INTERNATIONAL JOURNAL OF RESEARCH AND DEVELOPMENT IN ENGINEERING SCIENCES
e-ISSN: 2582 - 4201 Volume: 2 | Issue: 3 | Year: 2020

RAILWAY TRACK FAULT DETECTION SYSTEM BY USING INTERNET OF THINGS

[1] Dr. A.V.N.CHANDRA SEKHAR

[1] Professor,
Department of Information Technology,
Sasi Institute of Technology and Engineering(A),Tadepalligudem.
Jawaharlal Nehru Technological University Kakinada, Andhra Pradesh, India

G L N L Mounika [2] , Ch Sravanthi [3], D Navya Sri [4], M Phani Seshu [5]

[2,3,4,5] IV B.Tech Students,
Department of Information Technology,
Sasi Institute of Technology and Engineering(A),Tadepalligudem.
Jawaharlal Nehru Technological University Kakinada,

Abstract: Indian railway network is the largest rail-passenger transport and it is the backbone of country's transport infrastructure. In India, most of the commercial transport is being carried out by the railway network because it is being cheapest mode of transportation preferred over all other means of transportation such as buses, flights etc. But as per reliability and Safety parameter we do not reach Global standards. Many accidents in railway line is due to the railway track fault. So, to improve reliability and Safety standards Railway track fault detection system introduces GSM based technology, to prevent the train accident.

Two Ultrasonic sensors are installed at front end of the inspection robot which monitors the track and gives the status to Arduino controller. If there is crack found it immediately activates buzzer to produce sound, displays distance between ultrasonic sensor and track on LCD display, deactivates motor drivers to stop vehicle and activates GPS module to trace current location. This location is sent to predefined number by using GSM through Alert SMS so that many lives will be saved. this paper is maily deals with train derailment by detecting a crack in railway track using internet of things technology.

Key words: Aurdino Control,GSM,GPS.

1. INTRODUCTION

Railway is one of the most used mean of transportation. For the rail- way 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 devel- opment 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 problems.

a) Wastage of time
b) Wastage of energy
c) 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.

2. LITERATURE SURVEY

Abhi Ladola et al.[1] said that they designed an autonomous vehicle for railway track fault detection using some components like IR sensor which is used to detect crack on rail line after detecting crack it is also required to de- tect fault location it is fulfilled by GPS. The location of the fault is defined by the value of longitude and latitude coordinates from GPS module. This loca- tion is sent to pre-defined number by using GSM through SMS. In their whole system the central component is Arduino. The

autonomous crack detection vehicle is powered by solar panel and battery. B. Siva Rama Krishna et al.[2] said that they introduced Bluetooth based technology, to prevent the train accident. Two IR sensors are installed at front end of the inspection robot which monitors the track and gives the status to Arduino controller. If there is crack found it immediately sends the location of crack via Bluetooth to mobile phone.

This broken rail detection system automatically detects the faulty railway track without any human in- terference. Saurabh Srivastava et al.[3]. This track detection vehicle system is ba- sically a electronics device that detects the crack in track and provide the location of crack to nearby stations. This method which utilizes simple com- ponents inclusive of a Zigbee Transmitter and Receiver, Micro-controller, IR Sensors, Photodiode and LED display based crack detector assembly is very useful in railway crack detection. This vehicle will work as a patrolling vehicle on the tracks within regular intervals and transmit update information re- garding the tracks conditions.

If any fault is detected it will transmit the fault location as well as distance of that particular fault from the starting point by means of Zigbee transmitter to nearby stations. Hence, necessary steps can be taken as soon as possible by railway authorities to overcome the conditions. This setup is very cost effective as well as highly reliable. Utkarsh Mishra et al.[4]said that their proposed system is suitable for railways transportation to identify the cracks in the railway tracks earlier and prevent the accidents. Their system deals about one of the efficient methods to avoid Train Derailment. Here Arduino mega powered by solar pan‘ vel 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. Rijoy Paul et al.[5]said that their project discusses a Railway track crack detection using image processing and is a dynamic approach which combines the use of GPS tracking system and WIFI module to send alert messages and the geographical coordinate of location. A Raspberry Pi 3 is used to control and coordinate the activities of these devices. This project prevents train de- railment by detecting a crack in railway track using internet of things tech- nology.S. B. Deokar et al.[6] said that their prototype system, designed for con- tinuous monitoring of railway tracks using a combination of sensors.

