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Innovative Railway Track Surveying With Sensors and Controlled By Wireless Communication

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Abstract

Micro Electro Mechanical Switch (MEMS) are small integrated devices or systems that combine electrical and mechanical components. These sensors are used by many engineering disciplines because of their high-precision characteristics. In addition, Global positioning System (GPS) receivers are widely used in geodesy. In this project we use multiple sensors such as ultrasonic sensors and MEMS to check the status of the railway tracks and RF modules are used to transmit and receive the signal from one section to another. This project is a cost effective yet vigorous solution to the problem of railway track geometry survey utilizing a method that is unique in the sense that while it is simple, the idea is completely novel and up till now untested. The project discusses the technical and design aspects in detail and also provides the proposed Innovative railway track surveying with Sensors and controlled by wireless communication. This project also presents the details of the implementation results of the utilizing simple components inclusive of a GPS module and MEMS based track detector assembly.

Keywords: *MEMS, GPS,ULTRASONIC SENSORS.*

1. Introduction

Depending on recent developments in railway systems, high-speed trains are being extensively used, and rail transportation is being increased. Reasons for this increase are high speed, economical, environment friendly, safety, and modern characteristics of railway systems.

In railway tracks, anytime the track is damaged due to weather conditions, floods, earthquakes, cyclones etc. The existing track surveying systems have some limitations. It takes more time and it is less accurate. In this project, 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. Thus by placing the robot in each station and checking at uneven intervals will help to reduce train accidents. The robotic section in the proposed system consists of multiple sensors such as ultrasonic sensor which finds the cracks on the track and MEMS sensor which detects the shakes. This section mainly consist of GPS module which is used to find the exact position of the crack and RF modules for transmitting the information to railway authority and to receives the controlling signals from railway authority.

A vast majority of the work done in the field of crack detection uses the infrared sensing technique and It is a well understood technique so much so that it was initially thought to be the best solution to the problem of crack detection, but later it was found to be prone to external disturbances and hence came to be considered inaccurate. They can only inspect the core of the track that is it cannot check for surface and near surface cracking where most faults are usually located. The introduced surveying system in this paper is operational on both ballast and slab tracks. The system can be operated in tunnels without interruption.

This project proposes a cheap, novel yet simple scheme with sufficient ruggedness suitable to the Indian scenario to track geometry survey by using multi sensor, which proves to be cost effective as compared to the existing methods.

2. Related Works

There exist some works in the field of crack detection in the railway track. The majority of the work done in the field of crack detection uses infrared sensing technique but later it was found that it was affected by external disturbances and hence came to be considered inaccurate

Automatic broken track detection using LED-LDR assembly system[1] automatically detects the faulty rail track without any human intervention. .In this system GPS module was used so that we can get the exact location of the broken rail track but it cannot operate in slabs. This disadvantage can be overcome by using the proposed system

On the basis of the numerical method In Rotating Electromagnetic Field for Crack Detection in Railway Tracks system[2] they developed a finite element procedure for the analysis of the rotating magnetic field for the detection of railway tracks. Rotating Magnetic Field provides a good overall accuracy in discriminating defect presence but it was time consuming. At the same time, the procedure should be validating for other kind of defects, with different geometries or orientations. The same approach should find useful applications like: Detection of third-layer cracks, above all concerning alodine rivets within the framework of aging aircrafts inspection, or micro-crack and micro-voids detection in welding process

The introduced surveying system in this paper is operational on both ballast and slab tracks. Track axis coordinates, which are railway geometrical parameters, are obtained with integrated Global Positioning System (GPS).

This project proposes a cheap, novel yet simple scheme with sufficient ruggedness suitable to the Indian scenario. The introduced surveying system in this paper is operational on both ballast and slab tracks. The system can be operated in tunnels without interruption.

3. Problem Domain

The existing systems are inefficient in monitoring the surface and near surface cracks precisely and it is inappropriate in tunnels. The time delay in informing the railway authority about the crack is large. It has high cost and is less accurate.

4. Motivation

A. Real life Motivation

The earlier systems[1] are inefficient in monitoring the surface and near surface cracks precisely and it was inappropriate in tunnels and it was operated manually. So it required more time to detect the crack and inform the authority to avoid any accidents. Also it has high cost and less accuracy. The proposed system can overcome these drawbacks. It can detect the crack on track the authority without any delay. The use of multiple sensors makes the proposed system highly accurate. And the cost is low when compared with the existing systems.

B. Technical Motivation

The technical motivation is that, the earlier systems used techniques like LED-LDR[1], infrared etc for detecting the cracks, and all the above techniques are less accurate and are less efficient in detecting the cracks. Thus using multiple sensors will help for detecting the cracks effectively without any errors, and the GPS module will give the exact location of the crack to the authority.

5. Problem Definition And Statement

In the proposed system, the robot is made to run to and fro along the track at uneven intervals when the track is free. And if the robot detects any crack on the track it will send an error signal to the authority using a wireless module. Cracks are detected using MEMS and ULTRASONIC sensors and the error signal is transmitted using zigbee module.

6. Problem Issues

Earlier system used IR or LED sensors to detect the crack on the track. It was less efficient and to overcome this issue we used MEMS and ULTRASONIC Sensors.

Another issue for the existing system was the exact position of the crack cannot be detected. GPS module in our proposed system solved this problem.

