Railway Track Crack Detection System

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ABSRACT: Railways are large infrastructures, and in many countries they are the primary mode of transport. Because of their capacity, speed and reliability the railways have become a prime means of transportation. Only a small increase in railway efficiency has significant economic benefits for the rail industry. Therefore, a proper maintenance plan is required to control inspection frequency optimization and/or skill and efficiency improvements. Accidents that occur due to track breakage have been a major problem for the safety of life and timely service management of the railways. It is important to detect this breakage in real time before a train eventually reaches the damaged track and is subject to an accident. In this paper, the integration of ultrasonic crack detection method and complete station for eternal railway track geometry survey system into use and operation. This system consists of a GPS module, GSM modem, IR sensor, PIR sensor to put crack detection, contact intent and identification of any living being crossing the railroad track into operation. The GPS module and GSM modem lead to railway geometric parameter recognition and transmission of crack detection to nearby railway station. This paper also discusses the summation of a non-destructive ultrasonic test (NDT) and wireless sensor networks (WSNs) to hold the information in a continuous record without interruption in nobility during run-time. The PIR sensor is executed to keep manual patrolling and track finding of living beings away. This can work both during the night and the daytime. The summing up of both WSN and NDT technologies will form different advanced and trending applications to make wireless material scanning more cost-effective in real time.

KEYWORDS: acoustic sensor, Cracks detection, railway security, Wireless sensor network.

INTRODUCTION

The rail was first used as a supporting and guiding device in the sixteenth century. Holden roadways were used in England at the period. In 1800 the first free bearing rails were applied which were supported on wooden sleepers by cast iron sockets at the ends. Railways in many countries are very large infrastructures and are the main means of transport. In terms of human lives and infrastructure costs, railways pose a high risk because it is used for passenger and freight transport. New technology and new methods of protection are continuously being implemented but incidents still happen. Risks associated with derailments and crashes are still present but can be minimized by studying the root causes in depth [1]. A proper maintenance strategy is required to control inspection frequency optimization and/or skill and productivity improvements. The key challenge is identifying and rectifying the rail defects. Some of the defects include internal defects, welding problems, worn-out rails, corrugations and fatigue caused by rolling contact (RCF), such as surface cracks, head checks, squats, spalling and shelling. Unless detected and/or untreated, such defects can cause rail breaks and derailments [2].

Due to the advancement of wireless communications and MEMS (Micro Electro-Mechanical Systems) technologies [3], lower power consumption and low-cost wireless micro-sensors with sensing, signal processing and wireless communication capabilities have been developed. A base station aggregates and summarizes the data collected, and sends it to a user or remote host. Since sensor nodes obtain power from small disposable batteries, they have limited communication power available which limits their transmission range. Therefore, a sensor node can only communicate with the sensor nodes which lie within a short distance from it. A sink is responsible for gathering data and making decisions which can be manual or automatic. Here it suggest an automated method for detecting breakage of the railway track which is energy efficient from its ancestors. The purpose is to feel the railway track vibration and use its strength to detect disturbances in the line. If the track is not continuous the vibration can decrease drastically [4].

The device presented helps identify railway track defects using ultrasound test tool. Upon identification of the split, the respective coordinates are sent to the nearest station. GPS and GSM module do this logging and sending of coordinates. Ultrasonic technique is the most effective tool for detecting small cracks and also for measuring the crack growth rate. One can detect the growth rate at regular intervals. It implements non-destructive crack detection system. Non-destructive testing technique is one of the processes which help in the examination of material without causing any harm. NDT is a commonly used approach for repair of materials without discussing the material values. Due to the various behaviors as ultrasonic waves present in different material properties, the ultrasound waves are extensively used in this process. As the ultrasonic wave signal propagates from one medium to another distinct medium, a certain proportion of the signal energy propagates to the other medium, while at the same time reflecting back the remaining energy. The measured sound wave intensity in tested material is 5600 m/s. As specified the sound wave speed in the particular material density, calculation of the properties of such as time difference of arrival (TDOA) after having the reflected signals and can measure the thickness and the faults in the material by using this time arrival. The defects produce holes in the content, which make it appear as another medium that reflects the waves back [5].

PROPOSED SYSTEM

The device presented helps identify railway track defects using ultrasound test tool. When the device provided helps identify the defects in the rail track using method of ultrasound examination. Upon identification of the split, the respective coordinates are sent to the nearest station. GPS and GSM module do this logging and sending of coordinates. Ultrasonic technique is the most efficient device which also detects minor cracks and also calculates the crack's growth rate. The rate of growth can be detected at regular intervals, after several observations. Non-destructive testing technique is one of the processes that aid in the analysis of material without causing any damage.

