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Railway Track Security System

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***Abstract* –Railway is the backbone of transport system in India. Rail accidents occur more due to derailments than collision or fire in trains. These derailments are due to cracks in the railway tracks. Therefore, there is an immense need of crack detection and security system. This paper proposes the crack detection system in the rail tracks. This is to avoid rail accidents by using latest communication technologies. In this project GSM communication protocols are used to convey the message of crack detection via SMS. Crack detection is achieved by using the concept of eddy current losses implemented in the terms of darlington pair circuit. With the detection of cracks, the system also alerts the railway authorities facilitating the security system.**

Keywords: Crack detection, Eddy current loss, Security system, GSM

I. INTRODUCTION

In all transport systems, particularly in case of railways, safety and reliability are highly considered. There is a view that the current regulatory framework does not provide full set of tools to effectively deal with railway accidents and main-track derailments. There is also a view that the current framework needs to be modernized and better aligned with safety legislation that applies to other modes of transport in India. In recent years, with the development of railways, capability of the trains is constantly improving.

The organization of paper is as follows: Section II discusses the statistics of rail accidents in India along with the recent methods used for crack detection in railway system. Section III gives details about the block diagram of this project and section IV discusses results. Section V concludes the project in brief.

II. LITERATURE SURVEY

India has fourth largest rail network in the world comprising 115,000 km of railway tracks. Approximately, 60% of rail accidents are due to derailments, of which, 90% are due to cracks problems [1]. The Indian Railway Safety Act, which came into effect in January 1989, was designed to improve rail safety by managing rail safety regulatory frame work, together with streamlined regulation development and process, and providing railway companies with greater freedom. Since 2002, there has been an increase in railway accidents mainly due to train derailments. Accordingly, in December 2006, the government announced the Railway Safety Act Review to further improve railway safety in India and to promote a safety culture within the railway industry while preserving and strengthening the vital role this industry plays in the Indian economy.

Long range ultrasonic techniques along with radiography technique are the methods used for crack detection [2]. Wireless sensor network method [3] and electromagnetic system [4] are also used in detecting rail cracks.

Ultrasonic rail flow detection is carried out with two different types of equipments viz. single rail tester and double rail tester. Long range ultrasonic testing technique is proposed as a complementary inspection technique to examine the foot of rails, especially in track regions where corrosion and associated fatigue cracks are likely to happen. A suitable array of transducers is developed that is able to generate selected guided wave modes in rails which allow a reliable long range inspection of the rail. The characteristics of ultrasonic guided waves in the rail complex geometrical profile have been identified [5].

Digital X-ray radiography offers new possibilities and advantages in rail-wield evaluation over traditional film radiography based on gamma rays. Rail wields have been traditionally weak link in the rail network which has always been very difficult to evaluate accurately. Portable digital X-ray equipment can give information regarding the actual state of suspect rail wields [6].

In wireless sensor networks method the detection of cracks can be identified using infrared rays with the IR transmitter & receiver. IR receiver is connected to the signal lamp or electrified lamp with the IR sensor. Control Area Network (CAN) controller is connected to the main node and it sends the information via global system for mobile communications and transmit the message to railway engine and to the nearest railway station [3].

An electromagnetic system for rail detection and traction enhancement comprises, in a preferred embodiment, wheel axles, wiring coils around the wheel axles, respectively. It also consists of a power source coupled to the wiring coils for supplying power to produce electromagnetic flux. The wiring coils produce opposite magnetic north and south pole pairs on the axles [4]. The system also has provision for monitoring the flow pattern for locating the position where the crack pattern is detected as open. The flaws related to missing bolts or loosening of the fixtures at the railway track are inspected

The existing systems are more complicated and time consuming. Hence, this paper proposes a more reliable and less time-consuming mode of crack detection in the railway tracks. This is a real time application which can be performed easily.

III. BLOCK DIAGRAM

This section discusses the block diagram of work proposed by author in this paper. Fig.1 shows the block diagram of crack detection on railway tracks. The circuit uses standard power supply comprising of a step-down transformer from 230 Volts to 12 Volts and 4 diodes forming a bridge rectifier that delivers pulsating DC which is then filtered by an electrolytic capacitor of about 470 microFarad to 100 microFarad. The filtered DC being unregulated, IC LM7805 is used to get 5V constant at its pin number 3 irrespective of input DC varying from 9V to 14V. The regulated 5V DC is further filtered by a small electrolytic capacitor of 10 microFarad for any noise so generated by the circuit. One Light Emitting Diode (LED) is connected to this 5V point in series with a resistor of 330 ohms to the ground i.e. negative voltage to indicate 5V power supply availability.

