Google Maps Based Railway Track Fault Detection Over Internet

Utkarsh Mishra[1], Vistar Gupta[2], Syed Mohd Ahzam[3] and Shiv Mani Tripathi[4]

[1,2,3]UG Student, Department of Electronics & Communication Engineering,
Shri Ramswaroop Memorial Group of Professional Colleges, Lucknow, India.
Email: [1] utkarshmishru007@gmail.com,[2] vistar1997@gmail.com,[3]syedmdahzam.97@gmail.com

[4]Assistant Professor, Department of Electronics & Communication Engineering,
Shri Ramswaroop Memorial Group of Professional Colleges, Lucknow, India.
Email: ershivmani@gmail.com

ABSTRACT-
Indian Railways is one of the largest network in the world. The movement of train always depends on railway tracks only. If there is a crack in these rails, it creates a major problem. The manual inspection of railway track took more time and human fatigue. The proposed system is suitable for railways transportation to identify the cracks in the railway tracks earlier and prevent the accidents. This paper deals about one of the efficient methods to avoid Train Derailment. Here in this project Arduino mega powered by solar panel is used along with LASER source, APD and vibration sensor to detect the crack. Further the use of GSM and GPS module gives the exact location of crack to the authorities via SMS along with the link to open a location on Google Maps. The use of MOSFETs makes project more efficient as it reduces the speed of train or robotic vehicle.

Keywords- LASER, APD, GPS and GSM module, Google Maps, Arduino mega and MOSFET.

1. INTRODUCTION-

Transport is very important to carry the loads and goods from one place to the other and for this purpose Indian Railway play very important role. The length of Indian Railway is about 113617 km over a route of 63974 km and 7083 stations. Indian railway is the 4th largest railway network in the world, but in case of safety we had not reached at global standard. Because it carry passengers and goods from one place to other, we should have to focus on the safety of the Railway. Indian rail network is still on the growth trajectory trying to fuel the economic needs of our nation. Though rail transport in India growing at a rapid pace, the associated safety infrastructure facilities have not kept up with the aforementioned proliferation.

In this technical solutions offered by many companies in the detection of cracks in rails involve periodic maintenance coupled with occasional monitoring usually once a month or in a similar time frame. But the robotics possesses the inherent advantage of facilitating monitoring of rail tracks on a daily basis during nights, when the usual train traffic is suspended. Further, that the simplicity of this idea and easy availability of the components make for implementation on a large scale with very little initial investment[7]. The simplicity of this work ensures robustness of operation and also the design has been carefully modified to permit rugged operation. Another disadvantage that can be attributed to the conventional commercially available testing equipment is that they are heavy which poses a practical limitation. The principle point of the present exploration work is to outline and create a strong safety framework for train tracks that can avoid accidents and give data on mischance. These days trains accident cases are higher than any other time, it has gotten to be fundamental to give train tracks superb safety system with fault detecting technique. Train track fault detection system guarantees the best ensure to secure your train track from various types of faults. It is a train track security system that offers fantastic insurance to train and track. Framework is based on Google Maps. The outline and framework is inserted in robot[11][12]. Train track fault is detected by robot and the framework send information about fault to base station. After that the buzzer is the signal to the base station.

Project can be used as patrolling vehicle for inspection of cracks, tear and wear at various places like:

- Calculation of distance of the crack from the origin.
- Automatic crack detection in forged metal parts.
- Detection of cracks in concrete pipe.

2. LITERATURE REVIEW

In general, there exist two main categories of techniques are currently used for the damage identification and for the condition monitoring of railway tracks.

Visual inspections: [13] Visual inspection is the primary technique used for defect identifications in the tracks, and is effectively used in specialized disciplines. The successful implementation of this method generally requires the regions of the suspected damage to be known as a first step. The damage can be suspected by riding the trolleys all over the track and be readily accessible for physical inspection. But the visual Inspection could be costly, time consuming and ineffective for large and complex structural systems such as the rail track.