NDT is commonly used approach for the conservation of materials without discussing the material values. Due to the different behaviors as ultrasound waves display in different material properties are extensively used in this method Ultrasound-wave. As the ultrasonic wave signal propagates from one medium to another distinct medium, a certain proportion of the signal-energy propagates to the other medium, while at the same time reflecting back the remaining energy. The measured sound wave speed in the tested material is 5790 m/s. As the described sound wave speed in the particular material density and will be able to calculate the properties such as time difference of arrival (TDOA) after obtaining the reflected signals. Measurement of the thickness and the faults in the material can be calculated by using this time arrival. The defects produce holes in the content, which make it appear as another medium that reflects the waves back.

COMPONENTS USED

Dc Motor

DC motors are chosen according to robot weight and velocity having the 150 rpm and 2kg-cm torque engines. No charge current is equal to 60mA (max), and load current is equal to 300mA. DC motors can be operated simultaneously in its can mode of operation, both in forward and reverse direction. L293D is an Integrated Circuit (IC) Dual H-bridge motor driver. Motor drivers operate as current amplifiers since a low-current control signal is captured and a higher current signal is supplied. This higher-current signal acts to power the engines [6].

Wheels

Wheel selection is an important aspect, since the torque and rpm of the motor can differ depending on the wheel dimensions. Dimensions of the chosen motor are 68 mm in diameter and weight equals 200gm. The wheel's main material is steel alloy, with the outer portion (grip) being rubber. Using rubber to the outside increases rail traction [7].

GPS

GPS stands for Global Positioning system. Global Positioning System tracking is a method of working out where exactly the robot is. In the same way, it tells where exactly the crack is. It also tracks the movement of the vehicle at the same time [8]. When a crack is detected by the sensor the vehicle stops at once, and the GPS receiver triangulates the position of the vehicle to receive the Latitude and Longitude coordinates of the vehicle position, from satellites. Many systems will preserve the data in the GPS tracking system itself while some send the information to a centralized database or system by use of a modem within the GPS system unit or 2-Way GPS.

PIR Sensor

PIR sensors are electronic instruments that calculate the radiance of infrared light from objects in the field of view. The sensor consists of a pyroelectric electrode. This system is used to measure infrared radiation levels. This effectively serves as a tool for motion detection, helps identify human activity or any object on the railway line.

Ultra sound testing

The basic theory of ultrasonic material research is sound wave propagation and reflection. Think of a cylindrical workpiece for example. As a single crystal, the positions of atoms in it are extremely magnified and simplified. For starters, a rigid unyielding stop is attached to the cylinder's right front end. A disk is mounted at the left front end that is used to send and receive sound waves. Pushing and pulling at the disk momentarily allows a longitudinal wave of sound to travel through the ring. When the sound waves hit the rigid right edge, it is mirrored and runs back to the receiver disk. A free end can also mimic a wave. However, in this case, the outside tents run ahead in the reflected wave, and finally deflect the receiver to the right. The reflected wave is also mirrored again and passes over the length of the cylinder for many periods. Therefore if at one end of a workpiece a sound wave is produced, it will pass through the material with its sound speed. The sound wave is reflected at the free end of the workpiece, and it returns to the transmitter which then serves as a receiver [8].

In most cases, a large transmitter is used for ultrasonic testing of a work piece, but a more small transmitter produces a short ultrasonic pulse and a place free of defects, the ultrasonic pulse travels to the right front end, also called the back wall. The cavity reflects a portion of the wave when the transmitter is pushed a little downward. The part had arrived at the transmitter earlier than the rest of the sound wave. The cavity much farther down reflects the entire ultrasonic pulse. The echo of a defect can be used for material inspection. On the phenomenon this is the pulse echo mode where hardly any sound waves move through the imperfection. It is called the mode by transmission.

In pulse-echo the transducer mounted in a pro conducts both the transmitting and the receiving of the ultrasonic pulse on the device controlling the intensities being planted upwards on the y-axis and the time to the right on the x-axis with a probe at a position free of defects only two signals that are seen on the display i.e. the transmission pulse and the echo resulting from the lower surface. Moving the probe to the right results in an additional echo that is created by the defect. Only the defect echos are noticeable from the transmission sections, much further to the right.

This experiment is being conducted on a find cylinder. It includes artificial defects which are outwardly invisible. The material tester uses the pulse-echo system to detect the defects. To this end, a probe is used. Built a vivid well-played electric disk pioneer. It can convey and receive ultrasonic pulses. The probe is powered by a computer using a plug-in charge and power electronics. The intensities plotted upwards on the display, and the time is plotted to the right. Initially, after placing the probe atop the cylinder, it can be seen at all on the monitor. The explanation for that is the very small area of contact between the probe and the piece of work.

