Automatic Detection of Squats in the Railway Tracks

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ABSTRACT

The Transportation of train always depends on the railway tracks (rails) only. If there is a crack in rails, it creates the biggest problem. The design of crack finding robot helps in finding cracks in the railway tracks. The sensors placed in the robot senses the variations and the deviation in the track 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 stepper motor fixed on the wheels of the device and sends that location according to the number of revolutions of the device and sends crack information to the control section. The control section displays the exact location in the map by using Arduino ISP Software.

Keyword: - *Squats, Eddy current testing, Railway inspection, Rail crack*

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1. 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 detect 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.

2. EXISTING SYSTEM

The existing system uses the automatic detection of squats is based on wavelet spectrum analysis and determines the squat locations. The detection algorithm relies on the signature tunes of the squats, which were identified from numerical simulations in a previous work and were validated by field measurements. The detection algorithm was based on the SAWP. The averaging of the wavelet spectrum was performed at the frequency bands related to the squats.

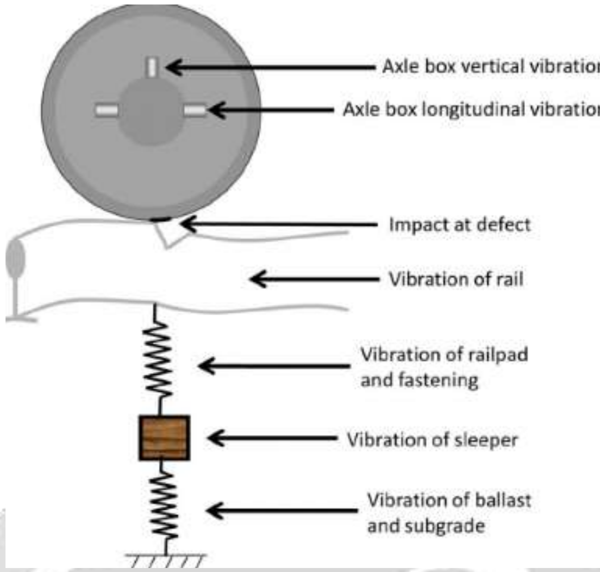

Fig -1 ABA Instrumentation setup

These frequency bands are different for light and for moderate and severe squats: 200–400 Hz and 1000–2000 Hz for light squats and 200–400 Hz for moderate and severe squats. The thresholds for detecting squats on the Dutch tracks were empirically obtained. The instrumentation setup as illustrated in fig -1 is similar for both trial measuring rounds. The accelerometers were mounted on the four axles of a bogie. Each data set included four vertical ABA signals, recorded on the axle boxes of one bogie, GPS coordinates for determining the location of the signals, and the train speed.

The ABA measurements were repeated three times on the same track. That was made because of several reasons. First of all, to examine the repeatability of ABA at short track irregularities: ABA signals measured at a short track irregularity should have similar response for every measurement within one day. The second reason to repeat the measurements is to increase the probability to detect light squats.

The wheel rail interaction at a squat is influenced by the lateral geometry of the squat. However, during the several measurements runs a wheel might have travelled along different trajectory on the rail because of the hunting oscillation and this method becomes less suitable to detect the internal and minute which is overcome by the proposed system.

3. PROPOSED SYSTEM

The design of crack finding robot is implemented for finding cracks (including surface and internal cracks) in the railway tracks. There are three sensors placed in the wagon. These senses the variations and the deviation in the track and then it sends 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 GPS fixed on the device and sends that location according to the number of revolutions of the device and sends crack information to the control section. The control section displays the exact location that is latitude and longitude value in map by using Arduino ISP software.