These sensors collect data and through computational analysis faults in the rail- way tracks are identified. The collected data can help in finding cracks in the tracks and catastrophic accidents can be avoided. Shailesh D. Kuthe et al.[7] said that their project discusses the tech- nical and design aspects and also provides the robust crack detection algo- rithm. Their project also presents the details of the implementation results of the RRCDS utilizing simple components inclusive of IR LED-PHOTODIODE based crack detector assembly.

The currently existing technical solutions in the detection of cracks in rails involve periodic maintenance coupled with oc- casional monitoring the inspection methods like are visual inspection, ultra- sonic inspection, eddy current and laser methods. P.Navaraja et al.[8] said that they introduced the integration of ultra- sonic and total station for railway track geometry surveying system. this project consist of GPS module, GSM modem, IR sensor, PIR sensor for ap- plication of communication purpose, crack detection and finding of human being present in the railway track. The GPS module and GSM modem 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 ultrasonic sensor for above process with high accuracy.

We implement PIR sensor in this project to avoid manual checking of detection of presences of human being in recent trends of application. The importance of this project is applicable both day and night time detection purpose. Maneesha Singh et al.[9] said that their paper mainly focuses on iden- tifying the demarcated areas of track circuit on which there is no such ar- rangements are done to detect any flaw in the track with the help of latest technologies. It will also reduce the responsibilities of manpower to manually check the track for damages. Jianmin Zhao et al.[10]said that their project a model is developed to analyse the risk of derailment using a probabilistic approach. The process of rail defects leading to rail breaks and further to derailment is analysed while addressing the factors relating to rail maintenance. The risk of derailment is measured with the expected number of rail breaks multiplied by severity.

To evaluate the risk, two models are developed to predict the rate of occurrence of rail defects and breaks. The hazard rate of thermit weld defects is predicted using a birth process with immigration. Imperfect inspections are modelled by employing a filtered non-homogeneous Poisson process. The performance and application of the proposed model are illustrated by an example. It is shown that the risk of derailment can be significantly reduced by more frequent in- spections, and grinding can also reduce considerably the risk of derailment relevant to rolling contact fatigue. S. Ramesh [11]

The main part of their work was to carry out a feasibility study on two methods for detection of cracks and avoidance of the collision between the rails. The detection of cracks can be done by ultrasonic waves or sensor.

Collision avoidance system can be done by the following nodes: Server side node, train side node, track side node and station side node. Nanditha R Gajanur et al.[12] said that Due to increased railway ac- cidents, they installed a camera on the face of the train to monitor the railway track up to 2Kms at all times. They also plan to install LCD screens in every coach, which displays the live screening of the camera. This will make sure that at all times some passenger on the train can monitor the tracks.

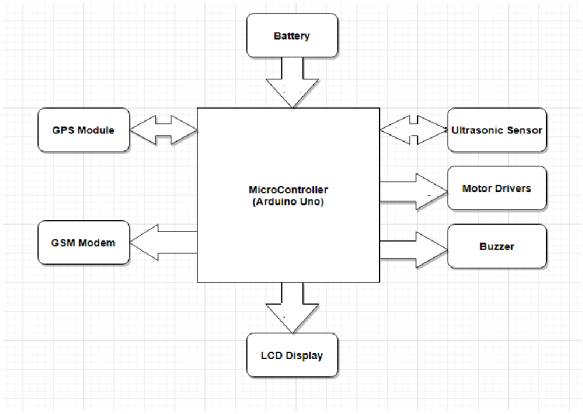
This whole system will be powered by solar energy harnessed using solar panels mounted on the train top. They will track the Maximum Power Point (MPP) of the solar array and the power generated will be stored in Li-ion batteries. This power is utilized during the absence of sun and its output voltage is regulated using DC/DC converters according to the energy needs of the camera, Wi-Fi and LCD. Hyun Cheol Cho et al.[13]said that Dynamic neural models provide an attractive means of fault detection and isolation in industrial process. One approach is to create a neural model to emulate normal system behavior and additional models to emulate various fault conditions. The neural models are then placed in parallel with the system to be monitored, and fault detection is achieved by comparing the outputs of the neural models with the real system outputs.

