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IR Sensor Based Crack Detection of Railway Track Using GSM & GPS System

Parag Nikhar¹, Rakesh Pise², Avinash Shelar³
^{1,2}Student, ³Assistant Professor, Electrical Engineering
DES'sCOET Dhamangaon (Rly), Maharashtra, India

Abstract: Today, India has possesses the fourth largest railway network in the world. In India, most of the commercial transport is transfer by the railway network from one place to another network and therefore, any problems occur in the same has the capacity to create major damage to the economy. However, in terms of the reliability and safety parameters, we have not provide protection to the traction system. The main problem occurs in the railway track is detection of cracks in the structure. If these deficiencies are not manage or protect at early stages they might lead to a number of derailments resulting in a heavy loss of life and railway property. This paper proposes a cost effective solution to the problem of crack detection of rail track utilizing IR sensors which detect the exact location of faulty tracks which then system operated immediately so that many lives will be saved and avoid the railway accident This project is implementation of with LPC2148 microcontroller using GSM module and GPS receiver. Here IR sensors are used to found the crack in the track, whenever crack is detected GPS receiver receives the location information. This information of the crack detecting is send to the railway authority by using GSM system. Whenever the crack is detected a buzzer will be activated to alert the surroundings and message will send automatically to the controlling station of railway authority.

Keywords— Transport, Efficient, Detection, Derailment, GSM, Liquid Crystal Display (LCD), GPS.

I. INTRODUCTION

Depending on the fast developments in railway systems, high-speed trains are used, and rail transportation is increased day by day. Today's most of the people uses railway for transportation, it is essential for transferring the goods and passengers from one place to another place. And also the railway system are provide facility such as high speed, with economical, environment friendly, safety, and better characteristics of railway systems. These characteristics can be performed by time to time maintenance and control measurements. But depending on different factors, deformations and derailment may occur on the superstructure of railways. These derailments and other problems of railway system like, improper maintenance and the currently irregular and manual track line monitoring mistake from workers. Such deformation and derailment are determining on time and taking precautions is very important for the safety of railway systems. Therefore effective solution system is design on this problem is introduced in this paper. For providing protection to the railway accident because of cracks occur in the rail road ,we design a detection system of cracks in the track based on IR sensor which is operated with GSM & GPS technology. It is used to determine the exact location of railway deformations and send message to the controlling station and signal system of railway will be stop automatically. This system also used in another application where cracking problem are occur. The accuracy of this system is high therefore no any problem are occurs in the detection of crack. Due to simple concept are design in this system, the installing this system on actual work are easy due to the simple design system.

II. PROPOSED SYSTEM AND ITS COMPONENTS

In this proposed system we use LPC 2148 microcontroller. It is a low power, high speed technology. LPC 2148 is a low cost and easy to program microcontroller. It is the widely used IC from ARM-7 family. Before the start of the rail- way line scan the robot has been programmed to self-calibrate the IR Transmitter and Receiver. After measurement, the robot takes time for a predetermined period so that the on board GPS module starts detecting the correct geographic location. The principle involved in this crack detection is that light reaching the IR receiver is proportional to the intensity of crack i.e. when maximum light transmitted by transmitter reaches the receiver the crack intensity is more. The IR transmitter will be attached on one rails track and the IR receiver mounted on opposite rails track. During normal operation, when there are no cracks, the light from transmitter does not fall on the receiver and hence the set value is low. When the light from transmitter falls on the receiver, the value gets increased and the amount by which it is incremented will be proportional to the intensity of the incident light. As a consequence, when light from the transmitter deviates from its path due to the presence of a crack or a break, a sudden increase in the value can be observed.

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This change in value indicates the presence of a crack or some other similar structural defect in the rails. In order to find out current location of crack in rail track, here we use of a GPS receiver whose function is to receive the current data form faulty location. To communicate the received information, we make a use of GSM modem The GSM module is being used to send information as an SMS. The system working is achieved by interfacing the GSM and GPS modules with the LPC2148 microcontroller. The robot having four wheels which are drive by using two motor and this powered by two 12V batteries. This design is very simple and sensible therefore device easily works.

