



Automatic Broken Track Detection Using IR Transmitter and Receiver

Reenu George¹, Divya Jose², Gokul T G³, Keerthana Sunil⁴, Varun A G⁵

Assistant Professor, Dept. of EEE, Mar Athanasius College of Engineering, Kothamangalam, Kerala, India¹

UG Student, Dept. of EEE, Mar Athanasius College of Engineering, Kothamangalam, Kerala, India²

UG Student, Dept. of EEE, Mar Athanasius College of Engineering, Kothamangalam, Kerala, India³

UG Student, Dept. of EEE, Mar Athanasius College of Engineering, Kothamangalam, Kerala, India⁴

UG Student, Dept. of EEE, Mar Athanasius College of Engineering, Kothamangalam, Kerala, India⁵

ABSTRACT: Most of the commercial transport in India is being carried out by the railway network and therefore, any problems in the same have the capacity to induce major damage to the economy. In terms of the reliability and safety parameters, Indian railway has not yet reached the international standards. The main problem about railway analysis is detection of cracks in the structure. If these deficiencies are not controlled at early stages they might lead to a number of derailments resulting in a heavy loss of life and property. This work proposes a cost effective solution to the problem of railway track crack detection utilizing IR transmitter and receiver which tracks the location of faulty track which then mended immediately so that many lives will be saved. The existing system has been modified by using smart phone which helps in detecting the exact location of the fault. There are many advantages with this system when compared with the traditional detection techniques. It includes less cost, low power consumption and less analysis time.

KEYWORDS: IR transmitter and receiver, Crack detection, GPS, GSM, PIC microcontroller.

I.INTRODUCTION

Transport is a key necessity for specialization that allows production and consumption of products to occur at different locations. Transport has throughout history been a spur to expansion as better transport leads to more trade. Economic prosperity has always been dependent on increasing the capacity and rationality of transport. But the infrastructure and operation of transport has a great impact on the land and is the largest drainer of energy, making transport sustainability and safety a major issue. In India, we find that rail transport occupies a prominent position in providing the necessary transport infrastructure to sustain and quench the ever-burgeoning needs of a rapidly growing economy. Today, India possesses the fourth largest railway network in the world. However, in terms of the reliability and safety parameters, we have not yet reached truly global standards. The principal problem has been the lack of cheap and efficient technology to detect problems in the rail tracks and of course, the lack of proper maintenance of rails which have resulted in the formation of cracks in the rails and other similar problems caused by anti-social elements which jeopardize the security of operation of rail transport. In the past, this problem has lead to a number of derailments resulting in a heavy loss of life and property. 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. Hence, owing to the crucial repercussions of this problem, an efficient and cost effective solution suitable for large scale application is required. The new method which utilizes simple components inclusive of a GPS module, GSM Modem, IR Transmitter and Receiver based crack detector assembly is very useful in railway crack detection. This idea can be implemented in the long run to facilitate better safety standards and provide effective testing infrastructure for achieving better results in the future.

Selvamraju Somalraju et.al [1] proposed a system that utilises LED-LDR configuration for railway crack detection. RRCDS utilises simple components inclusive of a GPS module, GSM Modem and LED-LDR based crack detector assembly. The proposed broken rail detection system automatically detects the faulty rail track without any human intervention. There are many advantages with the proposed system when compared with the traditional detection



