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Automatic crack detection mechanism for railway tracks

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Abstract-The 60% of accidents in railways are due to track problems which lead to derailment. This project presents the system for automatic crack detection in railway tracks. This project can help to detect the cracks or breakages in railway tracks if any before the train passes and the alert signal is sent to the train operator and the brakes are applied automatically to stop the train. The automatic crack detection system is constructed using vibration sensors and MEMS technology. Accelerometer sensor is used to detect the crack which has speed response to vibrations. MEMS are used to detect the track deviations and dislocations. MEMS is Micro Electro Mechanical System that combines electrical and mechanical components. In this project MEMS are used to check the status of the railway tracks and RF modules are used to transmit and receive the signal. Arduino is used to compare the input signals with threshold value at transmitter side. This project is cost effective and simple.

Index words-GSM, GPS, MEMS, Accelerometer, Arduino, LCD

I. INTRODUCTION

The Indian railway network is the fourth largest railway network in the world. It has a track length of 113,617 kilometres over a route of 63,974 kilometres and 7,083 stations. The track is damaged due to weather conditions, floods, earthquakes, cyclones etc. Even though we are in the modern world our rail network is still associated with lack of safety infrastructure. The rail network of India is known carry over 30 million passengers and 2.8 million tons of freight daily. The cracks and other problems on the rail tracks generally unnoticed due to improper maintenance and that have resulted in severe loss of valuable human lives and property as well.This paper proposes a new devicethat utilizes MEMS concept to identify the cracks in the track by measuring vibration. The proposed device monitors vibration level and sendsmessages to the control station when the vibrations on a track are varies beyond the threshold level.This device can be scaled up and implemented on running trains for checking the cracks in track in dynamic situation.

II. LITERATURE SURVEY

[1] Nisthul et al. (2017) made a study and concluded that 25% of the track length is in need of replacement due to the development of cracks on it. He used IR obstacle Sensors assembly system, which detects the cracks along its path, the vehicle is also capable of monitoring the location of the crack by using the GPS module and alerts through SMS messages using GSM module.

[2] Janahanlal P Stephen et al. (2014) conducted an experimental analysis of Innovative Railway Track Surveying with Sensors. Ultrasonic sensor and MEMS sensor are used to detect the cracks in the railway track. By using wireless modules the information is passed to the control section.

[3] K Ono and M Yamada et al. (1989)investigated the rail road vibration and evaluated the vibration difference between with and without crack while train is in running condition. This paper shows the vibration frequency diagram and its difference.

[4] Vinoth kumar et al. (2014)studied the train crack and warning system of the train. Then discussed the connection of the sensor and MEMS and warning system. The sensor detects any obstacle or object is in the track while train is running and the MEMS is used to check the vibration value and check it.

[5] Mohit kumar dodval et al discussed about the measure the track vibration while train is moving condition. The vibration is measured by the ultrasonic sensor. Also measured the vibration in with crack. Here knowing the different vibration for different types of crack and hence showing the image of the signal.

III. EXPERIMENTAL SETUP

An experimental set up is established as shown in fig 7&8. The experimental set up consists of main components likeArduino UNO, MMA7260Q-Accelerometer module, GSM modem, GPS module, LCD, Relays, Train and Track setup.

IV. COMPONENTS USED

1. Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328.It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 Analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button.The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip "Uno" means one in Italian and is named to mark the upcoming releaseof Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward.

Table.1 Description of ardunio uno

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14
Analog Input Pins	6
DC Current per I/O Pin	40Ma

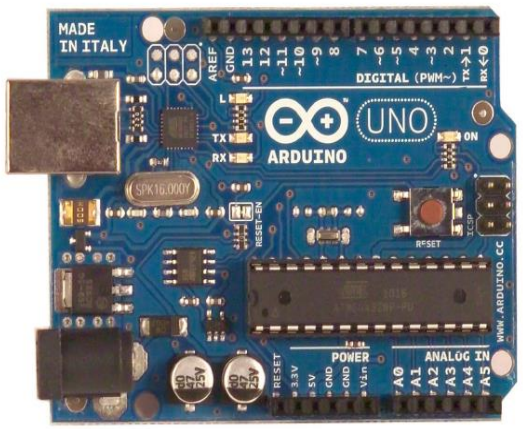

Fig. 1Arduino Uno

2. MMA7260Q-ccelerometer module

MEMS-based accelerometers are used in the track detection module. It is available in 1-, 2- and 3-axis configuration, with analogy or digital output in low-g or high –g sensing ranges. For high g-force MEMS accelerometer 1-2 axis is used. When it experience vibration or shock, it will produce proportional output voltage.A3 Axis Low-g Micro machined Accelerometer module has been used with a sensitivity selection using MMA7260 accelerometer. For high g-constrain MEMS accelerometer 1-2 pivot is utilized. When it encounter vibration or stun, it will create relative yield voltage. They are one of the least complex yet additionally most appropriate miniaturized scale electromechanical gadgets. This Module is also used in Robotic application and other tilt Measurements. The MEMS are used to measure and check the vibration variation and the varying signal is send to the microcontroller. Then it actuate train breaking system and send the signal to department control room for neared junction.

