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RESEARCH ARTICLE

RAILWAY TRACK MONITORING USING RF MODEM

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ABSTRACT

This paper investigates project of Railway track monitoring system using RF modem and Op-amp as a Comparator. This project consist of RF modem, Microcontroller, Comparator as current sensor, Project Window on VB 6.0for application of communication purpose, crack detection and approximate position indication of crack at control room PC respectively .The VB 6.0 and RF modem help us to find and send railway geometric parameter of crack detection to nearest railway station. In the present days, we are using the IR-LDR, IR-Photo diode, ultrasonic sensor, microwave antenna, Electromagnetic acoustic transducer (EMAT) for crack detection with less accuracy, high cost, which require man power to operate it, but we use the low cost sensor of current for above procedure with high accuracy to reduce man power. Project is applicable both during day and night time detection purpose.

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INTRODUCTION

In today's world, transport is a key factor because in its absence it would be impossible for products to be absorbed in areas which are not in the prompt vicinity of the production centres. Transport being one of the biggest drainers of energy, its ability to sustain and safety are issues of supreme importance. Despite being for the wrong reasons, Indian railways have been regularly in the news.

The frequency with which train accidents have been taking place has led to serious doubts in the public mind about the safety of rail travellers and the health of the network. Against this background, an attempt has been made in this paper to mitigate the railway accidents up to a great extent. The derailment problem has often result in damage to human lives and property.

The survey in 2011 until the month of July review that the frequency of accidents is going on increasing and in that year itself 11 accidents occurred due to improper railway track. To explain the crux of the problem, the accidents in railways are because of 60% derailments and 90% crack problems, inattentive of natural or antisocial reasons. Hence this problem of cracks on railways has became a critical problem which has to be dealt with paramount importance and attention due to its high frequency of usage. This problem issues of cracks which is in major proportion, contributes to major train accidents are unnoticed. Due to the irregularity in manual track line monitoring and maintenance. So as to avoid this drastic condition of Indian railway networks from stepping down still more, automated systems which do not rely upon the manual labour is brought into the vision.

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Because of the crucial repercussions of this problem, this paper presents an implementation of an efficient and profitable solution which is suitable for large scale applications .With the arrival of powerful digital signal processing, Image Processing techniques (Qiao Jian-hua *et al*., 2008) have been explored to formulate solutions to the problem of railway crack detection. Though it afford good and use full accuracy, this method uses techniques like image segmentation. The use of microwave antennas in crack detection (Vijayakumar *et al*., 2009) is investigated in research. Another important approach for crack detection is infrared sensing (Tranverse crack detection in rail head using low frequency eddy currents, Patent US6768298, www.google.com /patents/ US6 768298. and Cacciola *et al*., 2010) which seemed to be more suitable but later it became inaccurate. Other techniques based on ultrasonic (Wojna rowski) also contributed to the detection scheme but they can investigate the crux of the track rather than investigating for surface cracks and the surfaces faults are located. Several other methodologies (Richard J *et al*., 2007) (R.J. Greene *et al.*, 2004) and techniques like observation and study of the wave propagation involving model impacts and piezo actuation came into light but the approaches are exorbitant.

The problem innate in all these techniques is that the cost obtained is high. Hence this paper proposes a cheap, novel yet simple strategy with sufficient ruggedness suitable to the Indian scenario that uses OP-AMP as a Comparator arrangement to detect the crack in railway lines, which proves to be profitable as compared to the existing methods.

Conventional System

The existing system has railway labourers walking on the tracks and recognizing the cracks manually. This requires a

lot of effort and labour cost. In some countries railway track crack reorganization is carried out using infrared sensors. They cannot be used if there are external disturbances like perilous weather and poor climatic conditions. Another technique practiced is detection using LED-LDR sensors where LED will be placed on one side of the rails and the LDR to the opposite side. During normal operation, the LED light does not fall on the LDR, when no cracks are present and hence the LDR resistance goes high. Consequently, the resistance of the LDR gets reduced and the amount of reduction will be nearby proportional to the intensity of the incident light when the LED light falls on the LDR. This method cannot be used during night hours and in the slabs of the track. All these existing systems are less authentic and time consuming.

Proposed System

The core of the proposed crack detection arrangement consists of a OP-AMP as comparator assembly that functions as the rail crack detector. The principle involved in crack detection is the perception of comparison of voltage level at input of comparator. In the proposed design, +5V volt will be attached to both side of the rail tracks and +2.5V set as reference voltage for inverting terminal of comparator and non-inverting terminal is connected to the track.

During normal operation, when there are no cracks, the comparator output is high. Subsequently, when the non-inverting pin voltage level goes down less than +2.5V then comparator output goes low, immediately "CRACK DETECTED" message display on LCD screen as well as position of crack is display on PC Monitor in VB 6.0 project, buzzer is on. To communicate the received information, RF modem used which is connected to PC through RS232 serial port.

