Advanced Railway Track Crack Detection System

Vaishali.J.B[1], Jaishri.C.S[2], Shifanashrin.A[3], Dharanikumar.A[4]
[1, 2] Dept of Electrical Communication Engineering
[4]Assistant professor, Dept of Electrical Communication Engineering
[1, 2, 3, 4] Karpagam University, Coimbatore

Abstract- *This paper proposes the design of crack finding robot for finding cracks in the railway tracks. Here the microcontroller is interfaced with Robot, Global Positioning System (GPS), Liquid Crystal Display (LCD) and Crack Sensor. The IR sensor senses the voltage variations from the crack sensor and then it gives the signal to the microcontroller. The microcontroller checks the variations in the voltage of the measured value with the threshold value. If the microcontroller detects the crack in the railway track, it immediately gets the exact location information using Global Positioning System (GPS) and Global System for mobile (GSM) and sends that location and crack information to the control section. And the control section displays the exact location that is latitude and longitude value in map. The Liquid Crystal Display (LCD) is used to display the current status of the system*

Keywords- Global Positioning System (GPS),Global System for mobile(GSM),infrared sensor, Analog to Digital Converter,

I. INTRODUCTION

Railway is lifeline of India and it is being the cheapest modes of transportation are preferred over all other means of transportation. When we go through the daily newspapers we come across many accidents in railroad railings. Railroad-related accidents are more dangerous than other transportation accidents in terms of severity and death rate etc.

Therefore more efforts are necessary for improving safety. Collisions with train are generally catastrophic, in that the destructive forces of a train usually no match for any other type of vehicle. Train collisions form a major catastrophe, as they cause severe damage to life and property. Train collisions occur frequently eluding all the latest technology.

Review the present status of level-crossing accidents and train collisions. Present statistics, indicators, technology and problems relating to the systems adopted for railway protection; in practice

Analyze various alternative systems for train collision avoidance; and · Make recommendations pertaining to the selection of cost-effective protection systems.

Consider the following methodology

- Evaluation of the requirements of a Safety Management Information System which adequately addresses the needs of railway management for information on train collision avoidance performance;
- Review of the essential and effective safety, enhancements, measures and priorities for railway security.
- Assessment of level crossing safety performance and safety measures · Examination of Cost Benefit Analysis of investments on level crossing safety enhancement;
- Review of the technical attributes and suitability of Networked Anti Collision System (ACD) for level crossing protection system;
- Recommendations and guidelines for adoption of networked ACD Systems by railways.

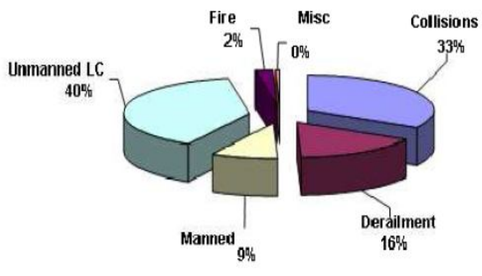

Fig1 Causalities in Train Accidents during

II. LITERATURE SERVEY

In [1] the development of an efficient Weigh-In-Motion (WIM) system, with the aim of estimating the axle loads of railway vehicles in motion, is quite interesting from both an industrial and academic points of view such systems, with which the loading conditions of a wide population of running vehicles can be verified, are very important from a safety maintenance perspective. The evaluation of the axle load conditions is fundamental especially for freight wagons, more likely to be subjected at risk of unbalanced loads that may be extremely dangerous both for the vehicle running safety and the infrastructure integrity.

In [2] squats and corrugation cause large dynamic forces between wheel and rails, leading to rapid deterioration of rapid quality. There is a strong need for improved detection and maintenance methods to treats such defects at reduced costs, and for better track design to avoid or retard occurrence of them.

In [3] the paper aims at studying the interaction between an elastic wheel set and ballasted track due to the polygonal wheels. The wheel set is considered a Timoshenko beam with attached rigid-bodies as axle boxes, wheels and brae discs. The track model includes a new model of the rail periodic support consisting in two three directional Kelvin-Voigt systems for the rail pad and the ballast. The main features of the wheel/rail vibration due to the polygonal wheel are analyzed via a new approach of the Green's matrix of the track method.

In [4] the prediction of impact forces caused by wheel flats requires the application of time-domain models that are generally more computationally demanding than are frequency-domain models. In this paper, a fast time-domain model is presented to simulate the dynamic interaction between wheel and rail, taking into account the non-linear processes in the contact zone.

In [5] The development of an efficient *Weigh-In-Motion* (WIM) system, with the aim of estimating the axle loads of railway vehicles in motion, is quite interesting from both an industrial and academic point of view. Such systems, with which the loading conditions of a wide population of running vehicles can be verified, are very important from a safety and maintenance perspective.

