RAILWAY BRIDGE TRACK SURVEYING SYSTEM FOR ACCIDENT REDUCTION

Vinod Bolle[1], Prof. Santhosh Kumar Banoth[2] , Prof. Puja Khangar[3]

[1] *M.Tech student Dept. of Electronics Engineering. WCEM Nagpur, India,* Vinod123bolle@gmail.com
[2] *Asst. Professors, Dept. of Electronics Engineering, WCEM, Nagpur, India,* Santhosh.banoth@gmail.com
[3] *Head of department, Dept. of Electronics Engineering, WCEM, Nagpur, India, Puja.khangar04@gmai.com*

Abstract -As railroad bridges and tracks are a very important infrastructure, which has direct effect on railway transportation, there safety is utmost priority for railway industry. This project aims at monitoring the tracks on the bridges along with structural health condition of the bridge for accidents reduction. In this paper we introduces railway tracks and bridge monitoring system using wireless sensor networks based on ARM processor. We designed the system including sensor nodes arrangement, collecting data, transmission method and emergency signal processing mechanism of the wireless sensor network. The proposed system reduces the human intervention, which collects and transmits data. The desired purpose of the proposed system is to monitor railway infrastructure for accident reduction and its safety.

Keywords: Railway bridge and track, Base station, Zigbee, sensor nodes, Arm controller.

.1. INTRODUCTION

In India most of the commercial transport is being carried out by the railway network and therefore as any problem occurred during transportation directly affects the economy and railway operation efficiency, also consume lots if time for re-production.
Over the last few decades, Rail Transportation has become one of the most effective means of transporting passengers and goods, so the safety and reliability is highly considered. In railway infrastructure, the anytime the bridge track can be damaged due to weather conditions, floods, earthquakes, cyclone etc.
 Therefore periodic monitoring of the infrastructure is to ensure the safety of railways. The existing track surveying systems have some limitations. It takes more time and it is less accurate. The proposed system immediately notifies the cracks in the track and informs to the railway authority and hence can reduce the train accidents due to cracks in the tracks. It also monitor the structural health condition of the bride along with track give through wireless sensor network thus increasing the safety of bridges.

 The proposed system consists of sensor nodes(SN), which consist of large no. of nodes, each capable of sensing, processing and transmitting information, which is use for structural health monitoring of bridge and railway track on the bridge. SN can provide continues real time data collection and transmission. It increases monitoring efficiently as compared to manual inspection. It improves data accessibility, transmission and data management.

This paper proposed a monitoring of the bridge structures and tracks on the bridges using sensor network helpful to avoid any accident.

2. System Framework

In the proposed monitoring system we placed different sensors at different places on the railway track and bridge according to requirements. The designed monitoring system divided into three sections –

1. System on field
2. Transmission of data
3. Receiver section

2.1 System on field

The monitoring of condition of railway infrastructure is uppermost priority of this system. The proposed system continuously monitor the condition of the bridge structures and tracks on the bridges, collect the information and efficiently transfer to the monitor center through base station. In this paper, the arrangement of the system is divided into two parts : the sensor node mount around railway track line and the sensor node mount on the bridge.

a. The sensor node mounted around railway track line

Track monitoring system is very important for collection of data for maintaining the safety. In this mode sensors are mount on different places. Like to detect vibration on track accelerometer mount on track, for detection of crack and fatigue Acoustic emission (AE)sensor can be deploy on track .for Analyzing the vibration data produced by accelerometers on the track, data from AE(acoustic emission) sensors the condition of track can be monitor. This collected data is then immediately delivered to the nearest monitor centre so that the monitor center can process the real-time data of the tacks and bridge structures.

b. The sensor node mounted on the bridge

The important task of the sensor nodes mount on the bridge is to monitor any defects on structures. In Bridges any defects occur due to passing of heavy load trains and constant strain. The sensor nodes placed at different position enable monitoring of the structure including the internal structure of the bridge.