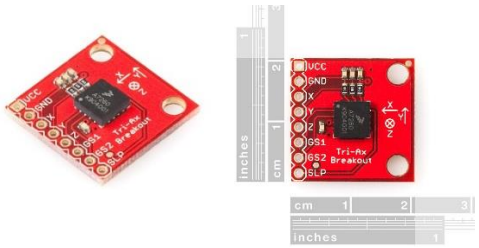

Fig. 2 MMA7260Q-Accelerometer sensor

3. GSM modem

GSM is a wireless modem which works with wireless network. The operation of GSM modem requires a SIM card to identify the subscriber. GSM module has a TXD and RXD pin for interfacing the GSM module with the Arduino UNO. The USART serial input pin RX and TX of the Arduino are connected to the TXD and RXD pins of GSM module. The GSM module can be interfaced with either RS232 or TTL. The module's voltage characteristics are 6.5V minimum and maximum of 15V respectively with500Ma maximum current. This component is connected to the Arduino for its activation. It works to measure the vibration value while train is running. After measuring the vibration value, it sends signal to MEMS. Then MEMS checks the vibration value with threshold level. The GSM modem having a sim port to insert the sim card. It will send the location sms to nearby junction. The location will be known by GPS module.

Fig. 3 GSM Modem

4. GPS module

The GPS module computes the geological position of the crack on the railway track. The module has 4 sticks fundamentally 5V,TXD, RXD and GND. TXD is transmit stick of the module and it is the yield pin.TXD is TTL rationale compatible. RXD is to the get stick of the module and GND is the ground. GPS module is interface with Arduino UNO, the TXD stick of the GPS and TTL is connected to RXD stick of the Arduino. The module has high affectability and low power utilization of around 50 mA. The module gives current time, date, longitude, latitude, speed, height and travel course/heading among other information. This finds the correct position of the crack. The GPS module will be activated by theArduino UNO when crack is detected. The crack location signal is send to GSM modem and it send the sms to nearby junction.

Fig. 4 GPS Module

5. Liquid Crystal Display (LCD)

A Liquid Crystal Display known as LCD, is essentially a display unit fabricated utilizing Liquid Crystal innovation. When we assemble genuine living/certifiable hardware based ventures, we require a medium/gadget to show yield esteems and messages. The most essential type of electronic display accessible is 7 Segment. The following best accessible choice is Liquid Crystal Displays which comes in various size determinations. Out of all accessible LCD modules in advertise, the most regularly utilized one is 16×2 LCD Module which can show 32 ASCII characters in 2 lines (16 characters in 1 line). Other ordinarily utilized LCD shows are 20×4 Character LCD, Nokia 5110 LCD module, 128×64 Graphical LCD Display and 2.4 inch TFT Touch screen LCD show.

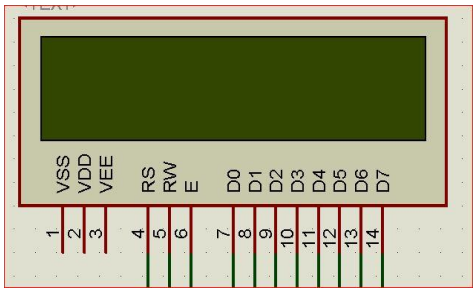

Fig. 5 LCD Display

6. Relay

Relays are electrically controlled switches. In the typical sort, a loop pulls in an armature when adequate curl current streams. It is accessible for DC or AC excitation and loop voltages from 5 volts up to 110 volts. The electrical hand-off offers a straightforward on/off exchanging activity in light of a control flag. At the point when a current moves through the loop of wire an attractive field is created.

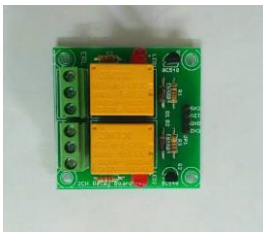

Fig. 6 Relay

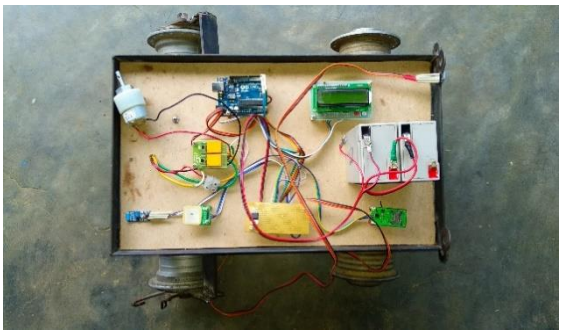

Fig. 7 Prototype model

Fig. 8 Prototype model with railway track

V. WORKING PRINCIPLE

The proposed system uses Arduino UNO.Whenever a proper power is given to the embedded module i.e., 12 Volt and 2 Ampere current.When the prototype model of train fitted with vibration measuring device moves on track, the vibration created on the prototype model would