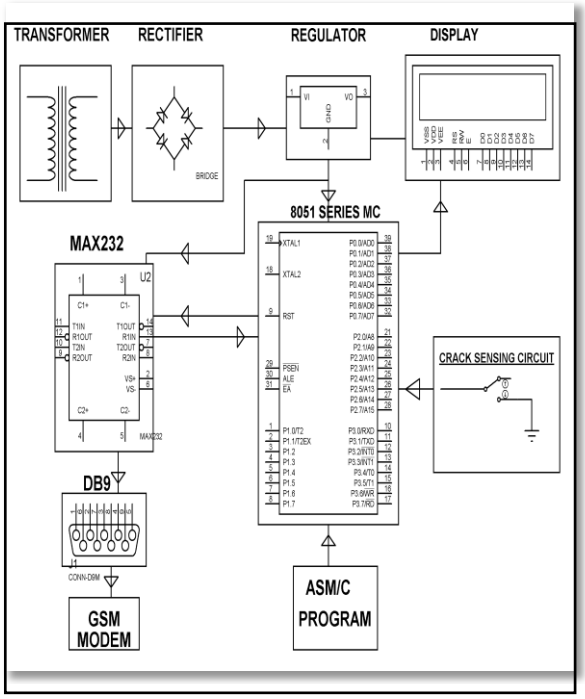

Fig 1.Block Diagram for Crack Detection on Railway Track

8051 microcontroller is a low cost, low-power, high-performance, most compatible 8-bit microcontroller. It is a 40 pin IC. It has 8K bytes of flash, 256 bytes of Random Access Memory (RAM), 32 I/O lines, watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. The MAX232 is an integrated circuit that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits, so that devices working on TTL logic can share the data with devices connected through serial port (DB9 Connector). The DB9 (originally DE-9) connector is a 9-pin plug mainly used for serial connections, allowing for the asynchronous transmission of data as provided by standard RS-232.

A GSM modem is a specialized type of modem which accepts a Subscriber Identity Module (SIM) card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. A GSM modem exposes an interface that allows applications to send and receive messages over the modem interface.

Liquid Crystal Display (LCD) is the example for the parallel port. This example doesn't use the bi-directional feature found on newer ports, thus it should work with most, if not all parallel ports. These LCD modules are very common these days, and are quite simple to work with, as all the logic required for running them is on board.

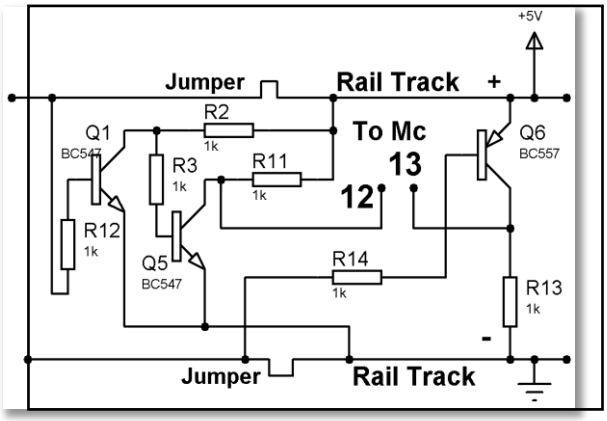

Fig.2. Crack Sensing Circuit

Fig.2 shows the crack sensing circuit. The railway track security system uses transistors Q_1 & Q_5 together with one more BC557 (Q6) in conducting mode, such that pin numbers 12 & 13 are held "HIGH" in normal situations. The crack on the railway track is initiated by two connectors. One is fed to Q_1 through R_{12} while the other is fed to Q_6 through R_{14}. One connector disconnects the positive supply while the other connector disconnects negative supply. While the shorting clip (jumper) is in place it could mean that Q1 is ON and Q5 is OFF. Also, Q6 is in ON state placing logic high at Pin Number 12 & 13 of the microcontroller. While the positive shorting clip is removed Q1 doesn't conduct and Q5 starts conducting making pin 12 of microcontroller low. When negative shorting clip is removed Q6 stops conducting making pin 13 of Microcontroller logic zero, for the program while executing sends a warning message via GSM Modem to the station master's mobile number for necessary action. The project uses a GSM modem duly interfaced to the microcontroller through the level shifter IC MAX232.

