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IoT BASED RAILWAY TRACK MONITORING SYSTEM USING ULTRASONIC SENSOR

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Abstract: **High speed railway has achieved remarkable development in China and safety monitoring of high speed railway is becoming an important research .Man has been developing various methods to protect himself from natural calamities since ages. The only scientific solution to natural calamities is development of systems to predict, detect and take preventive measures using recent advancement in technology. Along the highly landslide prone Konkan railway line, many people have lost their lives due to landslides. It is now high time to replace the present obsolete manual detection systems deployed along this line. Development of high-speed railroad transport in Russia imposes strict requirements to the railway flaw detection systems. Most of all those requirements apply to the measurement of dynamic interaction between the rail car and the railway. Raspberry Pi is used to control all the operations. The system is based on the principle of IOT. Location is tracked by using GPS Module. Currently railway track inspection and monitoring is done manually which is time taking and not accurate, due to the high chance of human error occurrence. Moreover, practically it is impossible to inspect and monitor the railway track manually as they run thousands of miles. To avoid this we propose a prototype system, designed for continuous monitoring of railway tracks using a combination of sensors. These sensors collect data and through computational analysis faults in the railway tracks are identified. The collected data can help in finding cracks in the tracks and catastrophic accidents can be avoided.**

Keywords *– Raspberry Pi, IOT, Webcam Monitoring ,GPS(Global Positioning System)*

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I INTRODUCTION

The Indian Railway has one of the largest railway networks in the world , crossing over 1,15,000 km in distance ,all over India .A recent study revealed that over 25% of the track length is in need of replacement due to the development of cracks on it. In the rapidly flourishing country like India, accidents in the rail road railings are increasing day by day. Timely detection and identification of faults in railway track circuits are crucial for the safety . Project deals with one of the track monitoring method to avoid train accidents . To avoid accident and to safeguard the people. It is high time to replace existing manual inspection of tracks with modern technology. It will also reduce inconvenience to passengers with efficient functioning of railway and maintaining scheduled train timing. This system also proposes a real time system which can monitor landslides and send warning signals to the concerned authorities.

Railway is one of the most used mean of transportation . For the railway system to operate constant monitoring and inspection of railway tracks is required . Currently railway track inspection done manually which is time taking and not accurate, due to the high chance of human error occurrence .To avoid the accidents we proposed this system which is an efficient method for railway track monitoring system. Our present Model is a minor attempt to find out how the aforesaid idea can be implemented. Though this model will not serve the purpose of actual commercial use, yet it is sufficient to show the way through which we can proceed to make the Train Systems completely automatic with the aid of Electronics. The detection of cracks in rails is a challenging problem, and much research effort has been spent in the development of reliable, repeatable crack detection methods for use on in-service rails. While crack detection in the rail head and shear web is reliably achieved using ultrasonic and eddy current methods, neither technique is particularly effective for the detection of cracks in the rail foot.

In our "Indian railway system" all the control system are done through Manpower. In this present condition we must have faced the following problem.

- Wastage of time
- Wastage of energy
- Difficulty for a manual operator

To overcome these problems we are going to proposed a system which gives best method for prevention and safety of passengers .

II HARDWARE-SOFTWARE REQUIREMENT

Hardware- Raspberry Pi3 model-B, IR sensor, Ultrasonic Sensor or GPS module.
Software– MPLAB IDE,PROTEUS

III SYSTEM DESCRIPTION

Figure 1 shows the block diagram of the desired system. There are two modules

1) Monitoring System 2) Train System

1) Monitoring System

This system is in moving position. We pass this system before the train is passed. We have to use three sensors. One IR sensor used for line follow and to detect the obstacle on the track and two ultrasonic sensors are used for measuring the perpendicular distance and according to that convey message to Raspberry Pi whether the crack or any obstacle is detected.

First we set some threshold range of distance. When the distance is increased or decreased then definitely there is any obstacle or crack. There is synchronization between the monitoring system and train system ,So this information of crack detection is send to train system which is implemented on railway and all the stations between the source station and destination station. GPS module is able to update location of monitoring system continually. There is also a Wi-fi connectivity for internet access.

2) Train System

Train System is placed on the train. It consist of Raspberry pi module B, GPS module and wi-fi connectivity. This is in synchronization with monitoring system . When it get signal that is track is detected then will be stop.

A. Block Diagram

B. Block Diagram Description at user end

- Ultrasonic Sensor(HC-SR04)

The limitations of methods in their ability to detect defects in the rail foot, especially in the side edges away from the region directly below the web and how the LRUT method provides a significant improvement for the same[7]. Long Range Ultrasonic Testing (LRUT) technique is proposed as a complimentary inspection technique to examine the foot of rails, especially in track regions where corrosion and associated fatigue cracking is likely, such as at level crossings. LRUT technique is found to be suitable for examining inaccessible areas of railway tracks such as areas where corrosion occurs and susceptible areas of fatigue cracking.