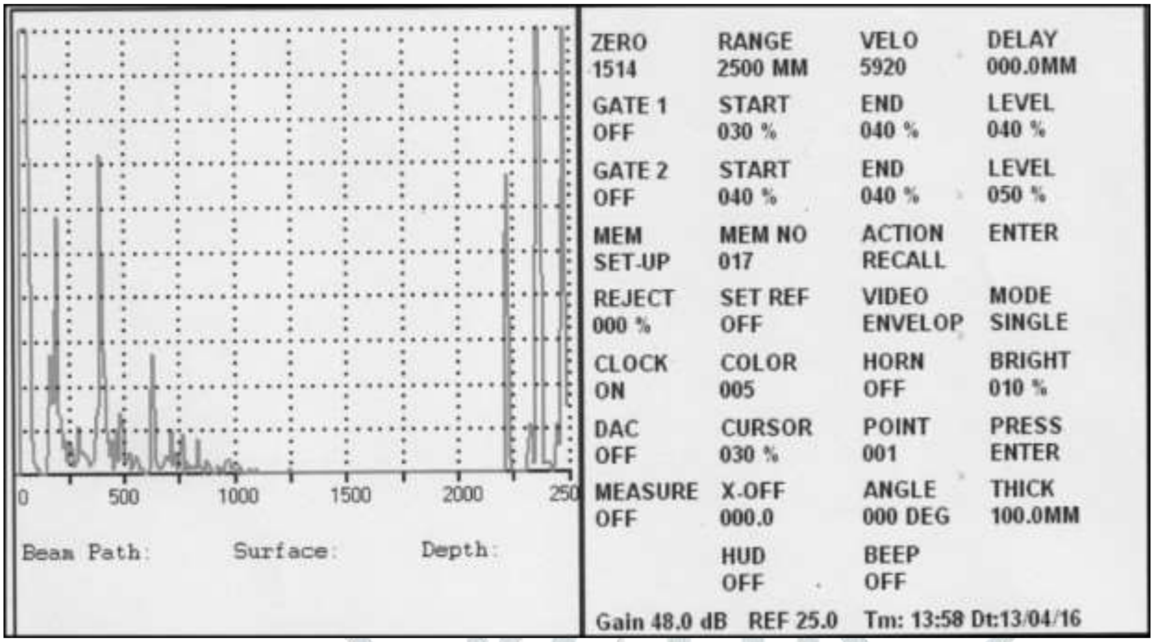

Figure 1: Ultrasonic Test Report.

Just by using a gel that is also called as a couple and the ultrasonic pulses will get into the workpiece and will go back into the probe as well. The back wall now lights up on the camera. The substance checks uniformly distribute the gel onto the top surface. That way, the whole cylinder can be finished. Using the sound velocity in the material one can map the measured depth on the display to the right instead of a very useful function in time. The depth of the defect can easily be read off at the lower left corner of the monitor with the aid of so-called trigger gates that can be placed on the device with the echoes head.

The back wall of the cylinder lies under the probe at a depth of around 200 millimeters. And the height of the cylinder is 200 millimeters. The content tester tests the cylinder's upper front end with a probe and watches the camera. An echo of a defect appears on the display. This echo is detected below the surface at a depth of 130 millimeters. Another echo shows the 87 millimeter-depth defects. Double reflection on the same imperfection causes the second smaller echo at 174 millimeters.

GRAPHS AND SIMULATIONS

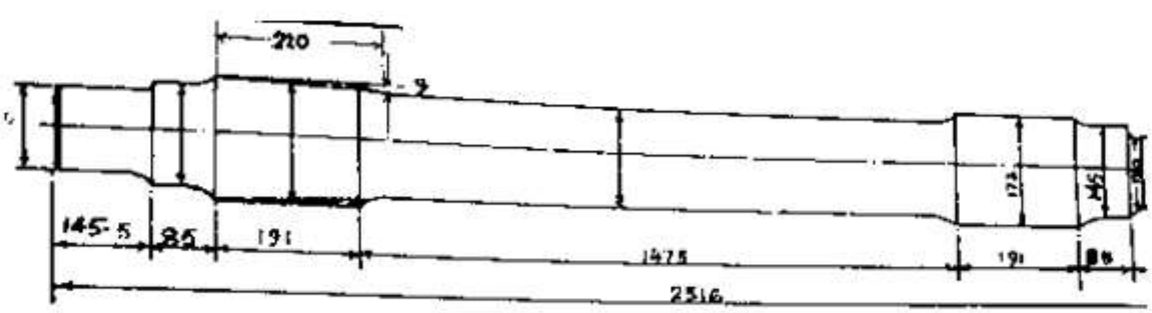

Figure 2: Far end scan trace pattern.