International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 4, April 2015

techniques. The advantages include less cost, low power consumption and less analysis time. By this proposed system the exact location of the faulty rail track can easily be located which will mended immediately so that man lives can be saved. Qiao Jian-hua et.al [2] proposed a system that takes the linear charge coupled device (CCD) as image sensor, processes the image signal collected, judges out the crack signal, and displays the curve through the LCD, and gives off the alarm. The system essential modules such as, the CCD timing generator, A/D converter timing generator, address generator, RAM memory all are realized on CPLD. It adopts the improved classical algorithm and morphology algorithm to perform noise elimination, the edge detection, the image segmentation and the edge linking to the railway surface crack image, which obtains the good detection result. The whole system is fixed on the vehicle-hold system, travelling along the railway, then conveniently examines the crack position, thus may promptly carry through track maintenance, avoiding the accident. Moreover, the system can connect with the PC, transforming the sampling data to PC to further analysis. In another method K. Vijayakumar et.al [3] has investigated crack detection using microwave sensors. It describes how a Microwave horn antenna can be used to detect the cracks in a rail track. Based on the simulation results obtained from the High Frequency Simulation Structure (HFSS), it has been shown that the design of the Microwave sensor has the potential for detecting defects in the rail surface including minor cracks as well as more serious as well as. In another method Richard J. Greene et.al [4] have presented a new crack detection method, for rail which utilizes the change in infrared emission of the rail surface during the passage of a train wheel. Initial data from this infrared method are presented, from studies of both a laboratory-based three-point bend specimen and a short section of rail. The results of these two studies confirm the ability of the proposed method to locate and quantify surface-connected notches and cracks. Richard J. Greene et.al [5] developed an improved version of infrared-based method for surface crack quantification at conventional train speeds which delivers crack detection capability over the full depth of the rail section, with a crack resolution capability comparable to competing detection techniques. Experimental results are presented for a laboratory three-point bend notched specimen, the geometry of which is representative of surface-connected cracks with lengths below 2 mm in sections of rail. Two analyses are considered: a simulated trackside system, where the observation point is fixed and the repeated loading event experienced by a section of rail during the passage of multi-carriage rolling stock is considered; and a simulated train-based system, where the observation point moves along the rail and the loading event produced by the passage of a single train wheel is considered. Data from the track side simulation system clearly identifies the precise location and severity of an artificially introduced notch on the upper surface of the specimen. Initial data the train-based simulation system identifies the notch location precisely, but is unable to quantify the magnitude of the flaw using the current processing method. The paper then describes modifications to the testing and data processing methods required to improve the performance of both system.

After going through all these papers, we came to a conclusion to do a project which would provide better safety standards in a cost effective way for railway crack detection. The method utilises IR transmitter and receiver for the purpose and have many advantages compared to the traditional technique.

II. WORKING

In this proposed system we use PIC16F877A microcontroller. It is a low power, high speed CMOS FLASH/EEPROM technology. It is also a low cost easy to program microcontroller which have only 35 instruction set. Before the start of the rail- way line scan the robot has been programmed to self-calibrate the IR Transmitter and Receiver. After calibration, the robot waits for a predetermined period of time so that the onboard GPS module starts reading the correct geographic coordinate. The principle involved in this crack detection is that light reaching the IR receiver is proportional to the intensity of crack i.e. when maximum light transmitted by transmitter reaches the receiver the crack intensity is more. The IR transmitter will be attached to one side of the rails and the IR receiver to the opposite side. During normal operation, when there are no cracks, the light from transmitter does not fall on the receiver and hence the set value is low. When the light from transmitter falls on the receiver, the value gets increased and the amount by which it is incremented will be proportional to the intensity of the incident light. As a consequence, when light from the transmitter deviates from its path due to the presence of a crack or a break, a sudden increase in the value can be observed. This change in value indicates the presence of a crack or some other similar structural defect in the rails. In order to detect the current location of the device in case of detection of a crack, we make use of a GPS receiver whose function is to receive the current latitude and longitude data. To communicate the received information, we make use of

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 4, April 2015

a GSM modem. The GSM module is being used to send the current latitude and longitude data to the relevant authority as an SMS. The aforementioned functionality has been achieved by interfacing the GSM and GPS modules with the PIC16F877A microcontroller. The robot has four wheels which are powered by two 12V batteries. The design is simple and sensible enabling the device to be easily portable.

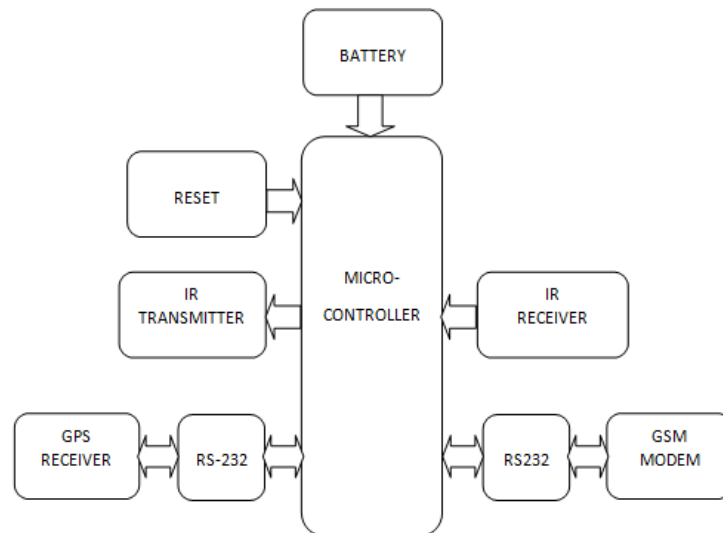


Fig. 1: Functional Block Diagram

In the fig 1, it shows the functional block diagram of the proposed system.