The various MEM'S sensors for monitoring structural changes in concrete like- for crack and fatigue detection we used piezo-based acoustic emission(AE) sensors , to analyze the static loads and stresses we used strain gauges sensors , to analyze dynamic loads as trains pass accelerometers used and temperature and humidity sensors to determine ambient conditions.

On the lower bridge and inside of the surrounding soil temperature extreme weather , also uses of pressure sensor and other sensor are use sensors can be placed to monitor the changes of soil in to keep record and to monitor the overall condition of the bridges.

2.2 Transmission of data

In this mode various data from different sensor nodes which are placed at different section of tracks and bridge are collected and transfer to base station. The base stations control the sensor nodes and act as a gateway for data transmission to monitor center. The collected data is transfer to the base station with the help of wcommunication such as zig-bee network. Zig-bee is a kind of wireless, short distance communication system having advantage of low power consumption. The collected data from base station is transmit to monitoring center through GPRS network. If sensors detect any defects on the track or bridge, the base station will immediately inform to the monitor center.

2.3. Reception of data

The transmitted data from base station is received at monitor center. The arrangement is made such that when emergency signal is transmitted, it will also received by loco pilot of the train so to avoid accident. The monitor center is to receive, storage, process the data is categories into four general methods such as performance, complementarity, complexity and speed.
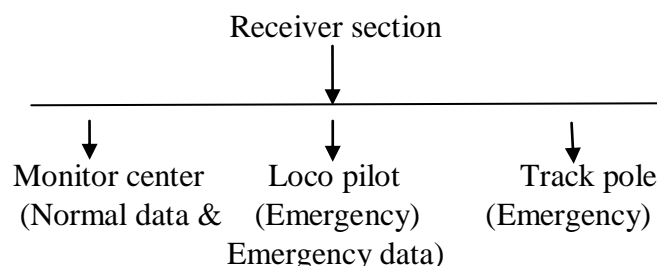
3. Working Principle

The proposed system categorized in two sections

- Transmitter section
- Receiver section

    The transmitter section is placed on the field. It consists of different sensors which mounted at different position on and along the track and some are placed at different section of the bridge. Transmitter section also consists of Base station. The base station controls the sensor nodes and acts as a gateway for data transmission to a remote server. The different sensor nodes connected to base station through wired network. The base station uses GSM Module for long range communication such as GPRS. GPRS is used to transmit collected data back to control center. The transmitted information received by Receiver at monitoring center. This data is processed and stored by the authorized staff persons of railway.

3.1 Receiver section

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                              Receiver section
                                     │
                                     ▼
        ┌────────────────────────────┬────────────────────────────┐
        ▼                            ▼                            ▼
   Monitor center              Loco pilot                    Track pole
   (Normal data &             (Emergency)                  (Emergency)
    Emergency data)
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The transmitted data received by the section. One section is monitor center which directly receive data and process it. Another section is Loco pilot. Who get status of the track on bridge whenever it passes through it. The received data also categorized as normal data and emergency data. The normal data is regularly transmitted and processed by the monitor center. If there is any fault on the track the emergency signal is transmitted to the three section , monitor center, loco pilot and track pole.
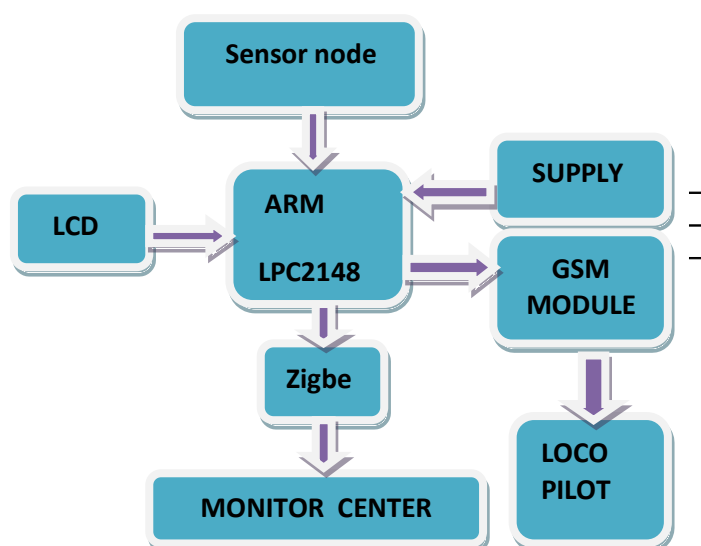
3 .2 Architecture of system

Fig.1 System structure

WSNs enable the continuous real- time monitoring of data. The proposed system bases on ARM microprocessor which enables the collection and transmission of information through ZigBee and GPRS module.

