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Broken Railway Track Detection Using LED-LDR

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ABSTRACT: In India rail transport occupies a prominent position in providing the necessary transport infrastructure to sustain needs of a rapidly growing economy. Today, India possesses the fourth largest railway network in the world. However, in terms of the reliability and safety parameters, we have not yet reached truly global standards. The main problem about a railway analysis is detection of cracks in the structure. If these deficiencies are not controlled at early stages they might lead to a number of derailments resulting in a heavy loss of life and property. This paper proposes a cost effective solution to the problem of railway track crack detection utilizing LED-LDR assembly which tracks the exact location of faulty track which then mended immediately so that many lives will be saved.

KEYWORDS: Railway track, crack detection, ARM, GSM, GPS, Auto matic Rail crack detection, GPRS.

I. INTRODUCTION

Transport is a key necessity for specialization that allows production and consumption of products to occur at different locations. Transport has throughout history been a spur to expansion as better transport leads to more trade. Economic prosperity has always been dependent on increasing the capacity and rationality of transport [1]. But the infrastructure and operation of transport has a great impact on the land and is the largest drainer of energy, making transport sustainability and safety a major issue. In India, we find that rail transport occupies a prominent position in providing the necessary transport infrastructure to sustain and quench the ever-burgeoning needs of a rapidly growing economy[4].The Indian railway network today has a track length of 113,617 kilometers (70,598 mi).over a route of 63,974 kilometers (39,752 mi) and 7,083 stations[11]. It is the fourth largest railway network in the world exceeded only by those of the United States, Russia and China. The rail network traverses every length and breadth of India and is known carry over 30 million passengers and 2.8 million tons of freight daily. Despite boasting of such impressive statistics, the Indian rail network is still on the growth trajectory trying to fuel the economic needs of our nation. In terms of the reliability and safety parameters, we have not yet reached truly global standards. The principal problem has been the lack of cheap and efficient technology to detect problems in the rail tracks and of course, the lack of proper maintenance of rails which have resulted in the formation of cracks in the rails and other similar problems caused by anti-social elements which jeopardize the security of operation of rail transport.[4]

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II.RELATED WORK

In general, there exist three main categories of techniques currently used for damage identification and condition monitoring of Railway tracks. These include:

• Visual inspections
• Non-destructive testing (NDT) technologies such as acoustic emissions or ultrasonic methods, magnetic field methods, radiography, eddy current techniques, thermal field methods, dye penetrant, fiber optic sensors of various kinds
• Vibration-based global methods.

Visual inspection is the primary technique used for defect identification in tracks, and is effectively used in specialized disciplines. The successful implementation of this method generally requires the regions of the suspected damage to be known as a first step, and be readily Accessible for physical inspection. As a result, this method Control Area Network be costly, time consuming and ineffective for large and complex structural systems such as the rail track [3].

NDT techniques have resulted in a number of tools for us to choose from. Among the inspection methods used to ensure rail integrity, the common ones are ultrasonic inspection and eddy current inspection. Ultrasonic Inspections are common place in the rail industry in many foreign countries. It is a relatively well understood technique and was thought to be the best solution to crack detection [6].The Ultrasonic Broken Rail Detector system is the first and only alternative broken rail detection system developed, produced and implemented on a large scale. By using ultrasonic Broken Rail Detector system railway operators will have the benefit of monitoring rails continuously for broken rails without human intervention. This will contribute to ensure that the people does not suffer losses as a result of train derailments[10].Ultrasonics Control Area Network only inspect the core of materials; that is, the method Control Area Network not check for surface and near-surface cracking where many of the faults are located[6].

Fig.1 Ultrasonic Broken Rail Detector

Another method for detection of cracks on tracks is by using wireless sensor networks. In this method the detection of Cracks Control Area Network be identified using IR rays with the IR transmitter & receiver.IR receiver is connected to the Signal Lamp or Electrified lamp with the IR sensor. Control area network controller is connected to the main node and it send the information via Global System for Mobile Communications (GSM) and transmit the message to engine and to the nearest station. The detection of Cracks Control Area Network be identified using IR rays and IR sensor.IR receiver is connected to the signal lamp and to the control area network controller. The electrified lamp is nothing but it sides of the tracks the electric lamp which is current flowing for the engines transportation [2],[9].But this type of system doesn't locate small cracks and the system is also costly.