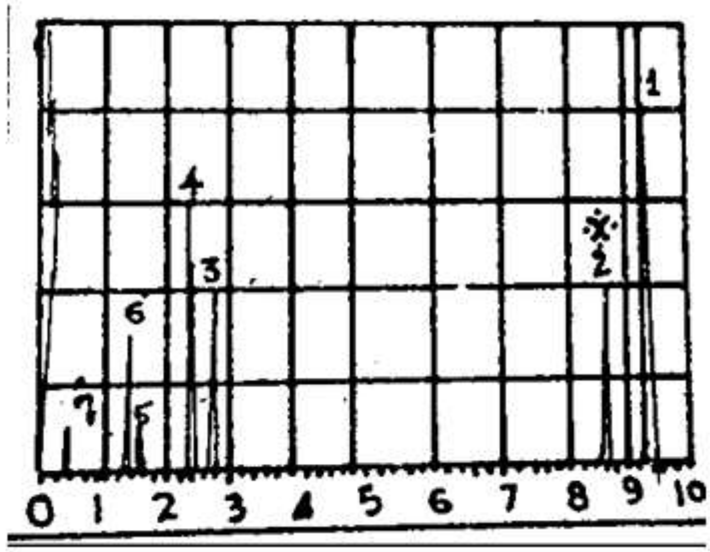

Figure 3: Control System.

Subsequent fig. 3 and 4 display Low angle scanning and high angle scanning respectively. Low angle scanning has longitudinal wave while the shear wave has the high angle scan.

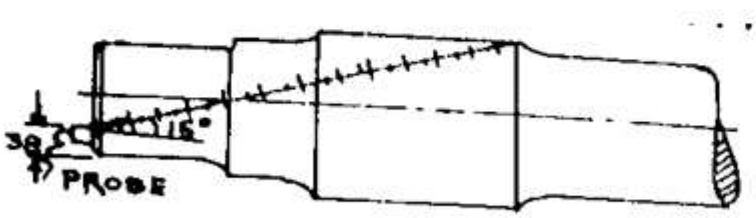

Figure 4: Low Angle Scan

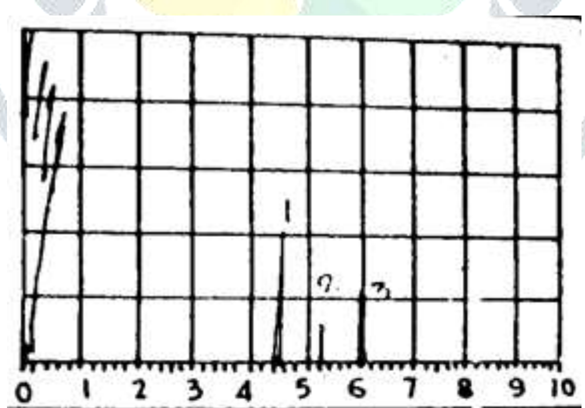

Figure 5: Low Angle Signal.

Ultrasound measurement using WSNs

Actually available ultrasonic non-destructive test equipment is primarily available Wireless sensor network is tremendously massive, power-intensive, and sumptuous. Graphically displaying quantified data in authentic-time on a colored show is a power-intensive process that involves very high sampling analog to digital converters and advanced graphical display technology. Such operating data is not needed for wireless sensor network because unprocessed data is transmitted directly back to a server where it is displayed only when necessary. The origination and timely reception of ultrasonic waves is the only desirable aspect of a Non-Destructive Test device in the ultrasonic region.

This somewhat reduces the number, usage and cost of Non-Destructive System based on wireless sensor network. Non-Destructive high-speed processing analog to digital converter would not be required for thickness-based testing, which could reduce power load on the device somewhat. Installation of a wireless sensor network based Non-Destructive approach will be advisable in a static and isolated environment for low-cost monitoring of material inspection. Device development frames on wireless network platform for a wireless sensor network based Non-Destructive Testing solution. This platform is a modular wireless sensor network platform which allows for natural identification of up to four characteristic modules.

CONCLUSION

Large-scale implementation of the idea can facilitate better safety standards for railway tracks in the future. This autonomous vehicle would have a significant effect on track safety and maintenance. This vehicle will help prevent train crashes. That can be achieved without any interference by humans. In this paper USFD computer is used to demonstrate the identification of the flaws. The detectable size of the flaw depends upon the ultrasonic wave's wavelength. A defect size of ÿ/2 is usually reliably observable. In a medium the amplitude of a single wave is constant. It gives no false output, and it has accurate detection. The transmitting signals are transferred instantly.

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