The LPC2148 microcontroller based on 32/16 bit ARM TDMI. It have 8 to 40 kB of on-chip static RAM and 32 to 512 kB of on-chip flash program memory.128 bit wide interface/accelerator enables high speed 60 MHz operation. Multiple serial interfaces including two UARTs, two Fast I2C-bus, SPI and SSP with buffering and variable data length capabilities.

 The ARM processor receives the data form sensor nodes through ZigBee network. The data then transfer through GPRS network on internet to monitor center
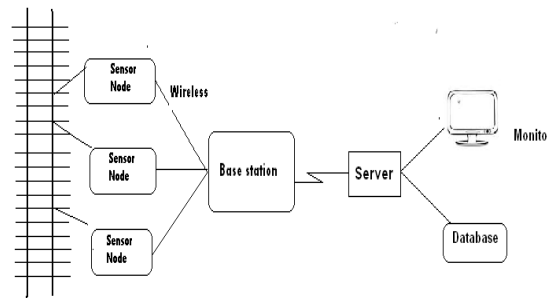
fig.1 System framework

Different sensor node collects data and transfer to base station. It can communicate with each other between different nodes. It uses Zigbee communication network to create a network which are used to collect information such as inclination in bridges, bridge cracks ,pressure on bridges, track condition etc. these data transfer to base station. Base station collects information from all the nodes and transfer to monitor center through GPRS network system.
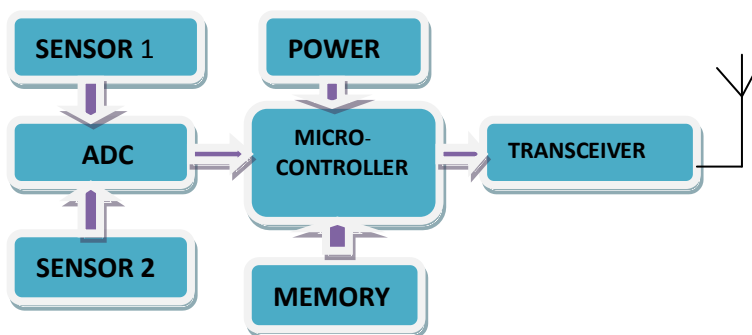
4. Sensor node

Figure. 3 Composition of typical sensor nodes

Many sensor nodes are deployed on the different places on the tracks and the different section of the bridges. These sensor nodes collect information and transfer to the base station. A typical senor node consists of a microcontroller, one or more sensors, data storage (memory) and a power source, transceiver,

5. Literature survey

1. "Wireless Sensor Networks for condition monitoring in the railway industry: A survey"
Vol.16 No.3 June 2015 IEEE, Anthony Mould , Michael Weeks, Hodge and Victoria J.

-This paper introduce various wireless sensor network technology for infrastructure monitoring in the railway industry for various purposes. This paper focus on identification of various sensor for various applications. Identification of sensor networks and various network topologies. Also this paper reviewed the distance limitation of WSNs used for condition monitoring in the railways.

2)"Research on the Railroad Bridge Monitoring Platform Based on the Internet of Things"
IJCA VOL.7 NO.1 2014 "Ying sun "

-This paper introduces methods for monitoring the railway bridges based on internet of things.

-Introduces various sensors and their deployment on the bridge and on the railway track. Successfully tested in railway corporation.