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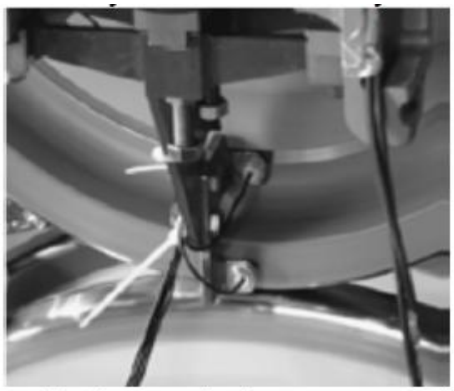

Fig.2 Model Figure to Fix the IR Sensor on the Wheel

Fig.3 Signal Lamp Example

III .PROPOSED SYSTEM

This paper proposes the limitations of both the traditional and the current system that are using for detection of faulty tracks. In the current system we don't get the exact location of the faulty track. We only receive latitudes and longitudes of the location. In the proposed system we are using Gprs module so that we can get the exact location of the broken rail track. In this proposed system we are also using ARM7 controller which consumes low power and also less cost. By using the ARM controller the analysis time of the proposed will be reduced drastically. Before the start of the railway line scan the robot has been programmed to self-calibrate the LED-LDR arrangement. It is necessary because the LDR has a natural tendency to show a drifting effect because of which, its resistance under the same lighting condition may vary with time. After calibration, the robot waits for a predetermined period of time so that the onboard GPS module starts reading the correct geographic coordinate.

This is necessary because any GPS module will take some time to synchronize with the satellites. The principle involved in crack detection is the concept of LDR. In the proposed design, the LED will be attached to one side of the rails and the LDR to the opposite side. During normal operation, when there are no cracks, the LED light does not fall on the LDR and hence the LDR resistance is high. Subsequently, when the LED light falls on the LDR, the resistance of the LDR gets reduced and the amount of reduction will be approximately proportional to the intensity of the incident light. As a consequence, when light from the LED deviates from its path due to the presence of a crack or a break, a sudden decrease in the resistance value of the LDR ensues. This change in resistance indicates

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the presence of a crack or some other similar structural defect in the rails. In order to detect the current location of the device in case of detection of a crack, a GPS receiver whose function is to receive the current latitude and longitude data is used. To communicate the received information, a global system for mobile communications modem has been utilized. The global system for mobile communications modem transfers the received information to the GPRS which then shows the exact location of the faulty rail track in the mobile.

