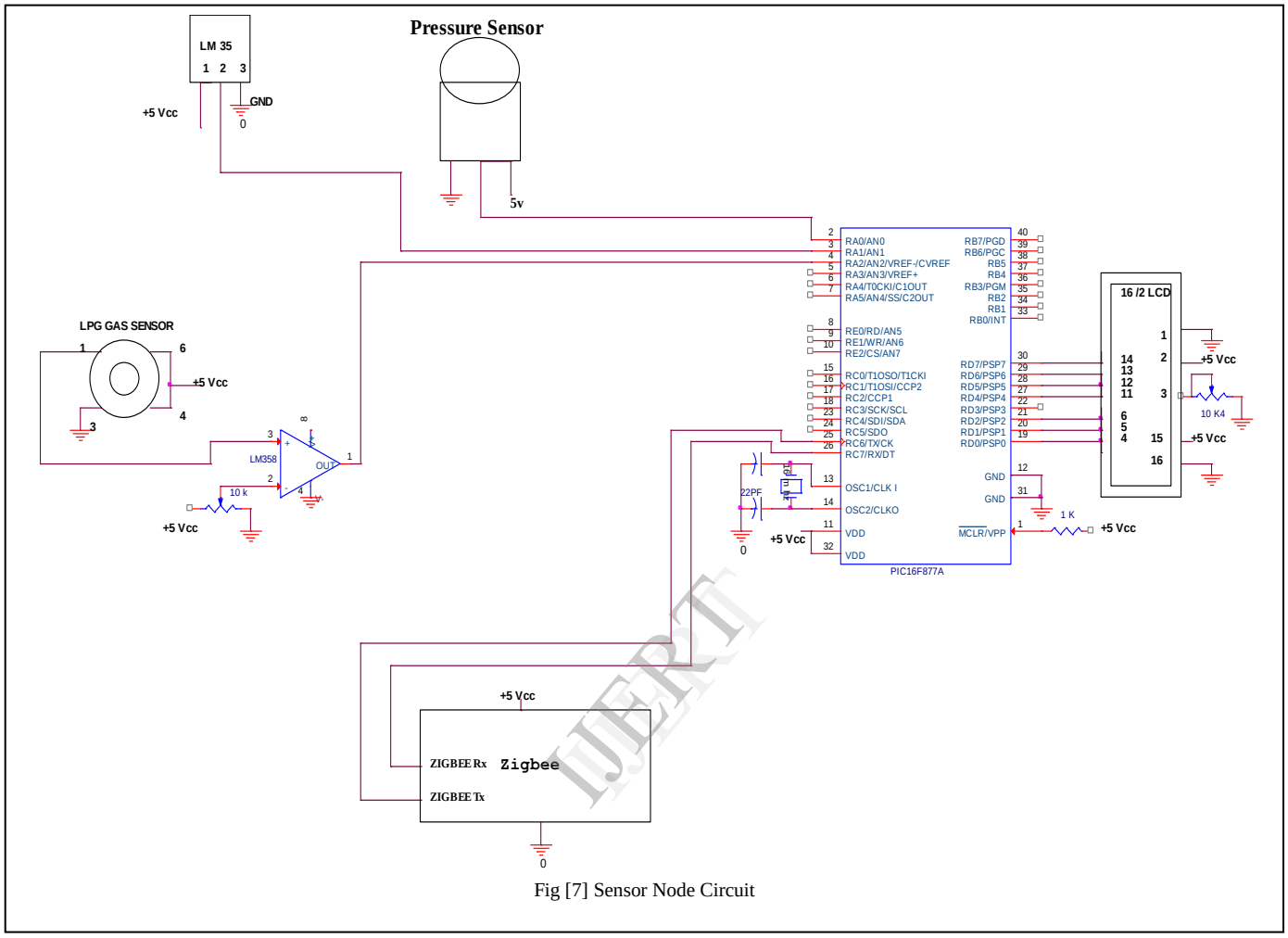

Fig [7] Sensor Node Circuit

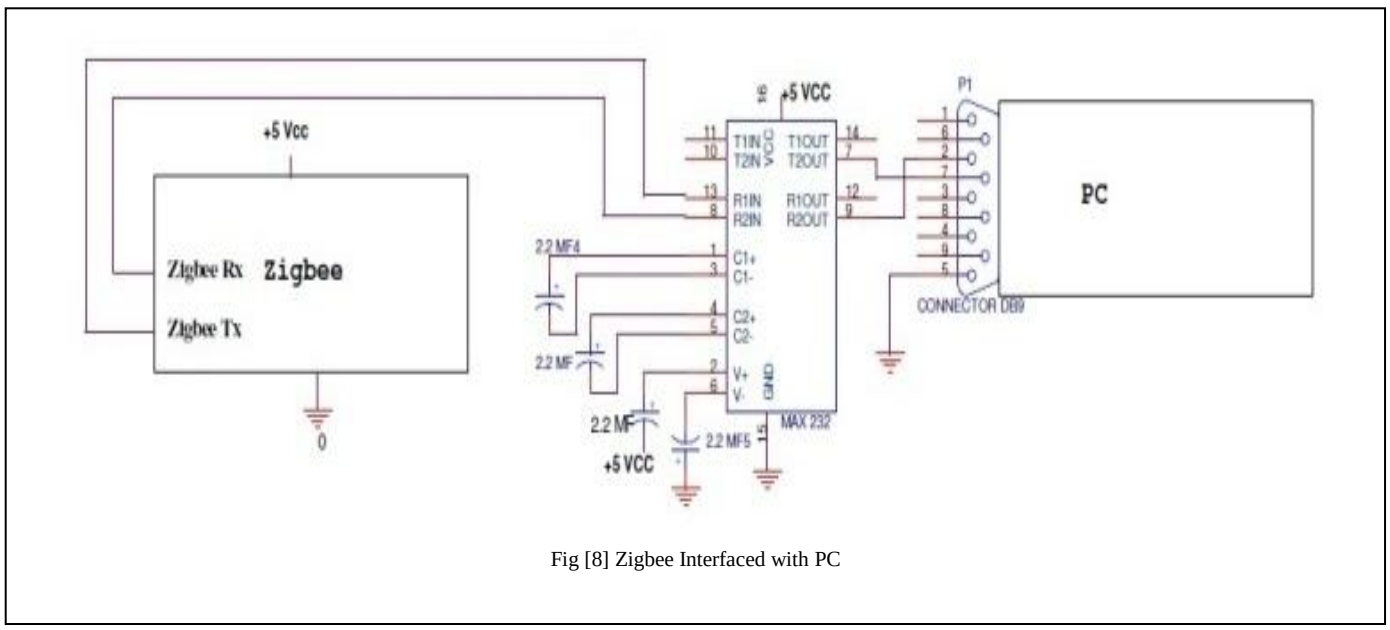

Fig [8] Zigbee Interfaced with PC

XI. RESULT OBTAINED

Sensor node with temperature, smoke detector and pressure sensor with LCD display Fig [9]. The sensor node gets the supply from the solar panel and wind mill through the back up battery Fig [10].

The Zigbee in the sensor node is used to transmit and receive the signal from and to multiple sensor nodes. Fig [11] shows simulated output with zigbee connected with PC the Micro Code Studio software is used to display the Information in the PC from the nodes using Zigbee.

Fig [9] LCD Output

Fig [10] Hardware Model

Fig [11] Simulated Output

Fig [12] shows the location of wheel bearing temperature sensor LM35 and Pressure Sensor

XII. CONCLUSION

In this paper, WSN has been investigated to monitor typical dynamic behavior of railway passenger wagons and provide security to the passenger. There are many problems in passenger wagon like wheel geometry, track dislocation, wheel crack and fire accidents. We can build a system to monitor the parameters using WSN or adhoc network for wireless communication between locomotive and wagons, we proposed a design of embedded system with more reliable and less power consumption for train operations. The data base of a train can be updated to the central railway controller room using WLAN. This proposal gives us better accuracy with better performance.

REFERENCES

[1] G. M. Shafiullah, member, salahuddin a. Azad, and a. B. M. Shawkat ali "energy-efficient wireless mac protocols for railway monitoring applications" IEEE transactions systems, vol. 14, no. 2, Jun 2013.

[2] G. M. Shafiullah, A. Thompson, P. Wolfs, and S. Ali, "Predicting vertical acceleration of railway wagons using regression algorithms," IEEE Trans. Intell. Transp. Syst., vol. 11, no. 2, pp. 290–299, Jun 2010.

[3] Ákos Lédeczi, Thomas Hay, Péter Völgyesi, D. Robert Hay, András Nádas, and Subash Jayaraman "Wireless Acoustic Emission Sensor Network for Structural Monitoring"