In [6] AC bridge techniques commonly used for precision impedance measurements have been adapted to develop an eddy current sensor for rail defect detection. By using two detected coils instead of just one as in a conventional sensor, we can balance out the large baseline signals corresponding to a normal rail.

In [7] today the railway is facing exposure of heavy loads, higher speeds and a very dense traffic. The development of testing methods for the rails inspection trains has became necessary to match the modern needs for a fast detection and detailed classification of defects .Nowadays, to guarantee the safe operation of rail traffic non-destructive inspection techniques with combined ultrasound and eddy current testing methods are used to detect damages on rails.

[8] Eddy current technique has been developed to enable identification and evaluation of rolling contact fatigue (RCF) defects. The ultrasound technique is aimed at measurements in the rail bulk volume, which are not feasible using through eddy current technique.

In [9] Corrugation can be detected by simpler measurement with this method using a microphone in the cabin. It was also confirmed that the extent of corrugation can also be diagnosed by this method, in an experiment using a commercial railway line.

In [10] Detection of rails defects are major issues for all rail workers around the world. Some of the most defects include worn rails, welding problems, internal defects, corrugations and initiated problems such as surface cracks, head checks, squats. If undetected or untreated these defects can lead to rail breaks and derailments.

III. SYSTEM DESCRIPTION

3.1 Problem identification

Ultrasonic surface waves that are similar in behaviour to Rayleigh waves are an obvious candidate for surface breaking crack detection. If a defect lies between the Rayleigh wave generator and detector then it will to some degree block the Rayleigh wave. And another existing method Train Anti Collision and Level Crossing Protection System consists of a self-acting microcontroller and two way ZigBee based data communication system which works round-the-clock to avert train collisions and accidents at the level crosses. Thus enhances safety in train operations by providing a NON-SIGNAL additional safety overlay over the existing signaling system.

3.2 Disadvantages

- Ultrasonic inspection of rails is usually restricted to low speeds of around 20-30mph, which limits the viability of testing many tracks regularly.
- Furthermore many of the most serious defects that can develop in the rail head can be very difficult to detect using the currently available inspection equipment.

3.3 Proposed system

This present system a crack detection method with the use of IR sensors. The crack is detected using an IR sensor assembly that is fixed in the front of the robot module. If a crack is detected robot module will stop immediately and gps location is sent to the sent to the nearby station using the GSM and is also updated to cloud storage. Data can be viewed on a webpage with the time and date at which crack is detected. Action status can be updated on webpage immediately after the work is finished so there will be no delays in action.

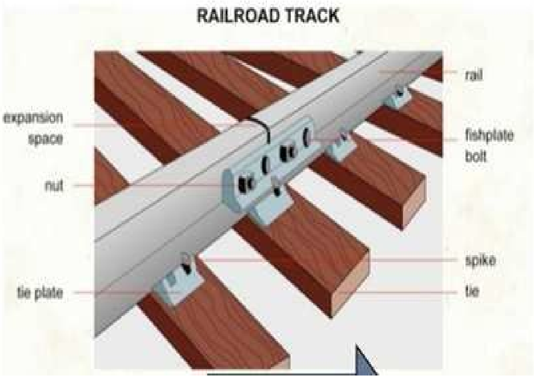

Fig2 General Schematic of a track

present there are a significant number of potential defects possible and the task has to be performed with some speed to reliably inspect the thousands of miles of track stretching across the land failures of an essential component can have serious consequences. 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 cause huge economical problems affecting the rail network expected requisition of spare parts, handling of incident and/or accidents.

The proposed signalling system most of the times relay on the oral communication through telephonic and telegraphic conversations as input for the decision making in track allocation for trains. There is large scope for miscommunication of the information or communication gap due to the higher human interference in the system. This miscommunication may lead to wrong allocation of the track for trains, which ultimately leads to the train collision. The statistics in the developing countries showing that 80% of collisions occurred so far is due to either human error or incorrect decision making through miscommunication in signalling and its implementation. IR sensors are also used to identify the cracks in the railway. IR sensors have limitations due to the geographic nature of the tracks. The Anti collision device system also is found to be ineffective as it is not considering any active inputs from existing Railway signalling system, and also lacks two ways communication capability between the trains and the control centres or stations. Later geographical sensors have also been used which makes use of satellites for communication. But the system is costly and complicated to implement. At present laser proximity detector is used for collision avoidance, IR sensors identifies the cracks in the railway track and gate control is done by manual switch controlled gate. But there is no combined solution for collision between trains, train derailment in curves and bends and the automatic control of railway gate.

