iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** XII **Month of publication:** December 2022

DOI: https://doi.org/10.22214/ijraset.2022.48319

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue XII Dec 2022- Available at www.ijraset.com

Iot Based Sensor Network for Crack & Bend Monitoring in Railway Track

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Abstract: ***In India railway is one of the most common means of transport, which is the fourth largest railway community in the world. Even though Indian railways has an outstanding boom, it remains plagued because of some of the major issues like problem in gate crossing, fire accidents and problem in the track which remains unmonitored causing derailment. The tracks contract and expand due to changes in season. Due to this crack may develop on the track. This proposed system identifies the cracks and the obstacles on the track using sensors***
The project railway crack and object detection are a forward step to improving the railway system. The system performs two main functions. The first one is detecting the crack on the railway track by using the Flex sensor and the second one is detecting the object by using IR sensor.

I. INTRODUCTION

Indian Railways is one of the largest revenue giving assets. It is the biggest railway system of Asia. The Bruisers used a railway system to carry the goods from different parts of India to different parts but now in the 21st century this system has a great importance for India. So, keep in mind about the growth of this system. The safety of this system is must. About 12,000 trains go from one place to another place every day. So, in this regard people's lives are important. We know that the current situation of Indian Railways regarding safety is not pretty good.

Structural health monitoring (SHM) has become a necessary measure to ensure the safe and reliable operation of large structures (railways, bridges, aircrafts, etc.). In civil machinery and aviation systems, the failure and fatigue of metallic objects may cause economic loss and endanger personal safety. Therefore, the detection of stress and fatigue cracks are important aspects of in-depth evaluation of sensitive metallic structures We can detect failures by embedding compact and portable sensors in the structure. With the development of sensors and the Internet of Things (IOT), defect detection and characterization techniques will be applied to products and infrastructures. Because of their passive, low-cost and wireless characteristics, they are used for identification and tracking of items. In today's world, transport, being one of the biggest drainers of energy, its sustainability and safety are issues of paramount importance. In India, rail transport occupies a prominent position in quenching the ever-urgent needs of a rapidly growing economy. However, if we consider the reliability and safety parameters, India has not reached the global standard yet. The major problem is that there is no efficient and cost-effective technology to detect problems in the rail tracks and the lack of proper maintenance. However, the proper operation and maintenance of transport infrastructure has a large impact on the economy. This model says about a proposed proto type of testing train for detecting obstacles and cracks, which is similar to that of the line following the testing train. The proposed testing train is cost effective and analysis time is less. With this proposed system the exact location of the faulty rail track can be easily located, so that many lives can be saved.

This technology is very effective and low cost and it will help to reduce the number of train accidents. Regarding life safety this is a great system.



Fig. 1 Railway Engine

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Today India is synonymous with transportation, but budget-friendly and the common man is “Indian Railways”, where on the one hand we have ordinary railways. Every day, the railway sector in India is making new progress and has many high-speed and luxury trains in India. Now we have moved from simple trains to bullet.

II. BLOCK DIAGRAM

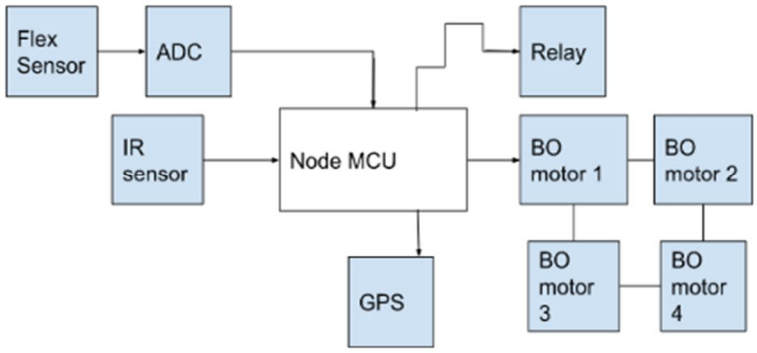


Fig. 2 Block Diagram

III. BLOCK DIAGRAM DESCRIPTION

A. *IR Sensor*



Fig. 3 IR sensor

Infrared technology is found not just in industry, but also in our day-to-day life. for example, Televisions, use an infrared detector to understand the signals sent from a remote control. Passive Infrared sensors are used for motion detection systems, and LDR sensors are used for outdoor lighting systems.