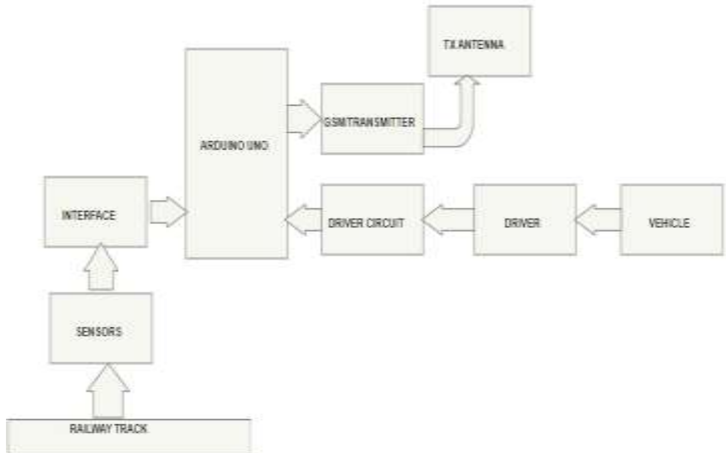

Fig -2: Transmitter section

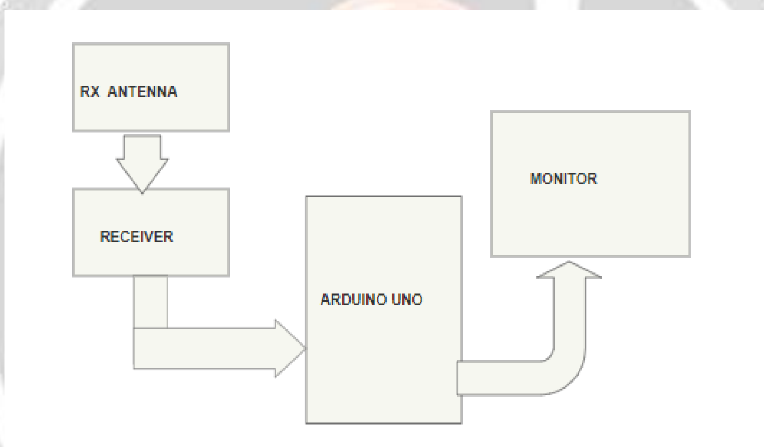

Fig -3: Receiver section

3.1 Block diagram description

Three sensors IR sensor, Ultrasonic, eddy current sensor are placed in the transmitter section block (fig -2) which detects the presence of crack in railroad. Infrared (IR) transmitter is one type of LED which emits infrared rays generally called as IR Transmitter. Similarly, IR Receiver is used to receive the IR rays transmitted by the IR transmitter. One important point is both IR transmitter and receiver should be placed straight line to each other. When the signal gets retransmitted from the object in the front of the wagon, then we can conclude that an obstacle is present in the track.

When the obstacle is detected the vehicle stops and intimates the control system that a hindrance in found in the track, if not, the wagon, as programmed continues to inspect. Ultrasonic and eddy current sensor serves for a similar purpose. Ultrasonic sensors are mounted facing the track surface and IR sensor in the back of the wagon and eddy current sensor facing the sides of the track as depicted by the fig -4. Ultrasonic sensor works on a principle of sending and receiving sound pulses. Using IO trigger for at least 10us high level signals sent, the Module automatically sends eight 40 kHz and detect whether there is a pulse signal back. If the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning.

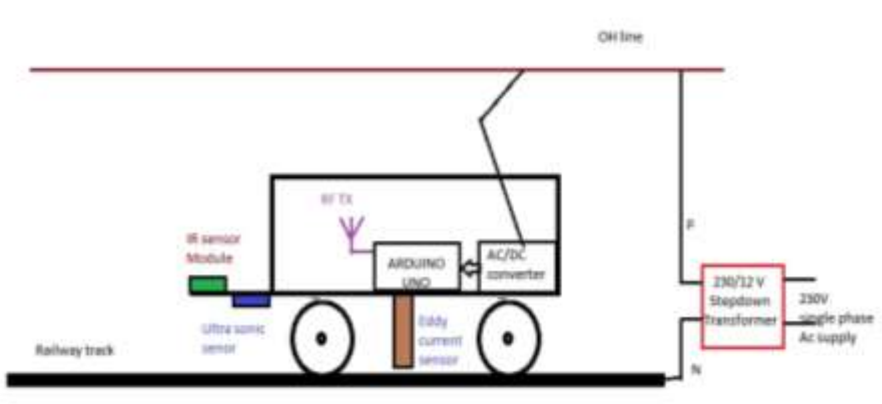

Fig -4: The general arrangement of squats detection system

For a flat surface the test distance sent and received signal is of same value.the value deviates only if there is a detected crack. For instance, if there is a crack and also if it's a flat surface, then the time duration for sent and the received pulse is normally higher than the usual normal track surface. Also, if the depth of the crack is too large, the received pulse may be lost in some cases.

Eddy current testing is an electromagnetic technique and can only be used on conductive materials. Here is how the technique works. When a coil carrying an AC current is brought near to the surface of a metal specimen, eddy currents are induced into the specimen. The AC current in the coil generates a changing magnetic field, which interacts with the test object and induces eddy currents. These eddy currents set up small magnetic fields of their own that tends to oppose the original magnetic field of the coil. This change in the original magnetic field can be detected through changes of the coil impedance. A probe moved over the surface of a defect free specimen has a constant impedance if its height above the surface is kept constant, but if there are defects present in the material, then the defects will cause the original magnetic field to vary beyond the expected value and that will indicate a presence of a defect in the material through changes of the coil impedance.