3)"An Innovative Railway Track surveying System for Accident reduction"

IJSETR ISSN2319-8885, VOL.03 DEC 2014 V.Radha , Ch. Sreedevi, V.Sandhya

-This paper introduces the multi sensor railway track geometry surveying system. Multiple sensors such as IR sensors and MEMS sensors to check status of railway tracks.

-The crack detection is performed by LED-LDR combination. The object detection is done through IR sensors. The MEMS sensors are used for vibration detection.

RESULTS

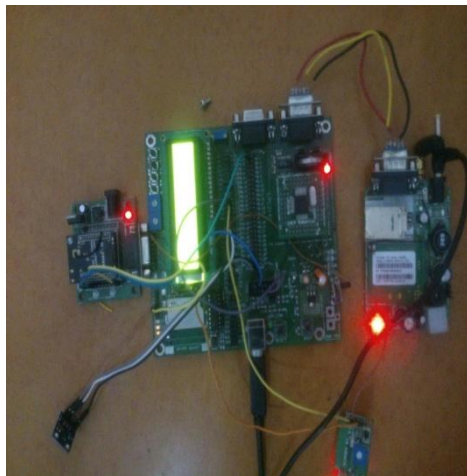1. **STRUCTURE OF THE COMPLETE HARDWARE**
   1.1 Transmitter section

Fig. Shows the hardware diagram of the transmitter section with sensors

1.1 Receiver section

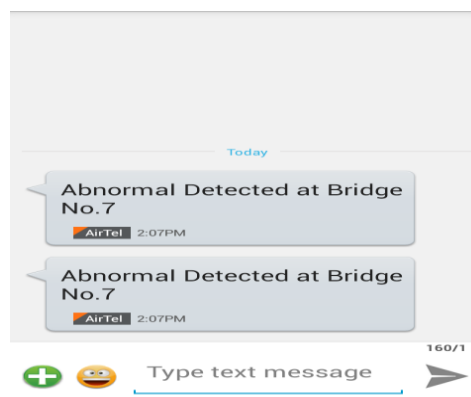2. **SNAPSHOT OF "MESSAGE ALERT SIGNAL TO LOCOPILOT"**

Fig. Showing message alert signal to Loco pilot
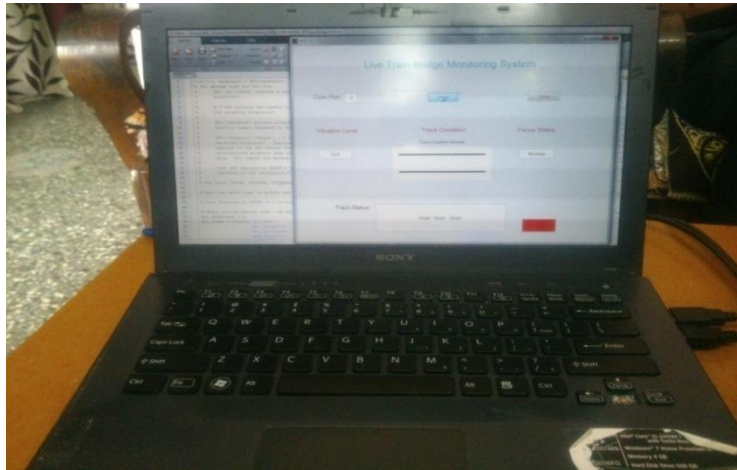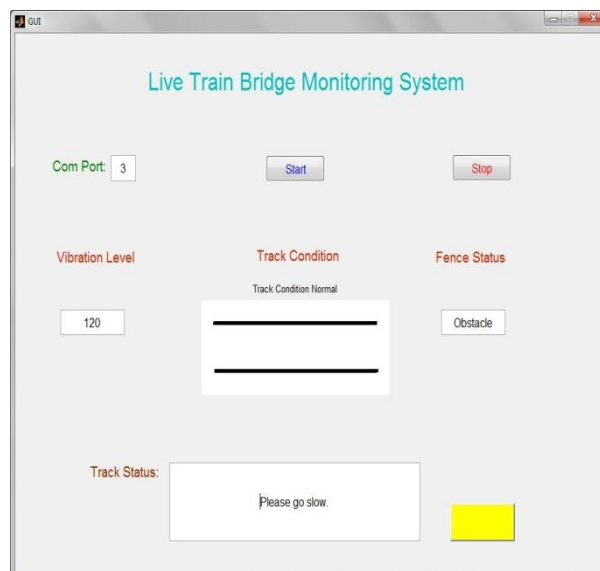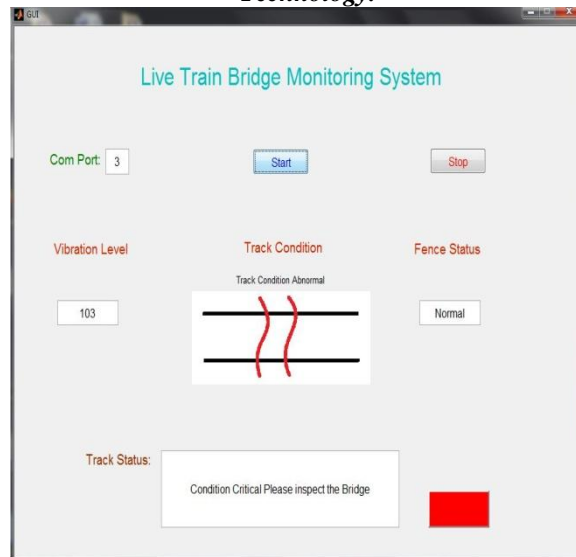
3 SNAPSHOT OF "MONITORING CENTRE OF SYSTEM"