B. *Flex Sensor*

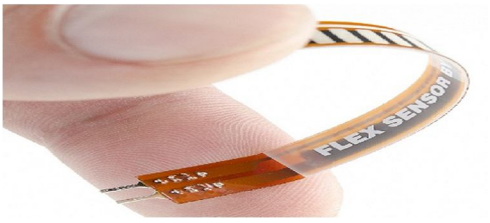


Fig. 2 Flex sensor

A flex sensor is a kind of sensor which is used to measure the amount of bending. The designing of this sensor can be done by using materials like plastic and carbon. The carbon surface is arranged on a plastic strip as this strip is turned aside then the sensor’s resistance will be changed.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
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1) Node MCU



Fig.3 Node MCU

Node MCU is a low-cost open source IOT platform. Initially include Firmware which runs on the ESP8266 Wi-Fi-SoC from Espressif systems & Hardware which was based on ESP12 Module.
Node MCU is an open-source Lua based firmware and development board specially targeted for IoT based Applications
It includes firmware that runs on the ESP8266 Wi-Fi SoC from Express if Systems, and hardware which is based on the ESP-12 module.
There are two available versions of Node MCU as Version 0.9 & 1.0 where version 0.9 contains ESP-12 & version 1.0 contains ESP-12E where E stands for Enhanced.

2) GPS

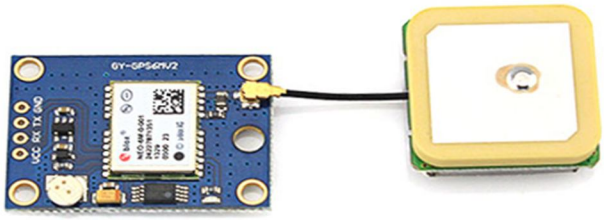


Fig.4 GPS

In this Project we used NEO-6MV2 GPS. The NEO-6MV2 is a GPS (Global Positioning System) module and is used for navigation. The module simply checks its location on earth and provides output data which is longitude and latitude of its position.

3) Relay



Fig. 5 Relay

Relay is an electromechanical device that uses an electric current to open or close the contacts of a switch.
The single-channel relay module is much more than just a plain relay, it comprises of components that make switching and connection easier and act as indicators to show if the module is powered and if the relay is active or no.

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4) Battery Operated Motor

BO (Battery Operated) light weight DC geared motor which gives good torque and rpm at lower voltages. This motor can run at approximately 150 RPM when driven by a single Li-Ion cell. Great for battery operated light weight robots. A specific type of DC geared motors that can be operated through battery and that why known as Battery Operated (BO) motors.

It is used for light weight applications mostly Available in different torque and RPM. BO motor run on the railway track with the help of relay.

IV. ARDUINO IDE SOFTWARE

An official software introduced by Arduino.cc, that is mainly used for writing, compiling and uploading the code in almost all Arduino modules/boards. Arduino IDE is open-source software and is easily available to download & install. Arduino IDE is an open-source software, designed by Arduino.cc and mainly used for writing, compiling & uploading code to almost all Arduino Modules.