7. Problem Capture

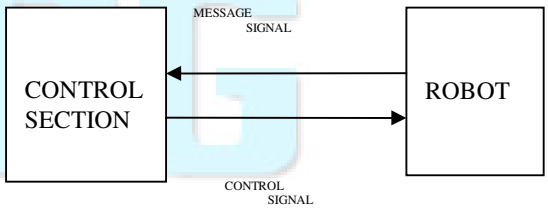

Fig. 1. Block diagram of the proposed system

ROBOT SECTION:

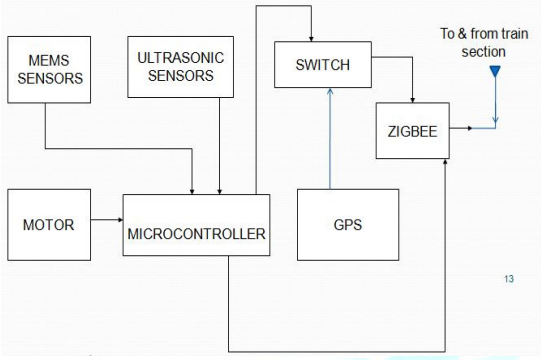

Fig2. Shows the block diagram of the robot section

CONTROL SECTION:

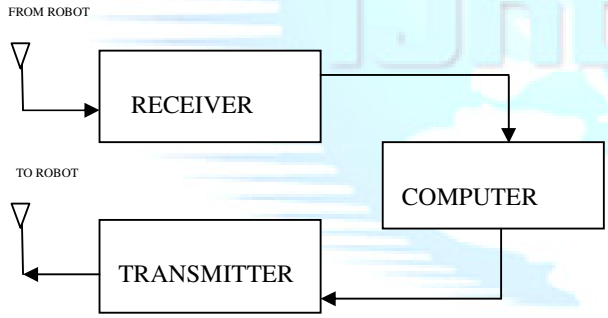

Fig 3. Block diagram of control section

In the proposed system, there are mainly two sections. One is control section and the other is robot section. The robot section consists of multiple sensors. They are MEMS and ultrasonic sensors. The MEMS detect the surface irregularities and the ultrasonic sensors constantly monitors the depth of the crack.

The control section consist of a computer which monitors the values which are sent by the robot section. When their values exceeds the threshold value, it produces the error signal.

8. Algorithm

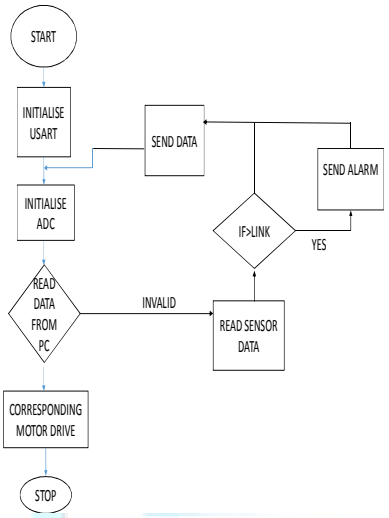

Fig. 4. Flowchart of the proposed system

9. Circuit Diagram

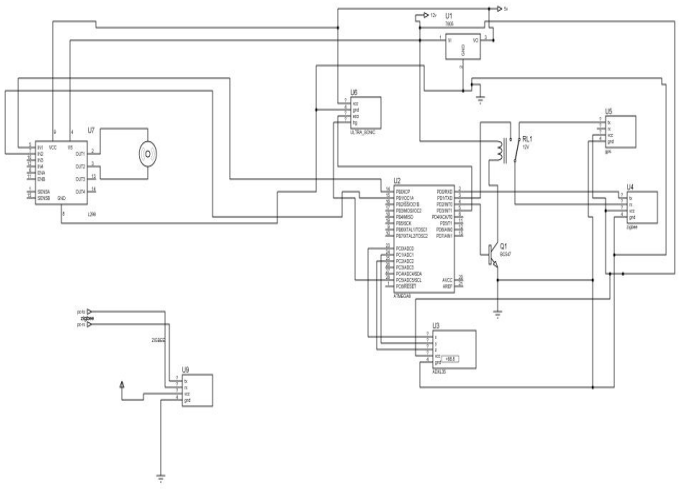

Fig. 2. Circuit diagram of the proposed system.

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10. Input-Output Model

A. ATmega8

Input : RF signal
Process : Monitoring RF and battery charge levels and convert the output to a signal that turns on the MOSFET driver circuit.
Output : Control Signal

B. ULTRASONIC SENSOR

Input :Echoes
Process : It receives the echo signal and calculates the time taken by the echo signal to return back to the sensor.
Output : Electrical signal

C. ZIGBEE

Input : RF signal
Process : transmits the data to the receiver side
Output : RF signal

10. Results

To test the accuracy of the designed surveying system, experiment had been done on a surface having crack. by running our designed robot section having multiple sensor such as ultrasonic sensor and MEMS sensor sense the crack. It is more accurate than the existing works more over the GPS module gives theexact position of the crack

11. Conclusion

In this paper, the system is presented to detect the cracks in the tracks effectively. With the ultrasonic sensor and MEMS sensor the cracks in the railway track is detected and by using wireless modules the information is passed to the control section. The control section is continuously monitored by authority,when there occurs a error a sound is produced and the authority can ask for the location of the crack. The location can be found out by using GPS module in the system. The introduced surveying system in this paper is operational on both ballast and slab tracks. The system can be operated in tunnels without interruption. In future work some more sensors can be adopted to fasten the detection , we may also use the cctv systems with IP based camera for monitoring the visual videos captured from the track.

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