A Novel Approach Railway Track Damage Detection Robot Using GPRS Technology

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ABSTRACT: The Indian railways are the largest rail passenger transport in today's world and it is the back bone of the country transport infrastructure. Almost nearly 24 million passengers use the railway system on a daily basis. Railway authorities had made an analysis of the recent accidents and customer complaints to provide a safe and secured system which can be widely used throughout the railway connecting system. India possesses fourth largest network in the world exceeded only by those of the United States, Russia and China. One of the most widely used and comfortable nodes of transportation system is train, but occasionally, accidents occur due to collision as well as other reason. It is very difficult to stop such collisions because of speed of moving trains, which makes a lead distance to stop. Collisions are happened due to human errors and/or faulty equipments. 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 project proposes a cost effective solution to the problem of railway track crack detection utilizing Zigbee control assembly which tracks the exact location of track damage which then mended immediately so that many lives will be saved.

Keywords - Track damage detection sensor, ARM Controller, Detection, GSM, GPS, GPRS

I. INTRODUCTION

In general rail transport in India growing at a rapid pace, the associated safety infrastructure facilities. Analysis of the factors that cause these rail accidents, recent statistics reveal that approximately 60% of all the rail accidents have derailments as their cause, of which about 90% is due to cracks on the rails either due to natural causes (like excessive expansion due to heat) or due to anti-social elements. These cracks and other problems with the rails generally go unnoticed due to improper maintenance and the currently irregular and manual track line monitoring that is being carried out in the current situation.

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. The sensor network is a wireless network formed by a group of sensors deployed in same region, which can be used to measure the air pressure, temperature, acceleration, etc. Sensors can transmit signals via radio signal. Since sensors are now small and cheap, they can be deployed on a large scale. It becomes more and more important for applications like security, traffic monitoring, agriculture, battlefield, etc. Most of these sensors are powered by batteries. This project proposes a cost effective solution to the problem of railway track crack detection utilizing Zigbee control assembly which tracks the exact location of track damage which then mended immediately so that many lives will be saved.

II. CURRENT INDIAN RAILWAYSAFTY

2.1. Present Perspective Indian Railways are the world's second-largest railway, with 6,853 stations, 63,028 kilometers of track, 37,840 passenger coaches and 222,147 freight cars. Annually it carries some 4.83 billion passengers and 492 million tons of freight cars. Of the 11 million passengers who climb aboard one of 8,520 trains each day, about 550,000 have reserved accommodations.

2.2 Train Collisions

Collisions are the most dreaded accidents. It is very difficult to stop such collisions because of speed of moving trains, which need a lead distance to stop. Collisions happen due to human errors and/or faulty equipment. Two types

1. Head-On
2. Rear-End-Collisions

A head-on collision is one where the front ends of two ships, trains, planes or vehicles hit each other, as opposed to side-collision or rear-end collision. With rail, a head-on collision often implies a collision on a single line railway.
III. EXISTING METHODS

3.1. Anti collision Device (ACD)

The Anti-Collision Device (ACD) is a self-acting microprocessor-based data communication device designed and developed by Kankan Railway.

The system consists of Loco ACD with a console (message display) for the driver (in each Loco Engine), Guard ACD with remote (fitted in Guard Van), Station ACD with console (fitted in Station Masters’ Cabin), Manned and Unmanned Gates ACD with hooters and flashers (in each location) and Repeater ACDs (fitted at locations having obstructions in radio communication such as hilly areas) which work in concert to prevent the following kinds of collisions and accidents like-

1. Head on collisions,
2. Rear end collisions,
3. Collisions due to derailment,
4. Collisions at the level crossing gates.

3.2. Related Methods

GPS based Cab Signaling, Block Signaling, Automatic Train Control (ATP), and Railway Collision Avoidance System (RCAS) and have been developed and used for avoiding collision and for getting proper communication, but not that much worth. Train Collision Avoidance System (TCAS) has also developed recently and Anti collision Device (ACD) is being developed and will be used till December 2013.

IV. PROPOSED SYSTEM DESIGN

This project proposes a cost effective solution to the problem of railway track crack detection utilizing Zigbee communication and ARM control, track damage detection robot, GPS, GSM assembly which tracks the exact location of track damage which then mended immediately so that many lives will be saved.

The sensor network is a wireless network formed by a group of sensors deployed in same region, which can be used to measure the air pressure, temperature, acceleration, etc. Sensors can transmit signals via radio signal. Since sensors are now small and cheap, they can be deployed on a large scale.
The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers. The LPC2141/42/44/46/48 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2141/42/44/46/48 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale.

4.3 Global Positioning System (GPS)

GPS (Global Positioning System) technology is used to find the location of any object or vehicle to monitor or a child continuously using satellite signals.

Three satellite signals are necessary to locate the receiver in 3D space and fourth satellite is used for time accuracy. GPS will give the information of parameters like longitude, latitude and attitude. With the help of these parameters one can easily locate the position of any object. In this GPS technology, the communication takes place between GPS transceiver and GPS satellite.

4.4. Global System for Mobile (GSM)

Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. The GSM specifications define the functions and interface requirements in detail but do not address the hardware.

A GSM modem is a specialized type of modem which accepts a 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.

When a GSM modem is connected to a computer, this allows the computer to use the GSM modem to communicate over the mobile network. While these GSM modems are most frequently used to provide mobile internet connectivity, many of them can also be used for sending and receiving SMS and MMS messages.

4.5. GPRS

GPRS (General Packet Radio Service) is a packet based communication service for mobile Devices that allows data to be sent and received across a mobile telephone network. GPRS is a step towards 3G and is often referred to as 2.5G. Here are some key benefits of GPRS: Speed 20-50 kbps. The serving GPRS support node (SGSN), like the GSM mobile switching center and visitor location register (MSC/VLR), controls the connection between the network and the mobile station (MS). The SGSN provides session management and GPRS mobility management functions such as handovers and paging. It attaches to the HLR via the Gr interface and to the MSC/VLR via the Gs interface. It also counts the number of packets routed.

4.6. IR Sensor

Infrared (IR) technology addresses a broad variety of sensing and remote control. An IR Emitter is a light emitting diode (LED). Different types of IR LEDs are specified based on their packaging and special features, such as output optical power, wavelength, and response time. IR Receivers are also called sensors since they detect the wavelength and spectral radiation of the light from the IR emitter. IR receivers are specified by optic features, packaging, special circuitry such as an ambient light filter, wide viewing angle, and more. Wireless applications, especially in the areas of sensing and remote control.

4.7. Robot platform-Gear Motor

A Gear motor is a brushless, synchronous electric motor that converts digital pulses into mechanical shaft rotation. Every rotation of the Gear motor is divided into a discrete number of steps, and the motor must receive a separate pulse for each step. The size of each step is same and the Gear motor can only take one step at a time. Since each pulse causes the motor to rotate a precise angle, typically 1.8°, the motor's position can be controlled without any feedback mechanism. The speed of rotation directly proportional to the frequency of the pulses.
V. CONCLUSION

In this project, track damage detection system for trains have been designed, simulated and tested. The simulation has been done using proteus and testing has been carried out using the developed prototype. It has been estimated that if the system is implemented in railways, trains accidently on the track fault detects automatically stops train and send the location of the track fault to control station to alert, train collision can be prevented and human life saved if this system is implemented.

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