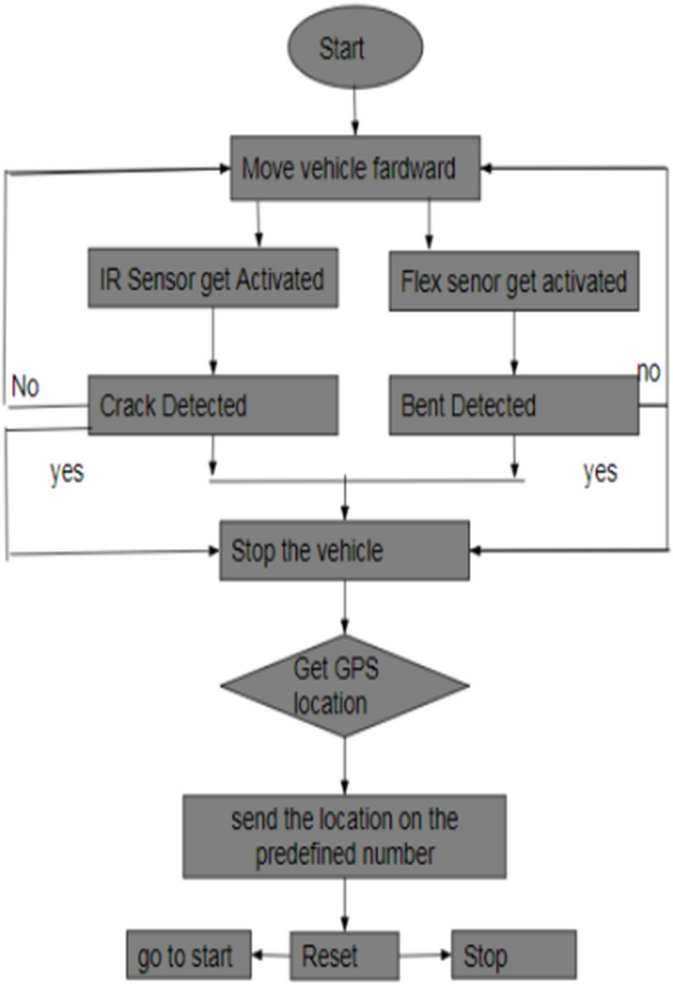
It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process.

It is available for all operating systems i.e., MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that

play a vital role in debugging, editing and compiling the code.

A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro and many more.

V. FLOWCHART



VI. HARDWARE



Fig. 3 Experimental set up

1) Fig. 3 show experimental set up of hardware of the project. In this project set up we used wooden plywood as railway track. We connected battery operated motor to wheels to run the project on the track.
2) We used zero PCB board for connection to GPS, Microcontroller, Flex sensor, IR sensor, Wi-Fi through connecting cables.
3) GPS send exact location via longitude & latitude coordinates in the Arduino IDE software & blynk App on mobile.
4) Microcontroller used is Node MCU ESP8266.It is processing unit it processes the data received from IR sensor & flex sensor & give further to the relay & Battery-operated motor.
5) Flex sensor is connected to detect the bend on the railway track.
6) IR sensor is connected to detect the crack on the railway track.

