Automatic Detection of Squats in Railway Track

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Abstract— **This paper proposes the design of crack finding robot for finding cracks in the railway tracks. Here the microcontroller is interfaced with Robot, ZigBee, 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 by using .NET Software. The Liquid Crystal Display (LCD) is used to display the current status of the system.**

Index Terms— ***ZigBee, Global Positioning System (GPS), Liquid Crystal Display (LCD) , Control section, Global System for mobile (GSM).***

I. INTRODUCTION

The Transportation of train always depends on the railway tracks (rails) only. If there is a track in rails, it creates the biggest problem. Most of the accidents in the train are caused due to cracks in the railway tracks, which cannot be easily identified by our naked eyes. Also it takes time to rectify the problem, we are using the crack detector robot, which will detects the crack in the rails and gives alarm. A robot is an apparently human automation, intelligent and obedient in nature but an impersonal machine. The robots have started to employ a degree of Artificial Intelligence (AI) in their work and many robots required human operators, or precise guidance through their missions. Slowly, robots are becoming more autonomous. In the advanced system, the robot designed for finding the crack in the railway track with the help of sensor and the exact location of the railway crack information is send to the control section using Global System for mobile (GSM) and Global Position System (GPS) technology.

II. LITERATURE SURVEY

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 brake 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

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conventional sensor, we can balance out the large baseline signals corresponding to a normal rail. In [7] Today the railway are 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. In [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. Proposed Method

The proposed method for the automatic detection of squats in railway track is illustrated in fig 1. The supply of 5Volt DC is given to the system which is converted from 230Volt AC supply. Firstly, the step down transformer will be used here for converting 230Volt AC into 12Volt AC. The microcontroller will support only the Direct Current supply, so the Alternating Current supply will be converted into DC using the bridge rectifier. The output of rectifier will have some ripples so we are using the 2200uf capacitor for filtering those ripples. The output from the filter which is given to the 7805 voltage regulator which will convert the 12Volt Direct Current into 5Volt DC. The output from the regulator will be filtered using the 1000uf capacitor, so the pure 5Volt DC is getting as the output from the power supply unit. Here we can use the PIC microcontroller which will be capable of getting the supply of 5Volt DC so we have to convert the 230Volt AC supply into 5Volt DC supply.

The microcontroller unit is used to detect the crack in the track by using the IR transmitter and IR receiver then the corresponding information is send to the control section using zigbee, the movement of robot also controlled by the controller. The display unit is mainly achieved by the 16X2 LCD. A liquid crystal display (LCD) is a flat panel display, an electronic visual display, or video display that uses the light modulating properties of liquid crystals (LCs). LCs do not emit light directly. In this project LCD is used to display sensor value.

In this work, Zigbee is the communication unit is used to transmit the sensor (IR transmitter and receiver) value to the monitoring section. Software is used to compile the coding of the desired application for the corresponding embedded system. GPS stands for Global Positioning System (GPS). It is a space-based on Global navigation satellite system. It provides position, and navigation to worldwide users on a continuous basis in all weather i.e. day and night, anywhere on the Earth. GPS is made up of 3 parts: between 24 and 32 satellites orbiting the Earth, 4 control and monitoring stations on the Earth. GPS satellites will broadcast signals from space that are used by help of GPS receivers to provide two-dimensional location (latitude, and longitude) .

IV. Experimental Setup and Result

In the advanced system, the robot is designed for finding cracks in the railway tracks. Here the microcontroller is interfaced with Robot, ZigBee, 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 by using .NET Software.

