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An Approach to Improve the Railway Crack Detection in the Tracks by Automated Engine

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Abstract : *Today in the real time world, so many type of transports are available like, flights, trains, buses, but majority of the people doing their travelling in trains only because due to less amount of charge for long time journey and at the same time it is more comfortable also. For those people we have to provide the safety journey, so the government has to take the responsibility for this. Although the government has taken necessary steps to safe journey but due to some reasons the accidents will happens. One of the major accidents in the railways networks are occurs due to track side faults. The track side fault means it will occur as natural or artificial. To avoid this we are going to design the automated engine model. In this design the engine should be automated and it is connected to the RF Rays. The automation techniques are based on two nodes, Track side node and Station side node. The proposed scheme has been modelled for Automation Engines in the Indian railway networks alone.*
Keywords : *Crack, Detection, GSM, Automation, Engines.*

I. Introduction

The basic objective of this project is to develop an automation engine which is used to find the detection of cracks in the railway networks. The Indian railway network today has a track length of 115,000 kilometres (71,000 mi) over a route of 65,000 kilometres (40,000mi) and 7,500stations. It is the fourth largest railway network in the world exceeded only by those of the United States, Russia and China. In 2011, IR carried over 8,900 million passengers' annually or more than 24 million passengers daily 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. Though rail transport in India growing at a rapid pace, the associated safety infrastructure are not up to international standards, To demonstrate the gravity of the problem, official statistics say that there have been 14 accidents in 2011 15 accidents in 2012. On further analysis of the factors that cause these rail accidents, recent statistics reveal that approximately 90% are due to cracks on the rails either due to natural causes (like high expansion due to heat, water floods) or due to antisocial elements. So in this proposed model we are giving the solution for the detection of cracks. Our design is based on automation engines with track side node and station side node.

II. Design Issues Inherent To Indain Scenario

Using automation there are two techniques are there one is automatic train control (ATC) and another is automatic train protection (ATP).Signalling system that can also use to automates operation of trains. We are going to design the proposed model in automated mode, in that all peripherals are internally connected to one system. From this system, the output is connected to the RF Rays which is connected to the front side of the engine.

III. Proposed Automation Engine Scheme

We know that the railway network of India is the biggest in south Asia and perhaps the most complicated in all over the world. There are so many different types of train's local, fast, super-fast, passenger, goods etc. and there are so many multiple routs. Although the time table is perfect it is not at all possible to maintain it. And that's why the train accidents are becoming more and more usual. So why not we add a kind of intelligence to the train engines itself so that it tries to avoid accidents. Using automation there are two techniques are there one is automatic train control (ATC) and another is automatic train protection (ATP).Signalling system that can also use to automates operation of trains. Our designed is based on automation engines with track side node and station side node. The track side node is mounted to the post which is located every 300 m. Here we can use the electrified lamp as post, because nowadays all routes are mostly electrified. According to our analysis for every 300m there is a post called electrified lamp. So from the control room (Automation engine) the output is connected to the RF rays. Here we are going to fix the rays in front of the engines. So engines should pass the rays in the tracks. The post is connected to the tracks also. In the control room all peripherals like sensor, controller, are connected to the automated mode. The automated output is connected to the RF rays. When the train gets starts ,the rays also starts and it will splashing in the tracks above

1km.Why here its passing 1 km above, because there are different types of trains available like rajdhani, duronto, jansatabadi, super-fast and express trains, all are having different speed conditions. In the track side node, it is based on the electrified lamp, we are fixing GSM on that node, Node is nothing but every 4 post interconnected to make the node. So when the trains get starts the rays will also starts. For example by our analysis we are making the survey for 3 kms ,the rays is passing 1km above, remaining 2 kms there must be 7 post are there by our appropriate analysis, incase if there is no cracks is in between the first two post the rays will pass through the next post without any disturbances, if the crack will occurs between 2 and 3 post, the rays will not pass through the next post within the particular duration, then the GSM will send the message to nearest station and engine also, after this the output will display in LED-LCD or alarm will sounds. Next one is station side node which consists of CAN controller, RF Sensor, memory and display. When a train is about to reach a station, the train-side node and the station-side node communicates. The train passes the management information to this station.

The management information to this station. Simultaneously it displays the intimation of the in-coming train to the passengers. Here we use RF sensors in that the transmitter and receiver are of RF type with minimum range of 2 Km.