be measured by the accelerometer sensor. That the vibration values from accelerometer sensor are noted and verified by the Arduino board to the threshold vibration value. AT commands initializes the GSM modem. When the vibration value change above or below the threshold level the crack has been detected. At that time automatically a message with Latitude and longitude value from the GPS module is send to the authority and an automatic brake may applied and the prototype model had stopped at the position of the crack detected.

VI. RESULT DISSCUSSION

As the railway network is one of the important means of transport in India by which most of the commercial transport is carried out, the safety of the whole system is equally important and must be taken care of efficiently.This paper, has presented and designed robust MEMS based railway crack detection mechanism.The discussed detection system has used the most compact modules like GSM, GPS, and MEMS-accelerometer which can be implemented easily in the present scenario.The vibration measured on track having different crack sizes are presented in fig 9, 10 & 11.

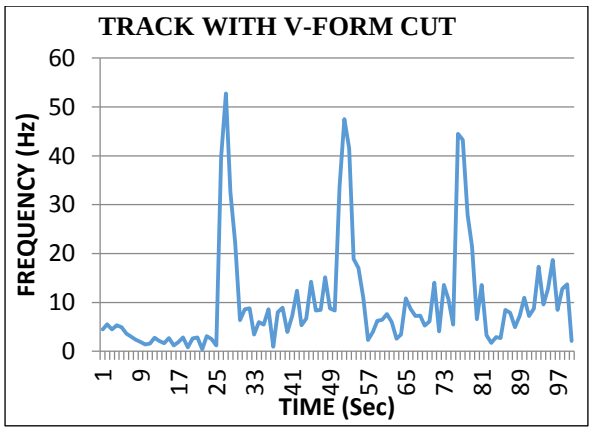

Fig 9. Track with V-form of cut

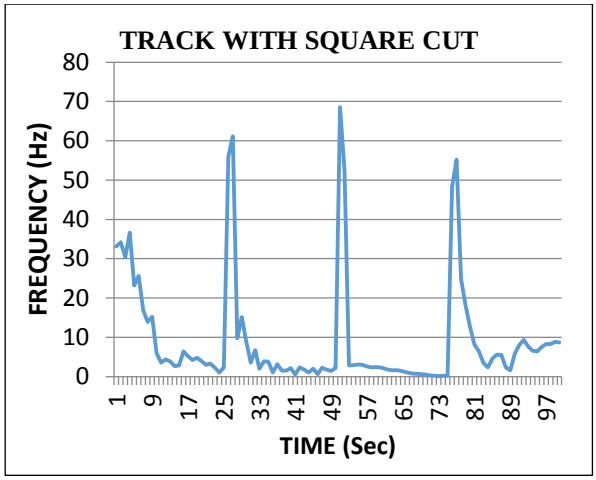

Fig 10. Track with square form of cut

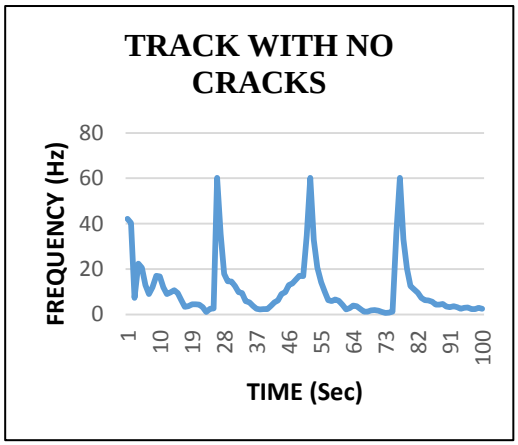

Fig 11. Track with no cuts

VII. REFERENCES

[1] *Nisthul G., "Automatic Railway Track Crack Detection System", volume 3, Issue 4, 2017, pp. 2272 – 2275.*

[2] *Janahanlal P Stephen., "Innovative Railway Track Surveying With Sensors and Controlled By Wireless Communication", Volume 2, Issue 2, April – May 2014, pp. 1 – 4*

[3] *K Ono and M Yamada. "Analysis Of Railway Track Vibration", Volume 2, Issue 3, September 1989, pp. 269 – 297.*

[4] *S Vinoth Kumar "Detection and Warning System for Railway Track Using Wireless with Multi Sensor", Volume 5, Issue 5, May 2014, pp. 102 – 107.*

[5] *Mohit KumarDodval., "Railway Track crack detection using vibration analysis", Volume 4, Issue 7, March 2017, pp. 1077 – 1081.*