The variation in the magnetic field causes the impedance of the coil to change and this is how it is measured. Thus, a defect will cause the impedance of the coil to change beyond that is expected of the given material, indicating the defect. This is eddy current testing. Hall effect sensor is used to measure the magnitude of the magnetic field.the output of the hall effect sensor is directly proportional to the magnetic field strength through it.The voltage varaitions are sensed and compared with the threshold values(without defect).the identifies crack's location is sent with the help of GPS and the location is sent to the receiver control section (fig -3) which displays the exact location of the crack in the serial communication window.This method is suitable for measuring internal as well as external cracks with the efficiency of 10% more than the ABA detection technique.

3.2 Results and Analyses

Fig-5: The vehicle which moves along the track.

After moving some certain distance, the vehicle identifies the obstacle along the track.

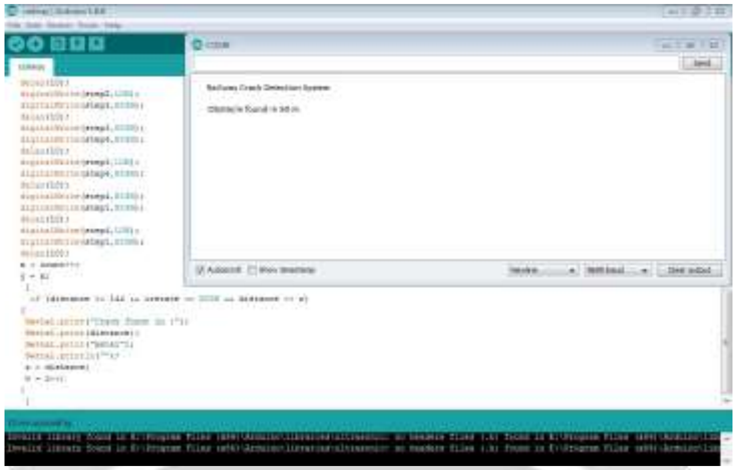

Fig -6: The serial monitor window in the receiver control section which shows the detected obstacle's distance.

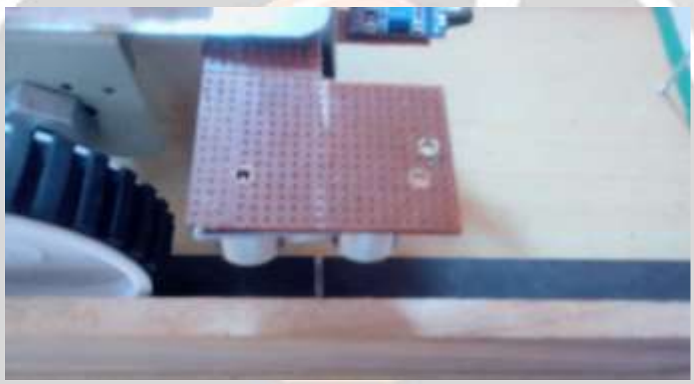

Fig -7: The presence of squats in the track.

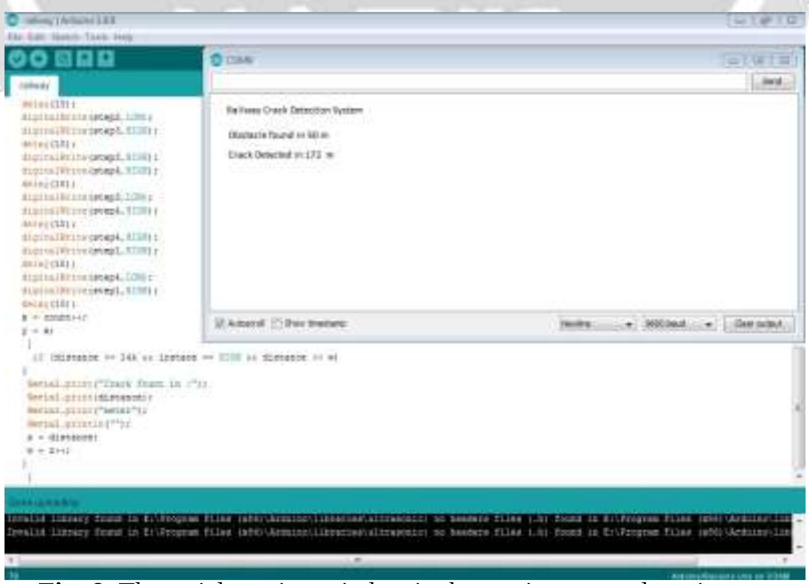

Fig- 8: The serial monitor window in the receiver control section which shows the detected squats location.

4. CONCLUSIONS

By using this Autonomous vehicle for purpose of railway track inspection and crack detection, have a great impact in the maintenance of the tracks which will help in preventing train accidents to a very large extent. The regions where manual inspection is not possible, like in deep coal mines, mountain regions and dense thick forest regions can be easily done using this vehicle. By using this vehicle for the purpose of Railway track inspection and crack detection and automated SMS will be sent to predefined phone number whenever the vehicle sensors detect any crack or deformation. 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.

5. REFERENCES

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