IV. Electrical Design

The electrical design parameters are explained below

A. CAN CONTROLLER

Controller area network (CAN or CAN-bus) is a vehicle bus standard designed to allow microcontrollers and devices to communicate with each other within a vehicle without a host computer. CAN is a message based protocol, designed specifically for automotive applications but now also used in other areas such as industrial automation and medical equipment. Development of the CAN bus started originally in1983at Robert Bosch GmbH. The protocol was officially released in 1986 at the Society of Automotive Engineers (SAE) congress in Detroit, Michigan. The first CAN controller chips, produced by Intel and Philips, came on the market in 1987.nBosch published the CAN 2.0 specification in 1991.CAN is one of five protocols used in the OBD-II vehicle diagnostics standard. The OBD standard is mandatory for all cars and light trucks sold in the United States since 1996, and the EOBD standard, mandatory for all petrol vehicles sold in the European Union since 2001 and all diesel vehicles since 2004.

i. AUTOMOTIVE

A modern automobile may have as many as 70electronic control units (ECU) for various subsystems. Typically the biggest processor is the engine control unit, which is also referred to as "ECU" in the context of automobiles; others are used for transmission, airbags, antilock braking, cruise control, audio systems, windows, doors, mirror adjustment, etc. Some of these form independent subsystems, but communications among others are essential. A subsystem may need to control actuators or receive feedback from sensors. The CAN standard was devised to fill this need. The CAN bus may be used in vehicles to connect engine control unit and transmission, or (on a different bus) to connect the door locks, climate control, seat control, etc.Today the CAN bus is also used as a field bus in general automation environments; primarily due to the low cost of some CAN Controllers and processors. Bosch holds patents on the technology, and manufacturers of CAN-compatible microprocessors pay license fees to Bosch, which is normally passed on to the customer in the price of the chip. Manufacturers of products with custom ASICs or FPGAs containing CAN-compatible modules may need to pay a fee for the CAN Protocol License.

ii. TECHNOLOGY

CAN is a multi-master broadcast serial bus standard for connecting electronic control units (ECUs).Each node is able to send and receive messages, but not simultaneously. A message consists primarily of an ID usually chosen to identify the message-type or sender and up to eight data bytes. It is transmitted serially onto the bus. This signal pattern is encoded in NRZ and is sensed by all nodes. The devices that are connected by a CAN network are typically sensors, actuators, and other control devices. These devices are not connected directly to the bus, but through a host processor and a CAN controller. If the bus is free, any node may begin to transmit. If two or more nodes begin sending messages at the same time, the message with the more dominant ID (which has more dominant bits, i.e., zeroes) will overwrite other nodes' less dominant IDs, so that eventually (after this Arbitration on the ID) only the dominant message remains and is received by all nodes. Each node requires a host processor. The host processor decides what received messages mean and which messages it wants to transmit itself. Sensors, actuators and control devices can be connected to the host processor. CAN controller (hardware with a synchronous clock).

B. GSM

GSM (Global System for Mobile Communications) is the most popular standard for mobile telephony systems in the world. The GSM Association, its promoting 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 1.5billion people across more than 212 countries and territories. Its ubiquity enables international roaming arrangements between mobile network operators, providing subscribers the use of their phones in many parts of the world. GSM differs from its predecessor technologies in that both signalling and speech channels are digital, and thus GSM is considered a second generation (2G) mobile phone system. This also facilitates the wide-spread implementation of data communication applications into the system.

i. Technical Details

The longest distance the GSM specification supports impractical use is 35 kilometres (22 mi) GSM-R, Global System for Mobile Communications - Railway or GSM-Railway is an international wireless communications standard for railway communication and applications. A sub-system of European Rail Traffic Management System (ERTMS), it is used for communication between train and railway regulation control centres. The system is based on GSM and EIRENE -MORANE specifications which guarantee performance at speeds up to 500 km/h (310 mph), without any communication loss. The standard is the result of over ten years of collaboration between the various European railway companies, with the goal of achieving interoperability using a single communication platform. GSM-R is part of the new European Rail Traffic Management System (ERTMS) standard and carries the signalling information directly to the train driver, enabling higher train speeds and traffic density with a high level of safety.

ii. GSM-R Uses

GSM-R permits new services and applications for mobile Communications in several domains:
•transmission of Long Line Public Address (LLPA) announcements to remote stations down the line
•control and protection (Automatic Train Control/ETCS) and ERTMS)
•Communication between train driver and regulation centre, Communication of on-board working people.
•Information sending for ETCS.
•Communication between train stations, classification yard and rail tracks.

B. Rf Sensors

Radio-frequency identification (RFID) is the use of a wireless non-contact system that uses radio-frequency electromagnetic fields to transfer data from a tag attached to an object, for the purposes of automatic identification and tracking. Some tags require no battery and are powered and read at short ranges via magnetic fields (electromagnetic induction). Others use a local power source and emit radio waves (electromagnetic radiation at radio frequencies). The tag contains electronically stored information which may be read from up to several meters away. Unlike a bar code, the tag does not need to be within line of sight of the reader and may be embedded in the tracked object.

i. RF Transmitter and Receiver

The RF module, as the name suggests, operates at Radio Frequency. The corresponding frequency range varies between 30 kHz & 300 GHz. In this RF system, the digital data is represented as variations in the amplitude of carrier wave. This kind of modulation is known as Amplitude Shift Keying (ASK).

Transmission through RF is better than IR (infrared) because of many reasons. Firstly, signals through RF can travel through larger distances making it suitable for long range applications. Also, while IR mostly operates in line-of-sight mode, RF signals can travel even when there is an obstruction between transmitter & receiver. Next, RF transmission is more strong and reliable than IR transmission. RF communication uses a specific frequency unlike IR signals which are affected by other IR emitting sources.