VII. RESULT & DISCUSSION

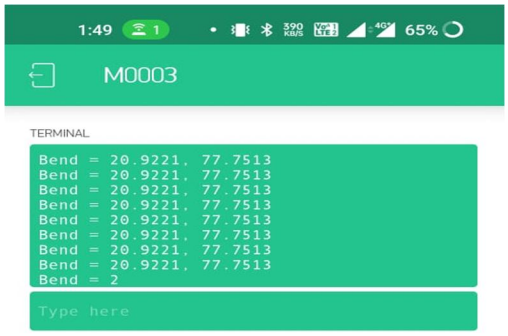


Fig4. shows that the output of bent and their location using Blynk App

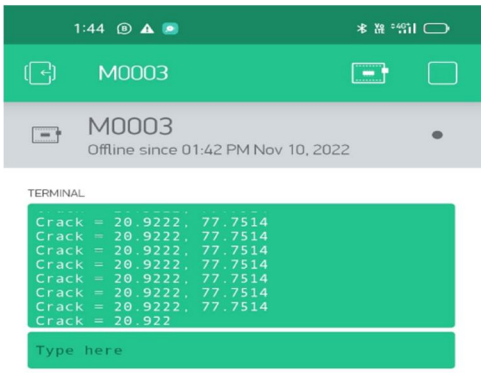


Fig 5 Shows that the output of crack and their location using Blynk App

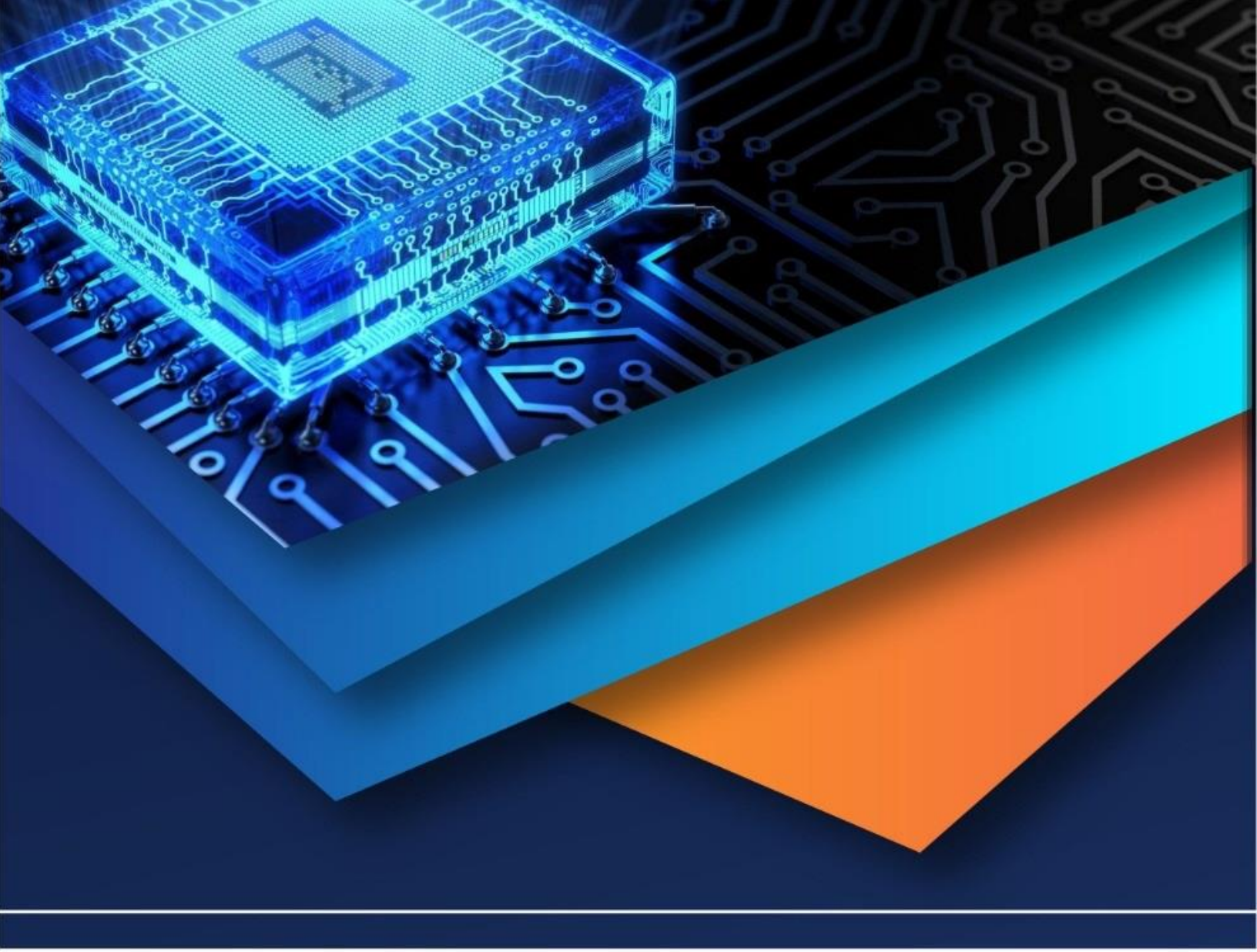
This project gives an idea how IOT can be applied in the railways sector. Using this mechanism, the accident can be prevented due to fast detection of track discontinuity in the railway tracks. This mechanism reduces the usage of manpower. More accuracy in the detection of cracks in tracks. Less time consuming and more effective than manual checking of tracks. This mechanism saves the property damages for the train and also saves the human by preventing accidents. Result shows bent and crack detection in the railway track. The location of bend and crack is shown on the blynk App using IOT application.

As per the study the existing systems are time consuming as well as uneconomical. The proposed system not only overcomes these problems but also improves accuracy and crack detection in rails. It is the most economical solution provided in order to achieve good results for the railways of our country in order to minimize the stats of accidents caused. Thereby saving precious lives of passengers and loss of economy. It also saves the time and money for identification of crack

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