Block Diagram

The various components in the block diagram are mentioned below:

- AT89S52 Microcontroller
- Power Supply (+5V, +12V)
- Crystal Oscillator (11.0952 MHz)
- Buzzer
- 16x2 Liquid Crystal Display(LCD)
- MAX 232
- RF Modem
- LM 358 OP-AMP
- Relay
- PC

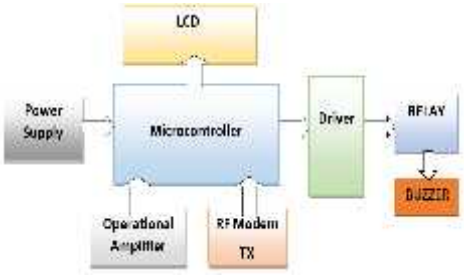

Figure 1 Transmitter Section

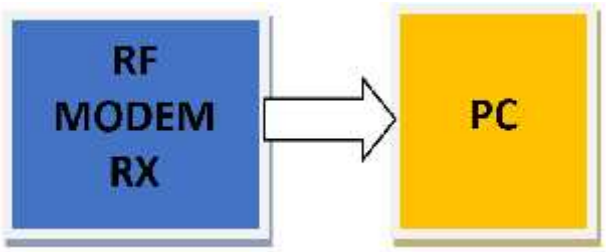

Figure 2 Receiver section

Figure 3 RF Modem

Figure 4 working of circuit LCD showing 'CRACK DETECTED'.

Electrical Design

Microcontroller Unit

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of insystem programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology and is consistent with the industry-standard 80C51 instruction set and pinout. The on-chip Flash allows the program memory to be modified in-system or by a conventional nonvolatile memory programmer. By connecting a adaptable 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel

AT89S52 is a powerful microcontroller which provides a profitable solution to many embedded control applications.

Features

- Compatible with MCS®-51 Products
- 8Kb of In-System Programmable (ISP) Flash Memory – Endurance: 10,000 Write/Erase Cycles
- 4.0V to 5.5V Operating Range
- Fully Static Operation: 0 Hz to 33 MHz
- 3-level Program Memory Lock
- 256 x 8-bit Internal RAM
- 32 Programmable I/O Lines
- Three 16-bit Timer/Counters
- Eight Interrupt Sources
- Full Duplex UART Serial Channel
- Low-power Idle and Power-down Modes
- Interrupt Recovery from Power-down Mode
- Watchdog Timer

Power Supply

The input to the circuit is tested from the regulated power supply. The microcontroller voltage is of 5V. The A.C. input i.e., 230V from the mains supply is step down by the transformer to 12V and is fed to a rectifier. The output accomplished from the rectifier is a pulsating D.C voltage. So in order to get a pure D.C voltage, the output voltage from the rectifier is fed to a filter to pull out any A.C components present even after rectification. Now, this voltage is given to a voltage regulator to achieve a pure constant dc voltage. We are using an IC 7805 as voltage regulator to get a 5V output Voltage.

Crystal Oscillator

A crystal oscillator is an electronic oscillator circuit that makes use of the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency. This frequency is generally used to keep track of time (as in quartz wrist watches), to provide a balanced clock signal for digital integrated circuits, and to maintain frequencies for radio transmitters and receivers. The most common category of piezoelectric resonator used is the quartz crystal, so oscillator circuits designed around them known as “crystal oscillators”. This block provides important frequency sine wave to the micro controller. This frequency is transformed to square wave within the micro controller.

D. MAX232

The microcontroller can communicate with the serial devices testing its single serial port. The logic levels at which this serial port function is TTL logics. But some of the serial devices function at RS 232 logic levels. So in order to communicate the microcontroller with modem, a mismatch between the logic levels occurs. In order to avoid this mismatch, in other words to match the Logic levels, a serial driver is used. A MAX232 is a serial line driver used to establish communication between modem and microcontroller.

E. RF Modem

The CC2500 is a low-cost 2.4 GHz transceiver designed for very low-power wireless applications. The circuit is planned for the 2400-2483.5 MHz ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency band. The RF transceiver is combined with a highly configurable baseband modem. The modem supports various modulation arrangements and has a configurable data rate up to 500 k Baud. CC2500 provides extensive hardware support for packet handling, data buffering, burst transmissions, clear channel assessment, link quality indication, and wake-on-radio. The main executing parameters and the 64- byte transmit/receive FIFOs of CC2500 can be controlled via an SPI interface. In a typical system, the CC2500 will be well adjusted together with a microcontroller and a few additional passive components.

Feature

- High sensitivity (–104 dBm at 2.4 kBaud, 1% packet error rate)
- Low current consumption (13.3 mA in RX, 250 k Baud, input well above sensitivity limit)
- Programmable output power up to +1 dBm
- Excellent receiver selectivity and blocking performance
- Programmable data rate from 1.2 to 500k Baud
- Frequency range: 2400 – 2483.5 MHz
- OOK, 2-FSK, GFSK, and MSK supported
- Suitable for frequency hopping and multichannel systems due to a fast settling frequency synthesizer with 90 us settling time.

F. OP-AMP

- The LM158 series consists of two nonpartisan , high gain, internally frequency compensated operational amplifiers which were constructed specifically to operate Internally Frequency Compensated for Unity Gain from a single power supply over a wide range of Large DC Voltage Gain: 100 dB voltages. Procedure from split power supplies is also possible and the low power supply current drain is (Temperature Compensated) independent of the magnitude of the power supply voltage.

CONCLUSION

This paper makes an attempt in providing a viable solution in making the railway tracks crack free with comparator based railway detection scheme. We hope that our idea can be implemented in the long run to expedite better safety standards and provide effective testing infrastructure for achieving better results in the future.

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