This RF module comprises of an RF Transmitter and an RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 MHz. An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The transmission occurs at the rate of 1Kbps - 10Kbps.The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter.

D. Lcd-Led Or Alarm

The LCD-LED part is used in the station side node for getting the information about the trains. But at the same time LED-LCD or ALARM is fixed in the engines for information purposes about the cracks.

V. Nature Of Work

We know that the railway network of India is the biggest in south Asia and perhaps the most complicated in all over the world. There are so many different types of trains local, fast, super fast, passenger, goods…. etc. and there so many multiple routs. Although the time table is perfect it is not at all possible to maintain it. And that's why the train accidents are becoming more and more usual. So why not we add a kind of intelligence to the train engines itself so that it tries to avoid accidents. Here we are designing the automated engine to solve the detection of cracks. For automated engines we handling two techniques called station side node and Track side node.

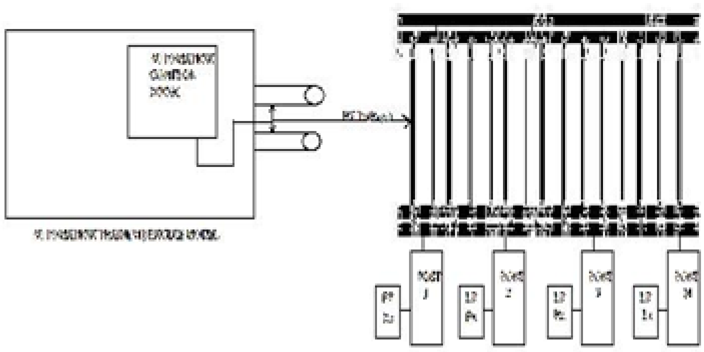

Fig: 6.1 Automation Train (AT) Engine model

i. Track side node

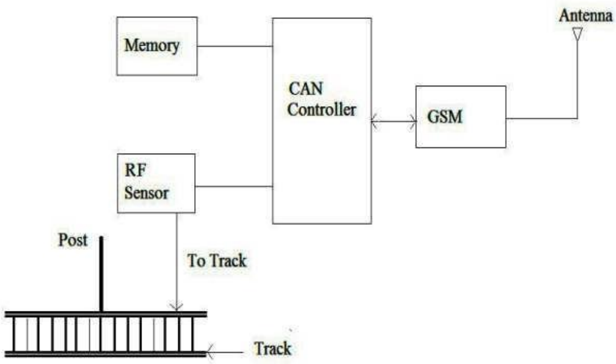

Fig.6.2 Track side node.

ii. Station side node

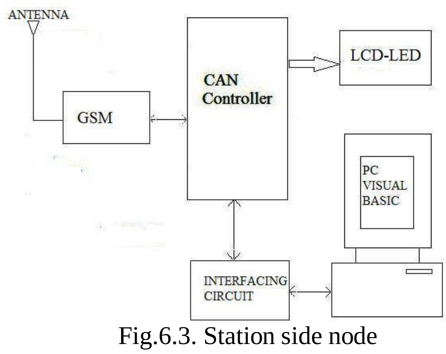

Fig.6.3. Station side node

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Of the in-coming train to the passengers. Here we use RF sensors in that the transmitter and receiver are of RF type with minimum range of 2 Km. This proposed concept can be implemented in electrified rail route alone because here post is used as electrified lamp, without electrified rail route also we can implement but in that situation we have to make the post for particular meter so the cost will increase. Reduction of cost purpose we are implementing in electrified route alone. But in India majority of the routes are electrified and then remaining routes also fully electrified in few years. This proposed model will be designed only for Indian railway networks alone.

VI. Results And Discussions

Our proposed model is facing a new challenge to further improve the reliability of rail testing techniques, while seeking for new and emerging technologies in automation engines that aid the detection of rail defects. Automation Engine (AE) will be done using RF Sensor, CAN Controller, GSM, LCD-LED or Alarm. In the point of view of reducing human errors, and save the public's we are going to implement this proposed concept. This proposal gives better accuracy, very fastest operation in Real-time where the human life is very important. The proposed concept already started to design and we are excepting the output. In real time it is not possible because we have to get the permission from the government side, so in demo model we are designing this concept. If we are getting the output as per our demo model then we planned to approach the government to implement this concept in real time systems. This proposed model will be designed only for Indian railway networks alone.

VII. Conclusions

From the monitoring data the following conclusions are drawn:

•In the railway track, cracks are occurring in two ways by natural and artificial

•The natural means (like high expansion due to heat, water floods)

•The artificial cracks are occurs due to antisocial elements (like terrorists, naxlites).

•From our analysis these two cracks are occurring periodically, but apart from this cracks some other cracks also occurs due to soil condition, water leakage problem.

As per our proposed model using this automated engine design in real time means we can able to easily avoid the accidents occurs by Track side faults.

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