ITS based railway track monitoring and accident avoidance using smart sensor technology

Komal patil, Prachi Tilekar, Damini Wadgaonkar, Mrs.Swati Patil

Abstract—— The increased growth in the railway sector has resulted in an increase in the train traffic density across the world. This project work is aimed towards addressing the issue by developing and automatic railway track crack detection system using signal processing technology. This has resulted in the increase in the number of accidents involving trains. Manual detection of tracks is not fully effective, owing to much time consumption and requirement of skilled technicians. This project will work without human interference. In this project, the proposed system includes several features which prevent train accidents. It includes automatic speed controlling in curves, crack detection, soil moisture detection and track continuity. This system makes use of soil moisture sensors, signal processing technology and other embedded systems.
Key Words: Signal processing, crack detection ,embedded system, soil moisture sensor, track continuity, RF module, wireless communication

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1 INTRODUCTION

India is the fourth largest railway network in the world. Indian rail network is still on the growth trajectory trying to fuel the economic needs of our nation. However, in terms of the reliability and safety parameters, we have not yet reached truly global standards. Cracks in rails have been identified to be the main cause of derailments in the past, yet there have been no cheap automated solutions available for testing purposes. On further analysis of the factors that cause these rail accidents, recent statistics reveal that approximately 60% of all the rail accidents have derailments as their cause, of which about 90% are due to cracks on the rails either due to natural causes (like excessive expansion due to heat) or due to antisocial. The presented system helps to detect the flaws in the rail track using ground and VCC testing method. When the crack is detected, signals are sent to the nearest station. This recording and sending of signals are done by RF module. Ground and VCC technique is the most effective method which detects minor cracks and also calculates the growth rate of the crack. The growth rate can be detected at regular intervals. Cracks in rails have been identified to be the main cause of derailments in the past. Hence, owing to the crucial solution of this problem, we have worked on implementing an efficient and cost effective solution suitable for this application. This system automatically detects the faulty rail track without any human intervention. The main aim of project is to design and develop an automatic rail crack detection system based on signal processing technology.

2.COMPONENTS OF RAILWAY TRACK MONITORING SYSTEM

Fig -1: system block diagram
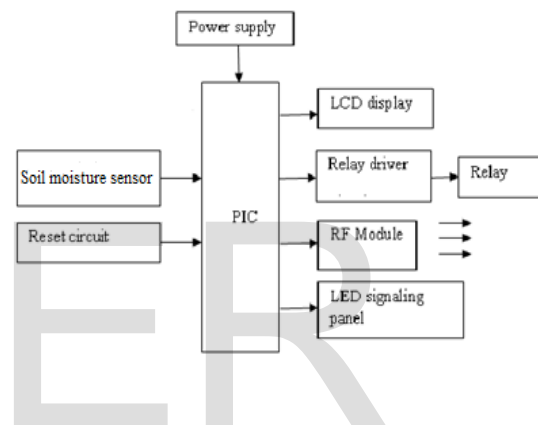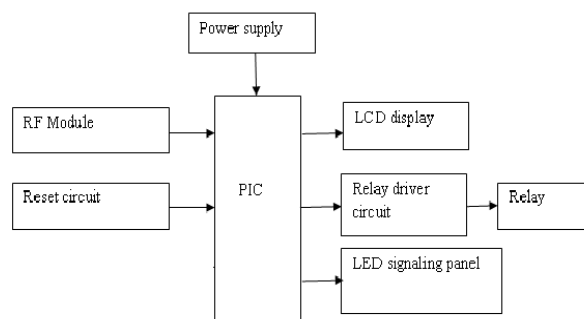

Fig -2: block diagram of track unit

Fig -3: block diagram of station unit

2.1.PIC MICROCONTROLLER

A microcontroller is a small computer on a single integrated circuit consisting internally of a relatively simple CPU, clock, timers, I/O ports, and memory. Microcontrollers are used in automatically controlled products and devices. Microcontrollers are designed for small or dedicated

applications. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes.

2.2.CRYSTAL CIRCUIT
This circuit gives the required clock pulses to the microcontroller to give it the sense of the reference time.

2.3.RESET CIRCUIT
This circuit gives the microcontroller the starting pulse required to start the operation from the start. Unless this pulse is given, the microcontroller doesn't start functioning.

2.4.LCD
Used for displaying various messages unlike seven segment display which can display only numbers and some of the alphabets.

2.5.MAX232
MAX232 IC is used for serial communication. Each receiver converts TIA/EIA-232-E C levels into 5V TTL/CMOS levels. Each driver converts TTL/CMOS levels into TIA/EIA-232-E levels.

2.6.SOIL MOISTURE SENSOR:
This sensor can be used to test the moisture of soil, when the soil is having water shortage, the module output is at high level, and else the output is at low level.

2.7.RF MODULE:
RF refers to radio frequency, the mode of communication for wireless technologies of all kinds, including cordless phones, radar, ham radio, GPS, and radio and television broadcasts.

2.8.RELAY:
Relay acts as a switch which is used to control the 230 volt AC supply. This relay can be used to turn off the electrical appliances like fan, tubes etc.

2.9.RELAY DRIVER CIRCUIT:
It is used to drive relay. In order to drive the relay, we use transistor and only less power can be possibly used to get the relay driven. Relays are electromagnetic devices which allow low-power circuit to switch a high current ON and OFF switching devices with the help of an armature that is moved by an electromagnet.

3 .WORKING
The track unit continuously check the continuity of the railway track. In this system we have use the concept of grounding. Hence if the track is cut, ground will also automatically get cut. Once the ground is cut, the message will

immediately send to the station unit through the RF module as well as the train drivers come to know about the track cut through the LED indication poles.