Neural network: [14] Neural network based IR sensor approach to fault diagnosis in railway track circuits. Faults are detected by predicting the values that the sensors will measure and comparing these with the true values. Methods for fault classification is based on predicting the output of a system are common as well. Artificial neural networks have achieved the state-of-the-art performance on several pattern recognition tasks. One reason for these successes is the use of a strategy called end to end learning. This strategy is based on moving away from hand-crafted feature detectors and manually integrating prior knowledge into the network. Instead, networks are trained to produce their end results directly from the raw input data. Since the railway track network is a large network, neural network is not realistic to assume that additional monitoring devices will be installed on each track circuit.

Muley et al proposed an op-amp based system where the crack has been identified by the change of output voltage in the op-amp[8]. Though a noise in the railway tracks can change the voltage and give a false alarm. Rizvi et al and Delforouzi et al uses a computer vision based railway crack detection system.

3. PROPOSED WORK

I. *Working*

The power is fed to Arduino mega board from a solar panel powered battery. This switches control to the motor driver circuit which runs DC geared motor. The motors starts running on the track. When the tracks are smooth and aligned the LCD will show the status that "No Crack Detected" and the robotic vehice will continue to move on the track. As soon as the crack is detected by Laser source and APD, it signals Arduino board. The Arduino board in turn with the help of MOSFET reduces the speed or stops the automated vehicle. Also it directs GSM module which traces the Geographic location of the place where crack is detected. This latitude and longitude co-ordinate position of vehicle received by the GPS is converted into a message, done by the Arduino microcontroller. GPS module sends this traced location to the registered mobile numbers(approx.10 in limit) along with the link to open that location on Google Maps. The SMS of geographic location is sent over smartphones. The attached link in SMS can be opened using internet and exact location can be traced. Immediately the nearest station or Base station will come into play for repairmen of track. In this way we can efficiently know the track fault location and work accordingly.

II. *Components Used*

A. LASER source :

A laser is a device that emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation. This laser light is made to pass or flashed on tracks.

B. Avalanche Photodiode as detector

An avalanche photodiode (APD) is a highly sensitive semiconductor electronic device that exploits the photoelectric effect to convert light to electricity. It will detect the light coming from laser as cracks would allow light to pass.

C. Arduino Mega:

After getting the signal from the detector it is fedinto the Arduino Mega. A GPS, GSM modem, and an LCD display are connected with Arduino also.

D. GSM Module:

GSM/GPRS-compatible Quad-band cell phone, which works on a frequency of 850/900/1800/1900MHz and which can be used not only to access the Internet, but also for oral communication (provided that it is connected to a microphone and a small loud speaker) and for SMSs. Externally, it looks like a big package (0.94 inches x 0.94 inches x 0.12 inches) with L-shaped contacts on four sides so that they can be soldered both on the side and at the bottom. Internally, the module is managed by an AMR926EJ-S processor, which controls phone communication, data communication (through an integrated TCP/IP stack), and (through an UART and a TTL serial interface) the communication with the circuit interfaced with the cell phone itself.[1][2]

E. LCD Display:

4-bit data interface for compatibility with ARM boards – LCD_E, LCD_RS, LCD_RW. 2 line x 16 character Display. Each character location consist of 5 dot x 8 bit display.

F. DC Motors:

A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. It has highest starting torque. So, here to run the vehicle on the tracks we use 2 DC motors. A MOSFET can also be used to control the speed in more efficient manner.[1][2][3][4][6]

G. Global Positioning Device (GPS):

A Global Positioning System (GPS) device is used to find out the longitude and latitude data.[1][2]

4. BLOCK DIAGRAM

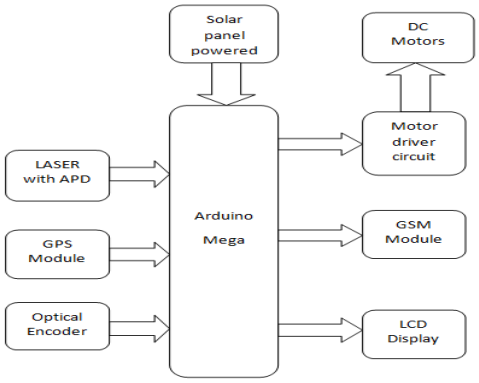

Figure 4-1
Basic block diagram of proposed work.