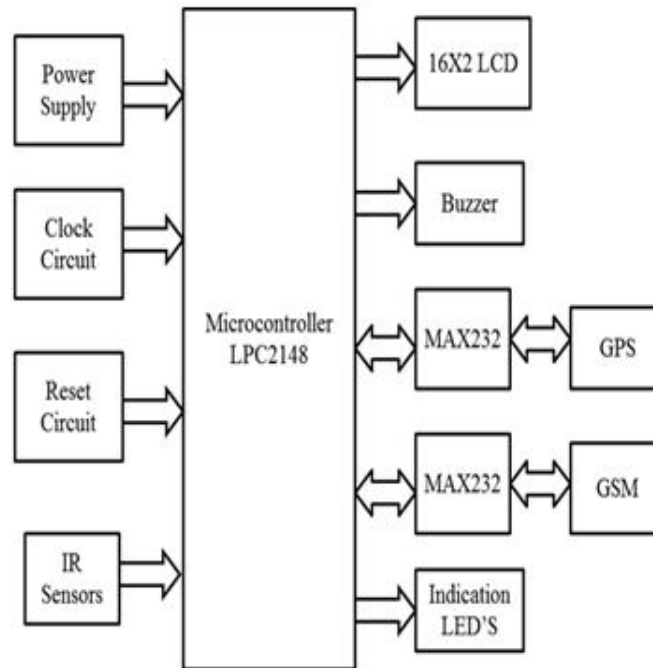


Fig -1: Functional Block diagram

This proposed system uses the GPS/GSM system will send accurate, dependable and timely information to the controlling station. GPS module detect the train location and transfers the information to the controlling unit via GSM. The availability of such information allows the Train, and for train location controller take accurate decisions. Location data can be further processed to provide signal to the system of signalling and it operate on train location. Therefore the time taken for detecting the crack in the track is less and operate easily.

III. REQUIRED COMPONENTS

There are various component use in the system which are as follows:

A. LPC2148 Microcontroller

The LPC2148 microcontroller board based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontrollers with embedded high-speed flash memory ranging from 32 KB to 512 KB. It is manufactured by Philips semiconductor. A 128-bit wide memory interface and unique accelerator architecture provide 32-bit code execution at the maximum clock rate. The meaning of LPC is Low Power Low Cost microcontroller. This is 32 bit microcontroller. This microcontroller having small size and minimum power consumption.

B. Infrared Sensor

Infrared sensor is a electronic device, which emits and sense some aspects of surroundings. IR sensor also detects the motion and measure the heat of an object. In the infrared spectrum, all objects are radiate in the form of thermal radiations. These kind of radiations are invisible to our eyes, which is detected by an infrared sensor. The emitter is same as that of an IR LED (Light Emitting Diode) and the detector is same as that of IR photodiode. When IR light falls on the photodiode, output voltage and resistance change in the proportion to the magnitude of the IR light received.

C. LCD (Liquid Crystal Display)

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LCD (Liquid Crystal Display) screen is nothing but an electronic display module and it is used for various applications. A LCD display is a 16x2 basic module. Basically this is used in various devices. This display has seven segments and other multi segment LEDs. The LCDs are economical and easily programmable. A .6x2 LCD display the 16 characters per line and there are 2 such lines. In this LCD is displayed in 5x7 pixel matrix in each character.

D. Buzzer

Piezoelectric buzzer is an electronic device which commonly used to produce sound. Low weight, simple construction and economical make it usable in various applications like car reversing indicator, computers, mobiles bells etc. Piezoelectric buzzer is works on the inverse principle of piezoelectricity which is discovered in 1880 by Jacques and Pierre Curie. It is a principle of generating electricity when mechanical pressure is applied to certain materials. This type of materials is known as piezoelectric materials. Here in this project buzzer is used to produce sound whenever robbery occurs.