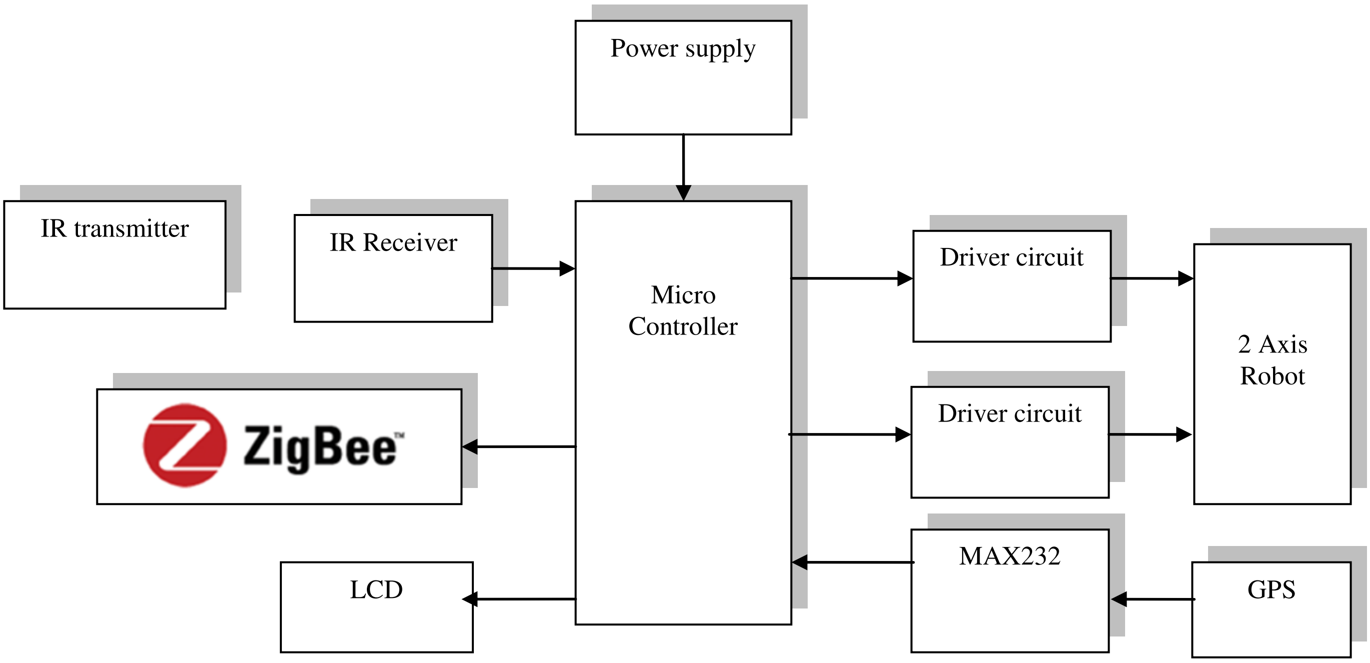

Figure 1. The Proposed method for automatic detection of squats

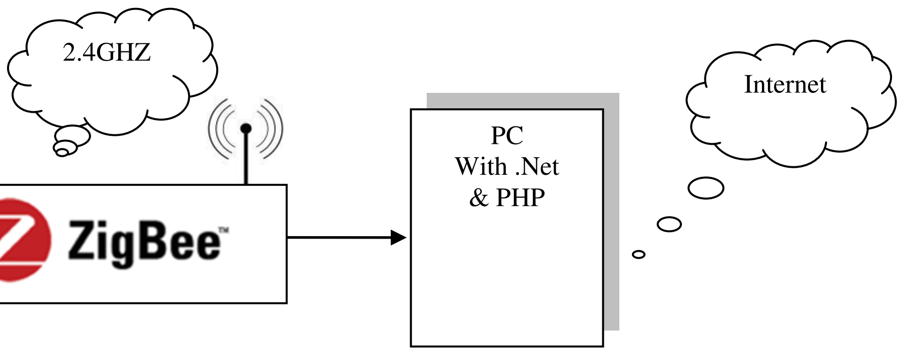

Figure 2. Control Section of the proposed method

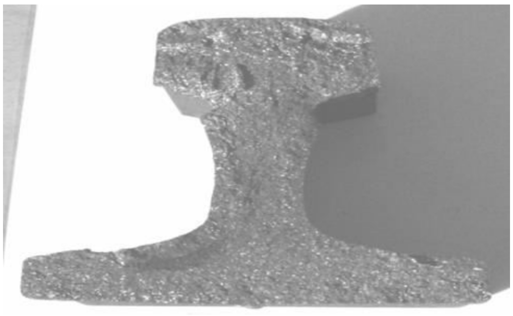

FIGURE 3. TRANSVERSE CRACK

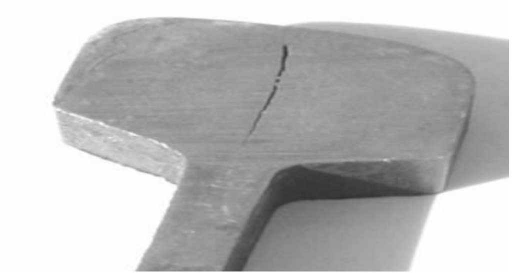

FIGURE 4. *LONGITUDINAL VERTICAL CRACK*

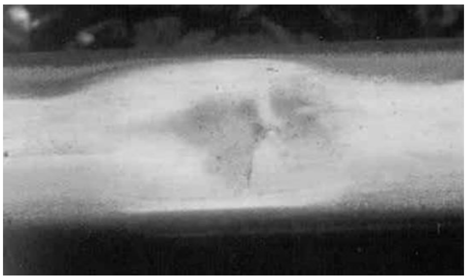

FIGURE 5. *SQUATS IN RAILS*

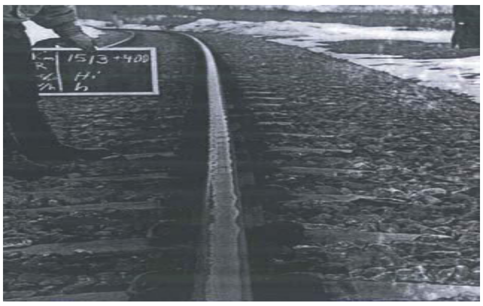

Figure 6. Corrugation in rails

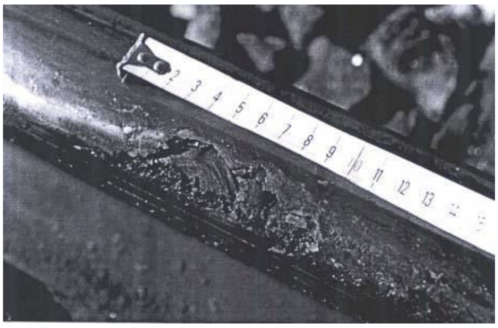

Figure 7. Gauge corner shelling in rails

Figure 8. Exact location

Figure 9. Global positioning system

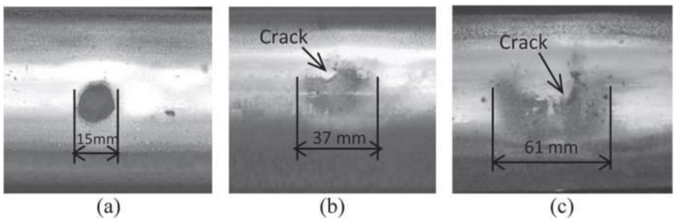

Figure 10. (a) Light squat (b) Medium squat (c) severe squat

V. CONCLUSION

In this paper, the design of crack finding robot for finding cracks in the railway tracks. Here the microcontroller is interfaced with Robot, ZigBee, 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. The control section displays the exact location that is latitude and longitude value in map by using .NET Software. The Liquid Crystal Display (LCD) is used to display the current status of the system. The exact location of the crack in the track with can easily be identified with the help of Global Positioning System (GPS) and Global System for mobile (GSM).

REFERENCES