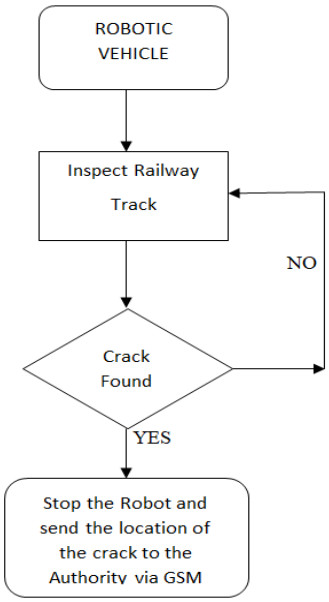

Figure 4-2
Flow diagram of the proposed work.

6. RESULT ANALYSIS

This project during working gives the result status on LCD as shown (Fig.6-1). During the movement of robotic vehicle on the tracks the Laser and APD will provide constant supervision. If no crack is found then LCD will display the same as 'No Crack Detected'. And when the crack is found the LCD will show the result as 'A Crack has been Detected'.

Description	Hardware Result
Real-time status of crack on LCD display	
Real-time status of crack on LCD display	

Figure 6-1
Real time status of crack on LCD.

After detection of crack the tracking of location is done. Tracked location along with coordinates are sent over registered mobile numbers with a link to open the exact location on google maps. The received message is shown (Fig. 6-2). After opening the location on google maps with coordinates is also shown (Fig. 6-3).

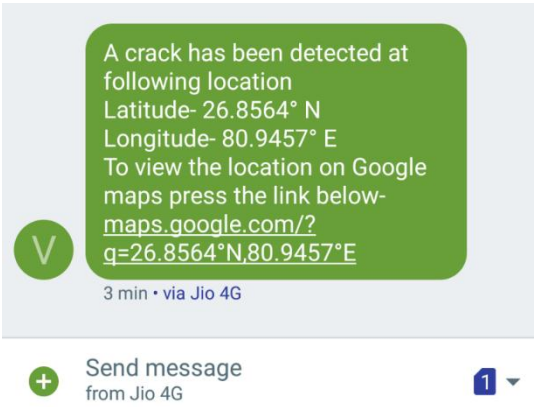

Figure 6-2
The message of location of the crack sent by GSM along with link to open on google maps is displayed (as screenshot taken from phone).

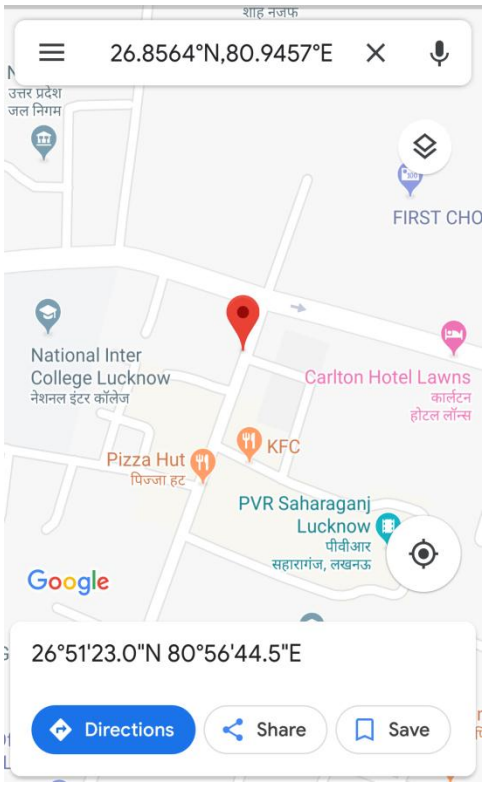

Figure 6-3
The location of crack on google maps based on coordinates sent by GSM.

7. CONCLUSION

In this paper, we have represented a Solar Railway track crack detection vehicle by suing LASER source and Avalanche Photo Diode as detector. A vehicle, to which power supply is given by Solar Panel, is so designed to detect the crack or any deformities on the railway track. This can be implemented to a large scale which will reduce the Man labor as well as the maintenance cost. By using wireless sensor networks techniques we also develop more and more reliable security systems applications, in which continuously monitors the railway track through the sensors and detect any abnormality in the track. When these sensors are placed in robotic vehicle or train itself the monitoring becomes automated and with help of motors and MOSFET the speed is

reduced. The location of crack is opened on Google Maps with the use of internet at receiver's side.