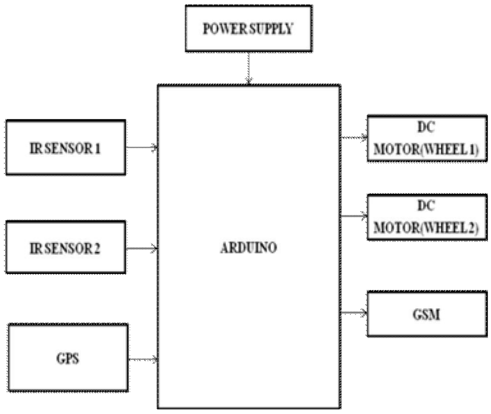

Fig3 Block Diagram for Proposed System

If there is any crack in the railway track, the vibration of train will not get continuously by the vibration sensor. This means that the crack is present. So we have to stop the train before passing the crack. The vibration sensor values are given to the analog channels of microcontroller. The train side a brake control system is present. When the false signal (presence of crack) reaches the train will automatically stops by releasing the brake of train. Thus the train can be stopped before the crack. There by we can avoid the derailment of trains in bends and curves

3.4 Advantages:

- Accurate crack detection.
- Highly efficient.
- Cost for the installation and maintenance of the system is Low.

It is applicable at every aspect of the railways for uninterruptible service · Saving human life, protection against accidents and the communicable electronic systems are the salient features and the added advantage of this project.

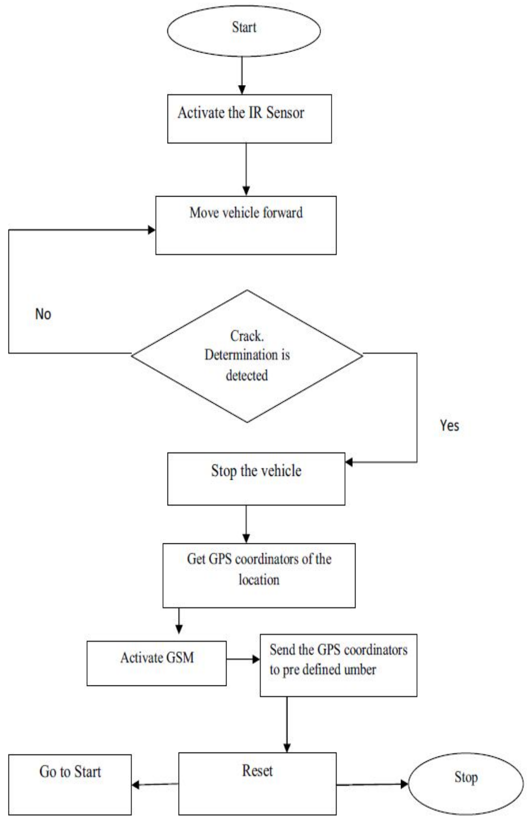

Fig 4 Proposed system flow chart

3.5 Result and discussion

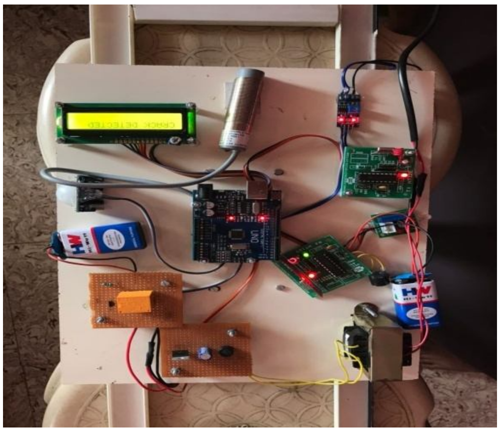

Fig 5 Result obtained proposed system

From the above discussion and information of this system we, up to now surely comes to know that it is highly reliable effective and economical at dense traffic area, sub urban area and the route where frequency of trains is more. As it saves some auxiliary structure as well as the expenditure on attendant it is more economical at above mentioned places than traditional railway crossing gate system. We know that though it is very beneficial but it is also impossible to install such system at each and every place, but it gives certainly a considerable benefit to us, thereby to our nation.

IV. CONCLUSIONS

Collision avoidance systems are especially useful in bad weather conditions**.** In this paper, a design for automatically averting train collisions and accidents at level crossing gate have been designed, simulated and tested. This will help in maintenance and monitoring the condition of railway tracks without any errors and thereby maintaining the tracks in good condition, preventing train accidents to very large extent railway track crack detection autonomous vehicle is designed in such a way that it detects the cracks or deformities on the track which when rectified in time will reduce train accidents. As it saves some auxiliary structure as well as the expenditure on attendant it is more economical at above mentioned places than traditional railway crossing gate system. We know that though it is very beneficial but it is also impossible to install such system at each and every place, but it gives certainly a considerable benefit to us, thereby to our nation.

V. FUTURE ENHANCEMENTS

As future expansion it is proposed that licensing procedures of satellite communications may be initiated so as to implement a system upgrade whereby real time data of moving trains like speed and current location may be tracked and monitored at the control station. Such real-time information can be utilized for system upgrade so as to avert accidents due to natural calamities such as land slide and cyclone. An additional geographic sensors and interface with geographic information system may be required for the same. Panic buttons may be provided in all compartments of the train which may be used by passengers in case of danger and alert the control station.

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