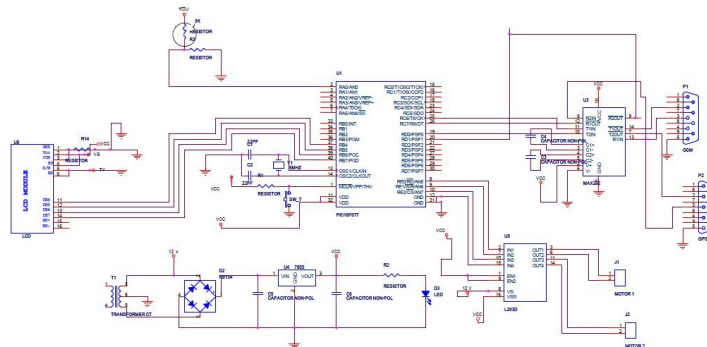


Figure 2: Circuit Diagram

In the fig 2, it shows the circuit diagram of the proposed system.

III. RESULT AND DISCUSSION

The components are assembled and program was burned in the PIC microcontroller. The program is done using the software Mikro C. The test plan formulated involved initial testing in a simulated track to study the feasibility of crack detection. The arrangement utilized aluminium frame kept in the form of tracks and the model was made to traverse it. We included a break manually and found that the device successfully detected that user-created crack and the current latitude and longitude values were received by the GPS receiver, converted into a suitable text format and then finally transmitted to a mobile phone by means of the GSM module. However, as the rail tracks did not contain any cracks, we were not able to test the GSM and GPS modules on field. But the previously mentioned simulated trial validates the project. Thus, the field trials indicate a fairly good degree of accuracy and also the GSM and GPS modules worked properly by transmitting the current latitude and longitude data to a mobile phone on detecting our simulated crack.

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 4, April 2015

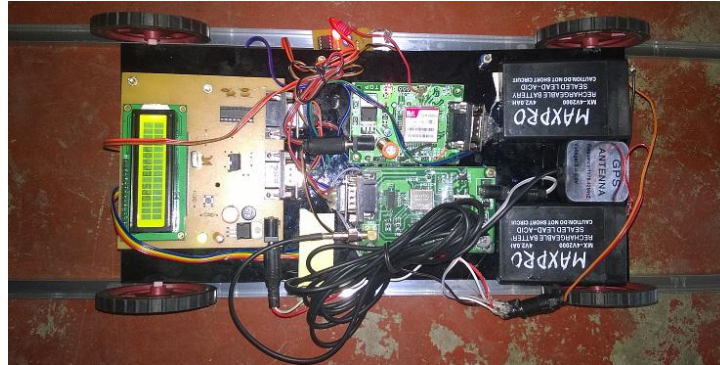


Fig. 3: Components assembled on a model railway track

IV. CONCLUSION

The Indian railways are the largest rail passenger transport in today's world and it is the back bone of the country transport infrastructure. The main problem about a railway analysis is detection of cracks in the structure. If these deficiencies are not controlled at early stages they might lead to a number of derailments resulting in a heavy loss of life and property. The proposed broken rail detection system automatically detects the faulty rail track without any human intervention. There are many advantages with the proposed system when compared with the traditional detection techniques. The advantages include less cost, low power consumption and less analysis time. By this proposed system the exact location of the faulty rail track can easily be located which will mended immediately so that many lives can be saved. The method can be implemented in large scale in the long run to facilitate better safety standards for rail tracks and provide effective testing infrastructure for achieving better results in the future.

REFERENCES

- [1]. Selvamraju Somalraju, Vigneshwar Murali, Gourav Saha, Dr.V.Vaidehi, "Robust Railway Crack Detection Scheme (RRCDS) Using LED-LDR Assembly," IEEE Int. Conf. on Networking, Sensing and Control, vol. 6, iss. 3, pg. 453-460, May2012
- [2]. 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
- [3]. K. Vijayakumar, S.R. Wylie, J. D. Cullen, C.C. Wright, A.I. Shammaa, " Non invasive rail track detection system using Microwave sensor," Journal of App. Phy., vol. 9, iss. 11, pg. 1743-1749, June 2009
- [4]. Richard J. Greene, John R. Yates and Eann A. Patterson, "Crack detection in rail using infrared methods," Opt. Eng. 46, 051013, May 2007
- [5]. R.J. Greene, J.R. Yates, E.A. Patterson, "Rail Crack Detection: An Infrared Approach to In-service Track Monitoring," SEM Annual Conference & Exposition on Experimental and Applied Mechanics, vol. 112, nos. 23, pp. 291301, May 2006