In future, we can detect cracks in railway tracks by using Image Processing techniques using MATLAB.

REFERENCES

[1] B.Siva Rama Krishna, D.V.S Seshendra, G.Govinda Raja, T.Sudharshan, and K.Srikanth, "Railway Track Fault Detection System by Using IR Sensors and Bluetooth Technology", Asian Journal of Applied Science and Technology (AJAST), Volume 1, Issue 6, pp 82-84, July 2017.

[2] Rakesh V. Pise, Parag D. Nikhar, Prof. Avinash H. Shelar, "Review on Railway Track Crack Detection Using IR Transmitter and Receiver"; International Research Journal of Engineering and Technology(IRJET), Vol-4, Issue-1, pp. 1723–1726, 2017.

[3] Er.Nisthul G, Lijo George, Nelson Varghese, Sebin Jose, Nithin John & Nandhumon K R., "Automatic Railway Track Crack Detection System", Imperial Journal of Interdisciplinary Research (IJIR) Vol-3, Issue-4, pp. 2272-2275 , 2017.

[4] Latifa Oukhellou, Patrice Aknin, Jean-Paul Perrin., "Dedicated Sensor and classifier of Rail Head Defects", U.S.A. International Journal of Scientific & Engineering Research, Vol-4, Issue-1, January-2013 ISSN 2229-5518 IJSER 2013.

[5] D. Sri Rajitha, L.Chandra Shekar and R. Murali, "An Embedded Based Railway Track fault Detection Using ARM7LPC2148", International Journal & Magazine of Engineering,Technology,Management and Research, Vol. 2, Issue 3, pp. 300-304, March 2015.

[6] S Hawkins, "Communication Systems", Fourth edition, Wiley India Pvt. Limited, 2006.

[7] Z. Mao, Y. Zhan, G. Tao, B. Jiang, and X.G. Yan, "Sensor Fault Detection for Rail Vehicle Suspension Systems with Disturbances and Stochastic Noises", IEEE Transactions on Vehicular Technology, Vol. PP, Issue 99, pp. 1-1, doı: 10.1109/TVT.2016.2628054, 2016.

[8]Richard J. Greene, John R. Yates, Eann A. Patterson, "Automatic Broken Track Detection Using IR Transmitter and Receiver", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol-4, Issue-4, pp 2301-2304, April 2015.

[9] S.Srivastava, R.Chaurasia, Prashant and S.Abbas "Railway Track Crack Detection Autonomous Vehicle", International Advanced Research Journal in Science, Engineering and Technologies Volume 4, Issue 2, pp. 145-148, February 2017.

[10] Q. Wei, X. Zhang, Y. Wang, N. Feng, and Y. Shen, "Rail defect detection based on vibration acceleration signals", Instrumentation and Measurement Technology Conference (I2MTC), 2013 IEEE International. IEEE, pp. 1194 - 1199, DOI: 10.1109/I2MTC.2013.6555602, 2013.

[11] R. T. Lemmon, ―The influence of the number of satellites on the accuracy of RTK GPS positions, II Australian Surv., vol. 44, no. 1, pp. 64–70, 1999.

[12] Qiao Jian-hua; Li Lin-sheng; Zhang Jing-gang; "Design of Rail Surface Crack- detecting System Based on Linear CCD Sensor," IEEE Int. Conf. on Networking, Sensing and Control, vol. 14, no. 4, pp. 961-970, April 2008.

[13] M. Yinghua, Z. Yutang, L. Zhongcheng, and Y. Cheng Ye, "A fail-safe microprocessorbased system for interlocking on railways," *Proceedings of the Annual Symposium on Reliability and Maintainability*, pp. 415-420, Jan. 1994.

[14] M.T. Musavi, K.H. Chan, D.M. Hummels, K. Kalantri, "On the generalization ability of neural network classifiers," IEEE Trans. Pattern Analysis and Machine Intelligence, vol-16, Issue-6, pp. 659-663, June 1994.