Neural network training is achieved using simultaneous perturba- tion stochastic approximation (SPSA). Fault classification is based on a simple threshold test of the residuals formed by subtracting each neural model out- put from the corresponding output of the real system. They present a new approach based on this well known scheme where a Bayesian network is used to evaluate the residuals. The approach is applied to fault detection in a three- phase induction motor.Mr. Anand S. Muley et al.[14]said that Cracks in rails have been iden- tified to be the main cause of derailments in the past, yet there have been no cheap automated solutions available for testing purposes.

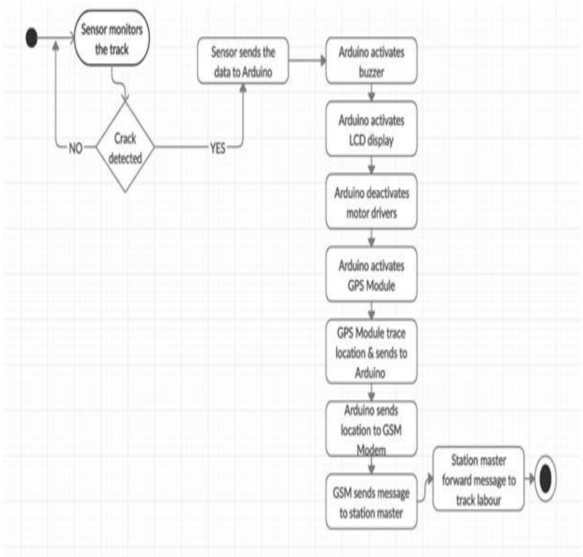
Hence, owing to the crucial repercussions of this problem, they have worked on implementing an efficient and cost effective solution suitable for large scale application. pathan et al. [15]said that their project presents a solution, to provide an intelligent train tracking and management system to improve the existing railway transport service.The solution is based on powerful combination of mobile computing, Ultrasonic Sensor, Passive Infrared Sensor, Arduino uno, Global System for Mobile Communication (GSM), Global Positioning System (GPS) technologies , bluetooth module and software. The inbuilt GPS module identifies the crack location with a highest accuracy and transfer the informa- tion to the central system.

3. IMPLEMENTATION

A) Block Diagram



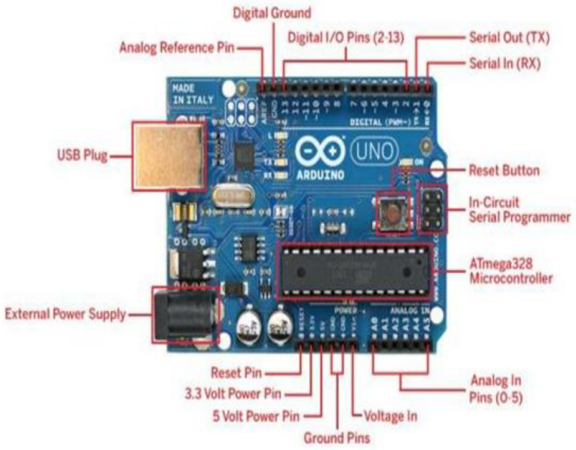
B) Activity Diagram



Arduino UNO:

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 ana- log inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. Simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno board is the rst in a series of USB Arduino boards.

The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board.