Software required is Kiel complier. Compilers are programs used to convert a High Level Language to object code. The language used can be Assembly language or Embedded C. Compared to assembly language, C code is more reliable, scalable, easy to debug and more portable between different platforms. Also, C language is processor-independent. This makes it convenient for a user to develop programs that can run on most of the systems.

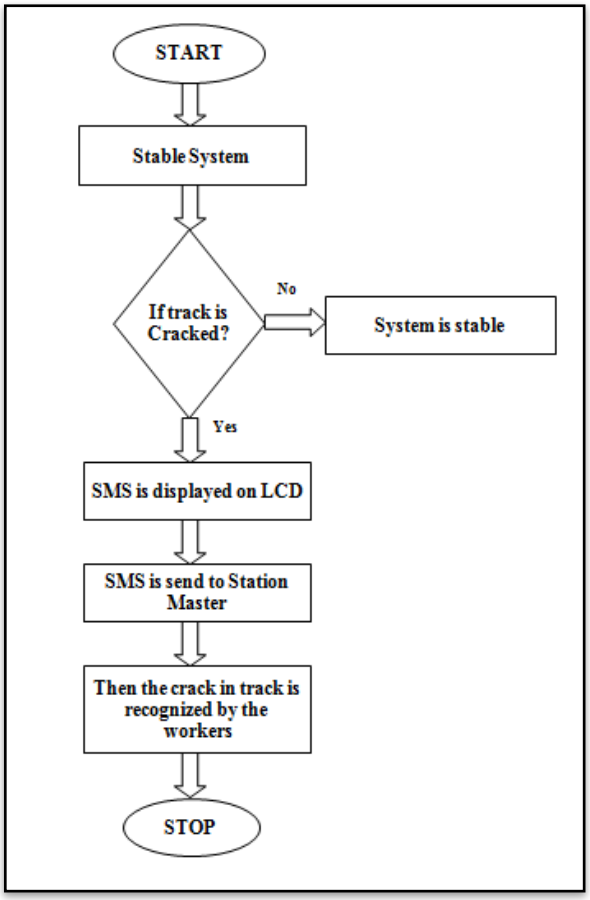

Fig.3. Flow Chart

IV. RESULTS AND DISCUSSIONS

The proposed system sets an example on how to use wireless network efficiently for railway track crack detection and the technology can be used at domestic and at commercial places. Instead of manual method of crack detection a more advanced technology is used to alert the railway office about the detected cracks immediately.

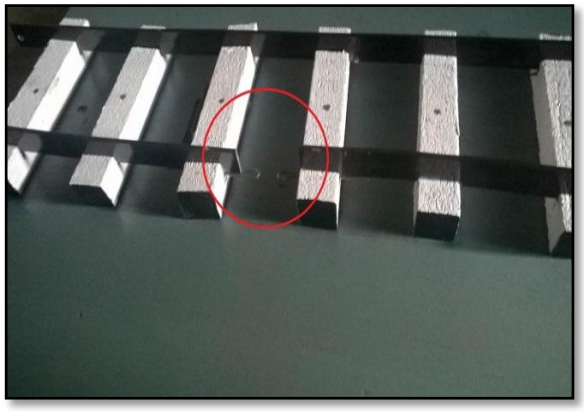

Fig.4. Photograph of Implemented model of Rail tracks

Fig.4 shows the implemented small scale model of railway tracks. The scaling model formed to demonstrate this project has two rails forming part of track. The rail tracks are connected with a detachable jumper (encircled) in between each track. Presence of jumper in the link represents the ideal case i.e. the railway track without the crack/flaw. Removing the jumpers result in delivering a different logic to the microcontroller which thereafter sends an SMS through GSM modem and the status of track condition is displayed.

V. CONCLUSION

This paper shows the implementation of the railway crack detection circuit and security system. The main component of the system is the crack detection circuit. The GSM Modem helps to alert the railway authorities about the crack in the tracks. Thus, an automated crack detection and security system is proposed in this paper which makes the system more reliable, less time consuming and has reduced man power requirement.

VI. REFERENCES

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