E. GSM (Global System for Mobile Communications)

Global System for Mobile Communications system is the most popular standard for mobile telephony systems in the global. The GSM is one the wireless networks which has low power and low cost communication device. The GSM Association, its support industry trade organization of mobile phone carriers and manufacturers, estimates that 80% of the global mobile market uses the standard. GSM is used by over 1.5 billion people in world across more than 212 countries. A GSM modem is a specialized type of modem which is provided slot for SIM card, and it operate just like a mobile phone. When a GSM modem is connected to a microprocessor kit it allows the microprocessor communicate with mobile network for sending message to the programming set mobile number.

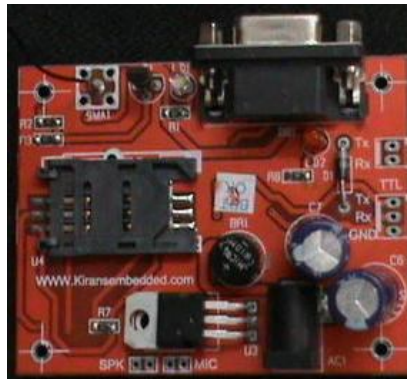


Fig -2: Circuit Diagram

F. Power Supply Circuit

The whole electronic system is depend on the power supply for providing the required power for their operational circuit. For the LCD, GSM, microcontroller keyboard, +5V are required and for operating buzzer +12V is required. The power supply supplied the regulated output of +5V & non-regulated output of the +12V DC supply.

G. Crystal Oscillator

A crystal oscillator is an electronic oscillator circuit which uses the mechanical resonance of a vibrating crystal of piezoelectric material to produce an electrical signal with a very precise frequency. This frequency is generally used to keep track of time to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers. Quartz crystal is the most common type of piezoelectric resonator used, so the oscillator circuits making around them became a called as "crystal oscillator", but other piezoelectric materials including polycrystalline ceramics materials. Crystal is the common term used in electronics for the frequency determining component, wafer of ceramic and quartz crystal with electrodes connected to it. This block of crystal oscillator generate sine wave frequency and send to the micro controller. This frequency is converted into the square wave within the microcontroller.

H. Max232

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The MAX232 is an integrated circuit which is created in 1987 by Maxim integrated products that converts signals from a TIA-232 serial port to signals suitable for use in TTL- compatible digital logic circuits. The MAX232 is a dual transmitter/dual receiver that mostly is used to change in the signals like RX,TX,CTS,RTS. Microcontroller can communicate with the serial devices by using single serial port. The logic levels at which the serial port operates in TTL logics. But some of the serial devices operate at RS232 logic levels. Therefore the microcontroller is communicating with modem, a mismatch between the logic levels occurs. In order to ignored this mismatch, in other words to match the logic levels, a serial driver is used. A MAX232 is a serial line driver which is used to connect the communication between modem and microcontroller.

I. IR-Photo Diode Assembly

This module basically works on the principle of reflection of infrared rays from the incident surface. A regular beam of IR rays is emitted by the IR LED. Whenever a reflecting surface comes in front of the receiver, these rays are reflected back and captured. The common 5V IR and photo diode are The IR is powered using one of the digital pin of the LPC 2148. The photo diode and a 45kΩ resistor form a potential divider arrangement are provide. The output of the potential divider is given to one of the analogue input channel of the LPC 2148

IV. RESULT & CONCLUSION

In this paper, we have presented the IR sensor based crack detection of railway system GSM & GPS technology. The crack can be detected easily & it does not give the false output. GSM base crack detection system automatically detects the faulty rail track without any human interface. This method having many advantages on traditional detection techniques. The main advantages of this system like less cost, low power consumption, on time data operation and minimum analysis time. The simple idea can be implemented in large scale in order to have long run to facilitate better safety and provide effective testing infrastructure for achieving better results in the future.

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BIOGRAPHY



Mr. Parag D. Nikhar
EMAILID:nikharparag@gmail.com
Contact no: 9420833592
Pursuing B.E. in Electrical (E&P)
Engineering from Sant Gadge Baba
Amravati University (SGBAU),
Amravati, India.



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