ULTRASONIC SENSOR

An Ultrasonic Sensor is a device that measures distance to an object using Sound Waves. It works by sending out a sound wave at ultrasonic fre- quency and waits for it to bounce back from the object. Then, the time delay between transmission of sound and receiving of the sound is used to calculate the distance.It is done using the formula

Distance = (Speed of sound * Time delay) / 2

The HC-SR04 is an ultrasonic ranging module. This economical sensor provides 2cm to 400cm of non-contact measurement functionality with a rang ing accuracy that can reach up to 3mm. Each HC-SR04 module includes an ultrasonic transmitter, a receiver and a control circuit. There are Four Pins on the HC-SR04. They are :

1. Vcc (5V supply)
2. Gnd (Ground)
3. Trig (Trigger)
4. Echo (Receive)

Connections between Ultrasonic sensor and Arduino Uno are as follows

1. Vcc to 5V Pin of the Arduino.
2. Gnd to Gnd Pin of the Arduino.
3. Trig to Digital Pin A0 .
4. Echo to Digital Pin A1.

BUZZER

Piezo buzzer is an electronic device commonly used to produce sound.Piezo buzzer is based on the inverse principle of piezo electricity discovered in 1880 by Jacques and Pierre Curie. It is the phenomena of generating electricity when mechanical pressure is applied to certain materials and the vice versa is also true. Such materials are called piezo electric materials.

Piezo electric materials are either naturally available or manmade. Piezo- ceramic is class of manmade material, which poses piezo electric effect and is widely used to make disc, the heart of piezo buzzer. When subjected to an alternating electric field they stretch or compress, in accordance with the frequency of the signal thereby producing sound. Connection between button and Arduino uno are as follows

1. Connect the Supply wire (RED) of the buzzer to the Digital Pin 9 of the Arduino
2. Connect the Ground wire (BLACK) of the buzzer to any Ground Pin on the Arduino

LCD DISPLAY

The LiquidCrystal library allows you to control LCD displays that are compatible with the Hitachi HD44780 driver. There are many of them out there, and you can usually tell them by the 16-pin interface.The LCDs have a parallel interface, meaning that the microcontroller has to manipulate several interface pins at once to control the display.

GPS MODULE

Global Positioning System (GPS) is a satellite-based system that uses satellites and ground stations to measure and compute its position on Earth.It is also known as Navigation System with Time and Ranging (NAVSTAR) GPS.GPS receiver needs to receive data from at least 4 satellites for accuracy purpose. GPS receiver does not transmit any information to the satellites.

This GPS receiver is used in many applications like smartphones, Cabs, Fleet management etc.GPS receiver module gives output in standard (National Marine Electronics Association) NMEA string format. It provides output seri- ally on Tx pin with default 9600 Baud rate.This NMEA string output from GPS receiver contains different parameters separated by commas like longitude, latitude, altitude, time etc.

GSM MODEM

GSM is a mobile communication modem; it is stands for global system for mobile communication (GSM). The idea of GSM was developed at Bell Lab- oratories in 1970. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.

GSM system was developed as a digital system using time division multi- ple access (TDMA) technique for communication purpose.

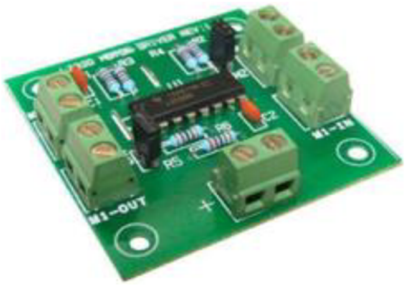
Connection b/w GSM and Arduino.

1. GSM Tx –> Arduino Rx
2. GSM Rx –> Arduino Tx.

DC MOTOR

A DC motor is designed to run on DC electric power. Two examples of pure DC designs are Michael Faraday's homopolar motor (which is uncom- mon), and the ball bearin motor, which is (so far) a novelty. By far the most common DC motor types are the brushed and brushless types, which use internal and external commutation respectively to create an oscillating AC current from the DC source – so they are not purely DC machines in a strict sense. DC motor has red and black wires.These wires are called input 1 and input 2,let us see the working condition of DC Motor.