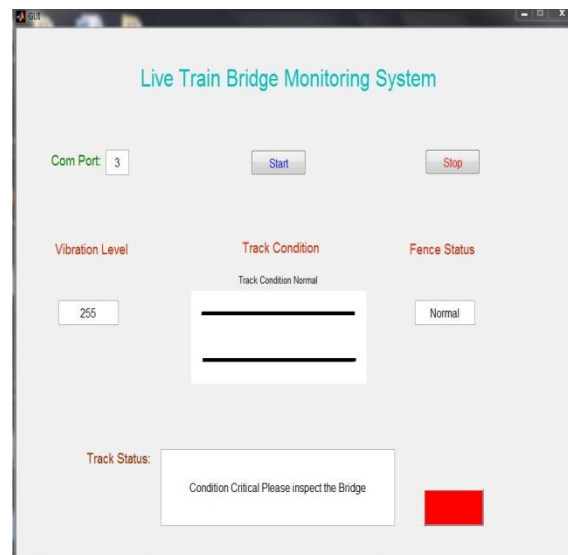Fig.22 Shows the Monitor centre of the receiver section

4. SNAPSHOT OF "OBSTACLE DETECTED ON THE TRACK"

5. SNAPSHOT OF "FAULT OCCURRENCE ON TRACK"

6 SNAPSHOT OF " VIBRATION LEVEL DETECTION"

6. Conclusion

This paper mainly focuses on condition monitoring of bridge structure and tracks on the bridge for avoiding any accidents. The proposed system automatically detects the faulty rail tracks and defects in the bridge structure which immediately transfer to the monitor center. A railway infrastructure health monitoring application that uses WSNs consists of three sections: wireless sensor's arrangements information collection, transmission and emergency signal processing. .

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8. Biographies

1. Mr. Vinod S. bolle

B,E in Electronics & Communication Engineering (2014)
From M.I.E.T Gondia
Student of M.Tech 4th Semester (Electronics Engg.),

Wainganga College Of Engineering & Management. Nagpur.

Mail id:- vinod123bolle@gmail.com

2. prof. Santhosh kumar banoth

M.Tech in VLSI DESIGN FROM VNIT NAGPUR
B.TECH in Electronics and Communication, Hyderabad.
Faculty of Electronics and Telecommunication department, Wainganga College of Engineering and Management, Nagpur.Mail id: -
santhosh.banoth@gmail.com