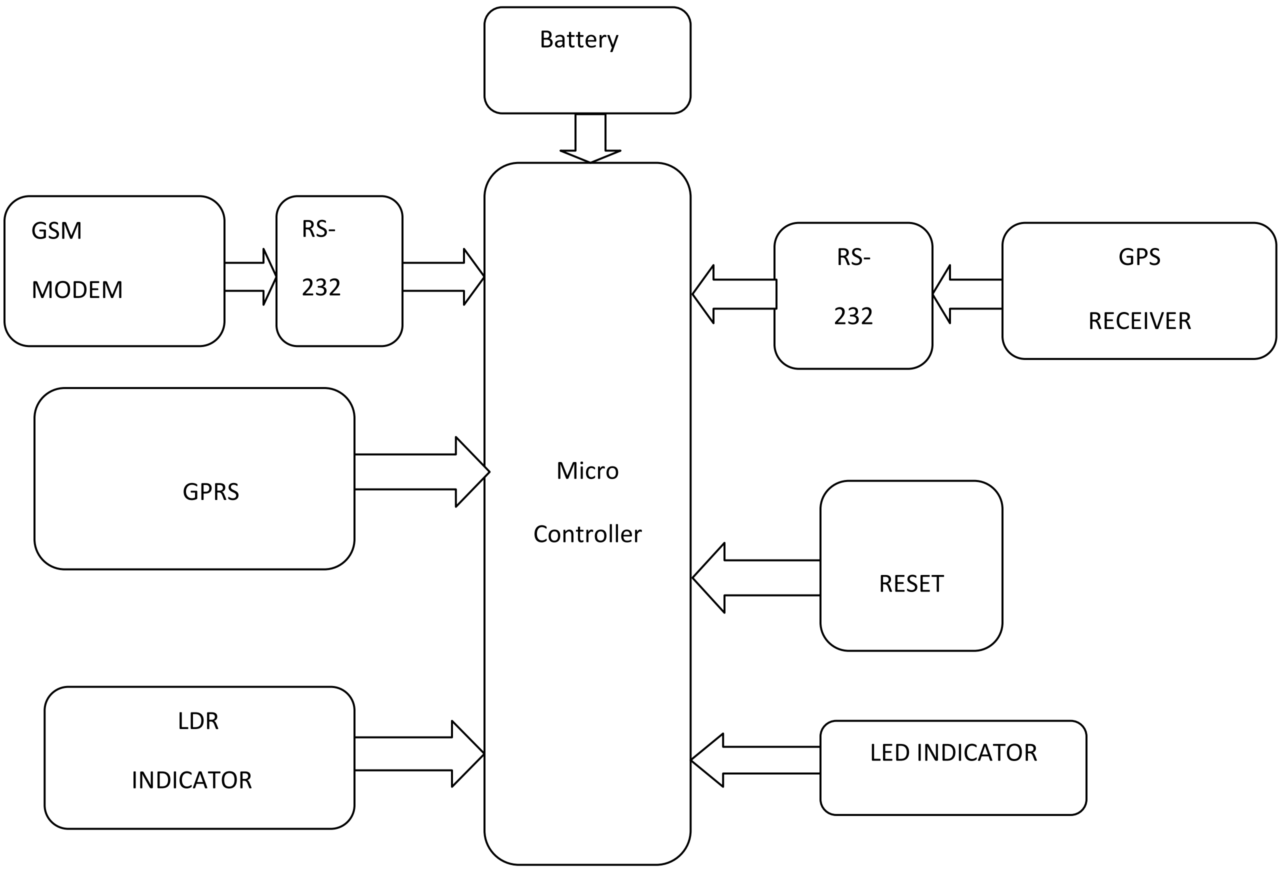

Fig.4 Automatic Broken Rail Detection Scheme using LED-LDR Assembly

The proposed rail track detection system architecture consists of ARM7 controller, GPS, global system for mobile communications, LED-LDR Assembly, GPRS, DC Motor.

Operation

This section explains the operation of modules present in the faulty rail track detection system architecture

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i)**Microcontroller**:

The microcontroller used in this system is LPC2148 microcontroller that is based on a 32/16 bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combines the microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB.Due to their tiny size and low power consumption, LPC21418 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. Some of the features of LPC2148

i) 16-bit/32-bit ARM7TDMI-S microcontroller in a tiny LQFP64 package.

ii) 8 kB to 40 kB of on-chip static RAM and 32 kB to 512 kB of on-chip flash memory. 128-bit wide interface/accelerator enables high-speed 60 MHz operation.

iii) In-System Programming/In-Application Programming (ISP/IAP) via on-chip boot loader software. Single flash sector or full chip erase in 400 ms and programming of 256 B in 1 ms.

iv) Embedded ICE RT and Embedded Trace interfaces offer real-time debugging with the on-chip Real Monitor software and high-speed tracing of instruction execution.

ii) GPS Module:

SR-92 GPS receiver has been used as the GPS module. SR-92 is a low-power, ultra-high performance, easy to use GPS smart antenna module based on SiRF's third generation single chip. The 5-pin I/O interface is then connected to the main board with either connector or wire soldering. The main features of GPS module includes

☐ High tracking sensitivity of -159dBm
☐ Low power consumption of 40mA at full tracking
☐ Built-in backup battery allowing hot/warm starts and better performance
☐ Hardware power saving control pin allowing power off GPS via GPIO[8].

iii) Global system for mobile communications (GSM) Module:

Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. Global system for mobile communications is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz It is estimated that many countries outside of Europe will join the global system for mobile communications partnership. Throughout the evolution of cellular telecommunications, various systems have been developed without the benefit of standardized specifications.

iv) LED-LDR Assembly:

The common 5V LED and cadmium supplied LDR was found to be sufficient. The LED is powered using one of the digital pin of the ARM controller. The LDR and a 45kΩ resistor form a potential divider arrangement. The output of the potential divider is given to one of the analog input channel of the ARM. The LDR is calibrated every time the robot is used. The light dependent resistor or cadmium sulfide (CdS) cell is a resistor whose resistance decreases with increasing incident light intensity.

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v) GPRS Module:

In this paper the Gprs module is used to know the exact location of the broken rail track.The global system for mobile communications modem sends the coordinates of the faulty rail track to the GPRS which then sends the exact location to the mobile.

vi) DC Motor:

The proposed design uses 4 DC motors (Torque Rating: 10Kg and Speed Rating: 500 rpm) interfaced with the ARM With a wheel diameter of 5.2 cm and the total mass of around 5 Kg[6]. The approximate speed of the robot is around 0.5 metres/sec.

IV.CONCLUSION

The proposed broken rail detection system automatically detects the faulty rail track without any human intervention. There are many advantages with the proposed system when compared with the traditional detection techniques. The advantages include less cost, low power consumption and less analysis time. By this paper the exact location of the faulty rail track can easily be located which will mended immediately so that many lives can be saved.

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