4.RESULT
Here are the results of the station unit and track unit. It shows the LCD displaying the message simultaneously at station as well as track unit.
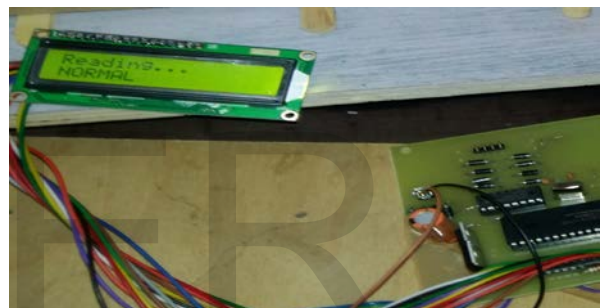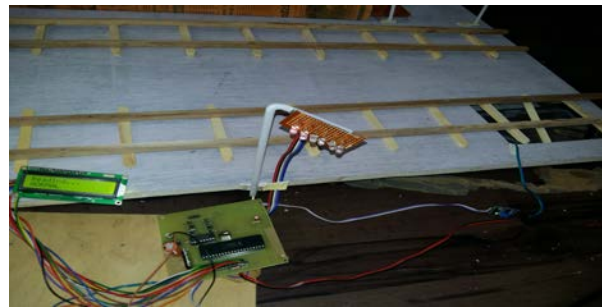

Fig -4: When track are in normal condition

The above photo depicts the initial blinking of the LCD of the track unit. When the tracks are in normal condition, then it display 'NORMAL'

Fig 4 shows that the crack is detected and it is then simultaneously displayed at station as well as track unit so as to alert the station master along with the train driver. Similarly, if crack is detected in another track, then it will display 'crack 2 detected'.
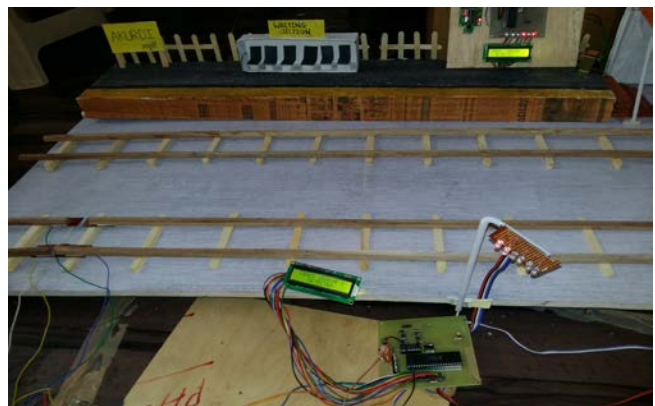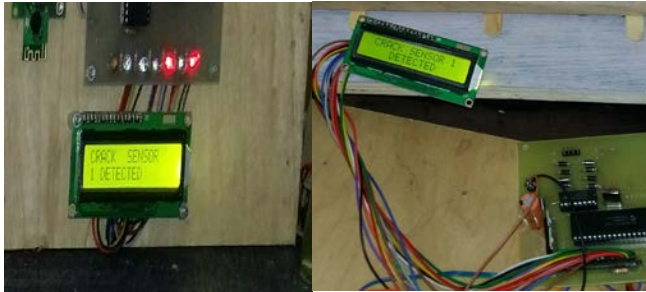
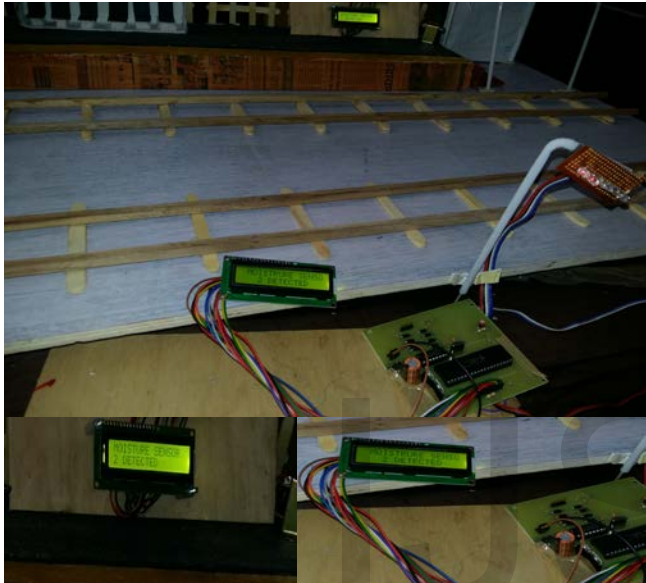**Fig -5**: Crack detected

Fig -6: Moisture sensor detected

One of the reason of derailment is increase in water molecules content in the soil which would led to bending of tracks. When this water molecule level crosses the threshold level of the soil moisture sensor, then that will also be alerted to the track and station units. fig 5 shows the moisture sensor detected.

5. CONCLUSIONS

By using this technology for the purpose of railway track inspection and crack detection, it will have a great impact in the maintenance of the tracks which will help in preventing train accidents to a very large extent. The regions where manual inspection is not possible, like in deep coal mines, mountain regions and dense thick forest regions can be easily done using this technology for the purpose of railway track inspection and crack detection. This will help in maintenance and monitoring the condition of railway track without any error and thereby maintaining the tracks in good conditioning, preventing train accidents to very large extent railway track crack detection system is designed in such a way that it detects the crack or deformities on the track which when rectified in time will reduce train accidents.

6. ACKNOWLEDGMENTS

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