[1] Zili Li , Rolf Dollevoet, Marija Molodova and Xin Zhao, "The validation of some numerical predictions on squats growth", September 15-18,Vol 271,PP.369-37

[2] M. Oregui 1, Z. Li 1, R. Dollevoet 2"Relating track parameter conditions to squat and corrugation initiation and growth"2010,15,pp.3519-3529

[3] Train Mazilu "Wheel and rail interaction due to the polygonal wheel",2011,vol D,pp.95-108

[4] A.Pieringer and w.Kropp"A fast time domain model for wheel/rail interaction"june 29,2008.

[5] Mirko Ignesti, Alice Innocenti, Enrico Meli, Luca Pugi, Andrea Rindi "Development and Validation of Innovative Weighing in Motion Systems"2013, pp.763-768.

[6] Ze Liu1, Andrew D. Koffman, Bryan C. Waltrip, and Yicheng Wang, "Eddy Current Rail Inspection Using AC Bridge Techniques", 2013,118,pp.140-149

[7] Thomas Heckeli,Hans-Martin Thomas1,Marc Kreutzbrucki & Sven Ruhe, "High speed non destructive rail testing with advanced ultrasound and eddy current testing techniques", 2006 ,pp.1320-1328

[8] H. Thomas, T. Heckel, and G. Hanspach, "Advantage of a combined ultrasonic and eddy current examination for railway inspection trains,"Insight - Non-Destruct. Testing Condition Monitoring, vol. 49, no. 6,

[9] Hitoshi Tsunashima1and Yasukuni Naganuma, "Condition monitoring of railway track using ln-service vehicle", pp.333-356

[10] Saurabh Kumar"Study of rail breaks associated risks and maintainance", 2006, vol. 5, pp. 2-33