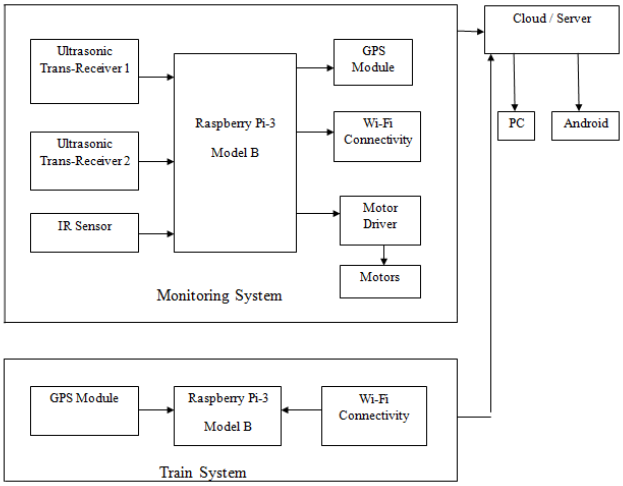

Figure 1 Block diagram of System

In different parts of the rail section (such as head, web and foot) properties of guided waves are used and are examined for their capability to detect defects in each part[7]. A suitable array of transducers is developed that is able to generate selected guided wave modes in rails which allow a reliable long range inspection of the rail. The characteristics of ultrasonic guided waves in the rail complex geometrical profile have been identified [3].

Figure2: Ultrasonic Sensor

- IR Sensor HDLC-4260

An infrared sensor is an electronic device , that emits in order to sense some aspects of the surroundings .An IR Sensor can measure the heat of an object as well as detect the motion. In the infrared spectrum ,all the object radiate some form of thermal radiations .These type of radiations are invisible to eyes , that can be detected by an infrared sensor [5].

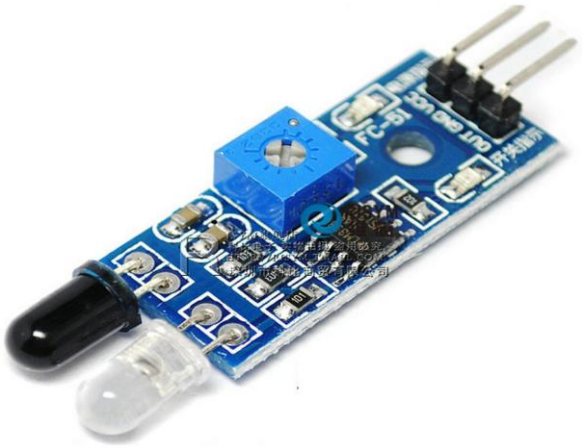

Figure 3: IR Sensor HDLC-4260

- GPS Module

This project consists of GPS module, IoT, IR sensor for application of communication purpose, crack detection and MONITORING in the railway track. The GPS module and IoT help us to find and sending railway geometric parameter of crack detection to nearest railway station. In the present of days we are using the measurement of track distance by using high cost LVDT with less accuracy, but we use the less cost IR sensor for above process with high accuracy[3].The importance of this project is applicable both day and night time detection purpose. In this project IR sensors will sense the crack that signal will send to the microcontroller. Microcontroller will send signal to the GPS. Again the information that is collected by the GPS modem is passed to the microcontroller. The information provided by the GPS module of ARSMS[4].

Figure 4: GPS Module

- Raspberry pi

The Raspberry Pi is a series of credit card-sized single-board computers developed in the United Kingdom by the Raspberry Pi Foundation. Several generations of Raspberry Pis have been released. The first generation (Pi 1) was released in February 2012 in basic model A and a higher specification model B. A+ and B+ models were released a year later. Raspberry Pi 2 model B was released in February 2015 and Raspberry Pi 3 model B in February 2016. These boards are priced between US$20 and 35. The Foundation provides Raspbian, a Debian-based linux distribution for download, as well as third party Ubuntu, Windows 10 IOT Core, RISC OS, and specialized media center distributions. It promotes Python and Scratch as the main programming language, with support for many other languages. The raspberry pi board comprises a program memory (RAM), processor and graphics chip, CPU, GPU, Ethernet port, GPIO pins, Xbee socket, UART, power source connector. It also requires mass storage, for that we use an SD flash memory card. So that raspberry pi board will boot from this SD card similarly as a PC boots up into windows from its hard disk.Essential hardware specifications of raspberry pi board mainly include SD card containing Linux OS, US keyboard, monitor, power supply and video cable. Optional hardware specifications include USB mouse, powered USB hub, case, internet connection, the Model A or B: USB WiFi adaptor is

used and internet connection to Model B is LAN cable.

Figure 5: Raspberry pi

- Motor Driver(L293D)

L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal.

Figure 6: Motor driver

This higher current signal is used to drive the motors. L293D contains two inbuilt H-bridge driver circuits.

In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively. Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their inputs. Similarly, when the enable input is low, that driver is disabled, and their outputs are off and in the high-impedance state.

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