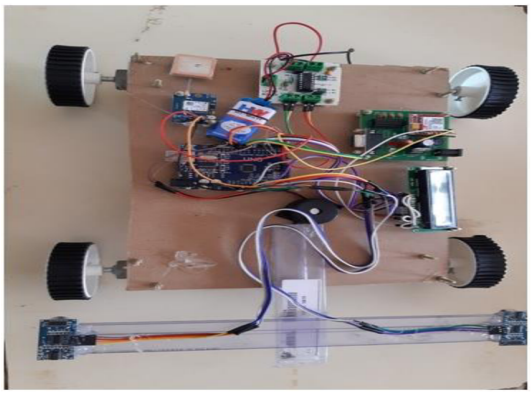
L293D MOTOR DRIVER



A single L293D chip there are two h-Bridge circuit inside the IC which can rotate two dc motor independently. Due its size it is very much used in robotic application for controlling DC motors.

4. RESULTS

The below prototype device always examine detactable noise and Railway Track Fault Detection System, and results will appear when user insert valid identies. This mechanism always suitable and useful for existing system.



5. CONCLUSION

In this paper we've got designed a cost effective, low energy embedded system, which facilitate better protection standards for rail tracks using internet of things technology.

REFERENCES

[1]. A. Ladola, C. Parekh, D. Patel, and H. Bhagatwala, "Solar based railway track fault detection system," International Research Journal of Engineer- ing, vol. 5, 2018.
[2]. B. S. R. Krishna, D. Seshendra, G. G. Raja, T. Sudharshan, and

[3]. K. Srikanth, "Railway track fault detection system by using ir sensors and bluetooth technology," Asian Journal of Applied Science and Technol- ogy (AJAST), vol. 1, no. 6, pp. 82–84, 2017.
[4]. S. Srivastava, R. P. Chaurasia, S. I. Abbas, P. Sharma, and N. K. Singh, "Railway track crack detection vehicle," International Advanced Research Journal in Science, Engineering and Technology (IARJSET), vol. 4, no. 2, 2017.
[5]. U. Mishra, V. Gupta, S. M. Ahzam, and S. M. Tripathi, "Google maps based railway track fault detection over internet,"
[6]. R. Paul, N. Varghese, U. Menon, et al., "Railway track crack detection," International Journal for Advance Research and Development, vol. 3, no. 3, pp. 123–126, 2018.
[7]. S. Deokar, A. D. Kadam, N. D. Pachupate, and N. D. Kudale, "Iot based railway track monitoring system using ultrasonic sensor,"
[8]. S. D. Kuthe, S. A. Amale, and V. G. Barbuddhye, "Smart robot for railway track crack detection system using led-photodiode assembly," 2008.
[9]. P. Navaraja, "Crack detection system for railway track by using ultra- sonic and pir sensor," International Journal of Advanced Information and Communication Technology, vol. 1, no. 1, pp. 126–130, 2014.
[10]. M. Singh, S. Singh, J. Jaiswal, and J. Hempshall, "Autonomous rail track inspection using vision based system," in 2006 IEEE International Confer- ence on Computational Intelligence for Homeland Security and Personal Safety, pp. 56–59, IEEE, 2006.
[11]. J. Zhao, A. Chan, and A. Stirling, "Risk analysis of derailment induced by rail breaks-a probabilistic approach," in RAMS'06. Annual Reliability and Maintainability Symposium, 2006., pp. 486–491, IEEE, 2006.
[12]. S. Ramesh, "Detection of cracks and railway collision avoidance sys- tem," International Journal of Electronic and Electrical Engineering ISSN, pp. 0974–2174, 2011.
[13]. N. R. Gajanur, A. Singh, and A. Jain, "Solar powered railway track mon- itoring system," in 2016 IEEE International Conference on Power and Re- newable Energy (ICPRE), pp. 190–194, IEEE, 2016.
[14]. H. C. Cho, J. Knowles, M. S. Fadali, and K. S. Lee, "Fault detection and isolation of induction motors using recurrent neural networks and dy- namic bayesian modeling," IEEE Transactions on Control Systems Tech-nology, vol. 18, no. 2, pp. 430–437, 2009.
[15]. A. Muley, S. Patil, and P. Shelar, "Railway track crack detection based on gsm technique," International Research Journal of Engineering and Tech- nology (IRJET), vol. 4, no. 1, pp. 1252–1254, 2017.
[16]. S. Pathan et al., "Railway track crack detection," 2016.