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Automatic Railway Track Crack Detection System

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Abstract*: The Indian Railways has one of the largest railway networks in the world, criss- crossing over 1,15,000 km in distance, all over India. However, with regard to reliability and passenger safety Indian Railways is not up to global standards. Among other factors, cracks developed on the rails due to absence of timely detection and the associated maintenance pose serious questions on the security of operation of rail transport. A recent study revealed that over 25% of the track length is in need of replacement due to the development of cracks on it. Manual detection of tracks is cumbersome and not fully effective owing to much time consumption and requirement of skilled technicians. This project work is aimed towards addressing the issue by developing an automatic railway track crack detection system integrating an infrared red (IR) crack sensing module and a communication module based on GSM technology by which information about the location of the crack can be conveyed to a central location enabling the immediate attention and intervention of maintenance personals.*

Keywords: GSM,GPS,IR

*1.*Introduction

This is an era of automation where it is broadly defined as replacement of manual effort by Electronics in all degrees of automation. The operation remains an essential part of the system although with changing demands on physical input as the degree of mechanization is increased.

Degrees of automation are of two types, viz.

- Full automation.
- Semi automation.

In semi automation,a combination of manual effort and mechanical power is required whereas in full automation human participation is very negligible. Our project is fully automated one.

Automation can be achieved through computers, hydraulics, pneumatics, robotics, etc., of these sources, form an attractive medium for low cost automation. The main advantages of all automation systems are economy, accuracy and simplicity. Automation plays an important role in all industries.

- To achieve Quick Response
- To reduce man power
- To increase the system efficiency
- To reduce the work load
- To achieve grater accuracy
- To reduce the time of operation
- To reduce the fatigue of workers
- To achieve good system quality
- Less Maintenance

2.Literature Review

Avinash.Vanimireddy1 ,D.Aruna Kumari et al said that 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 lead to a number of derailments resulting in a heavy loss of life and property.

Ramavath Swetha et al inferred the ideas in designing railway track crack detection autonomous vehicle using Microcontroller, IR obstacle Sensors assembly system, which detects the cracks along its path; the vehicle is also capable of monitoring the location of the crack by using the GPS module and alerts through SMS messages using GSM module.

3.Components And Description

The main components of the automatic railway track crack detecting vehicle are :

- IR Sensor
- GSM transmitter and Receiver Unit
- D.C. Motor
- Body (Spur Gear Mechanism)
- Railway Track
- Battery

3.1. IR Sensor

In our project IR transmitter and receiver circuit is used to sense railway track cracks. There are two pairs of sensor are used.

Sensor 1 : One side of the train track
Sensor 2 : Other side of train track

Sensor 1 and Sensor 2 are used to sense the crack in the railway track and giving control signal to the GSM transmitter unit.

3.2.GSM Transmitter Unit:-

GSM transmitter unit is used to activate the receiver unit when the signal is received from the IR sensors.

Transmitter Circuit Description

The transmitter is made to activate with the supply from a 9volt battery. When IR sensor is giving the crack detection signals the voltage is supplied to the Frequency modulator. The frequency modulator modulates the base hand signal by using a proper carrier frequency. The output of the modulator is given to a high power amplifier to raise the modulated signal. This modulated signal is then fed to the transmitting antenna.

Receiver Circuit Description

The transmitted signal is received by the receiving aerial at the station master. The received signal contains unwanted energy, which is usually termed as noise. The noise affects the receiver sensitivity. So the noise should be filtered, this filtering is done by the low noise amplifier block. This weak signal is now amplified so that it turns the relay circuit ON (i.e.) to activate the main contactor.

3.3. D.C. Motor:-

In our project permanent D.C motor is used. An electric motor is a machine which converts electrical energy to mechanical energy. Its action is based on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a magnetic force whose direction is given by Fleming's left hand rule.

When a motor is in operation, it develops torque. This torque can produce mechanical rotation. DC motors are also like generators classified into shunt wound or series wound or compound wound motors.

3.4 .Body:-

Detection system consist of battery, motor and spur gear mechanism. One gear is fixed to the motor shaft and another one gear is fixed in the wheel shaft of the system.

3.4.1.Spur Gears:

Spur gears are used to transmit power between parallel shafts. They impose only radial loads on their bearings. The tooth profiles are ordinarily curved in the shape of an involute. Variations in center distance do not affect the trueness of the gear in action unless the change is so great as to other jam the teeth into the root of the mating member or with draw the almost out of action. Spur-gear teeth may be hobbed, shaped, milled, drawn, sintered, cast, and shear-cut. They may be given a finishing operation such as grinding, shaving, lapping, rolling, and burnishing. Generally, there are more kinds of machine tools and processes available to make spur gears than to make any other gear type.

The spur gears, which are designed to transmit motion and power between parallel shafts, are the most economical gears in the power transmission industry.

Application:

- Material handling
- Feed drives
- Machine tools
- Conveyors
- Marine hoists

3.4.2. Internal Spur Gear:

The internal gears are spur gears turned "inside out." In other words, the teeth are cut into the inside diameter while the outside diameter is kept smooth. This design allows for the driving pinion to rotate internal to the gear, which, in turn, allows for clean operation. Intended for light duty applications, these gears are available only in brass. When choosing a mating spur gear, always remember that the difference in the number of teeth between the internal gear and pinion should not be less than 15 or 12.

Applications:

- Light duty applications
- Timing
- Positioning
- Rollers
- Indexing

3.4.3. External Spur Gear:

Perhaps the most often used and simplest gear system, external spur gears are cylindrical gears with straight teeth parallel to the axis. They are used to transmit rotary motion between parallel shafts and the shafts rotate in opposite directions.

They tend to be noisy at high speed as the two gear surfaces come into contact at once. Internal spur gears: The internal spur gear works similarly to the external spur gears except that the pinion is inside the spur gear. They are used to transmit rotary motion between parallel shafts but the shafts rotate in the same direction with this arrangement.

3.5.Railway Track:-

Railway track is made up of M.S.Steel materials. The length of the track is 12 feet. Train wheel is also made up of M.S Steel materials. The center of the wheel is V-grooved, so that the vehicle moves on the exact track path.

3.6. Battery:-

Material : Lead-Acid Battery
Output Voltage : 12 V
Output Power : 7 Ampere-Hour

4. Design And Drawings

The main design considerations are,

- SPUR GEAR
- BEARINGS

4.1. Spur Gear:
Diameter of the motor gear wheel (D1)
= 36 mm
Diameter of the Shaft Gear Wheel(D2)
= 72mm
Speed of the Motor (N1) = 60 RPM
Speed of the shaft wheel (N2)
= (D1 / D2) x N1
= (36 / 72) x 30
= 15 RPM

4.2. Bearing:-

Bearing No. 6202
Outer Diameter of Bearing (D) = 35 mm
Thickness of Bearing (B) = 10 mm
Inner Diameter of the Bearing (d)
= 15 mm

r_1 =Corner radii on shaft and housing
r_1 =1(From design data book)
Maximum Speed =14,000 rpm (From design data book)
Mean Diameter (dm) =(D + d) / 2
=(35 + 15) / 2
dm =25 mm

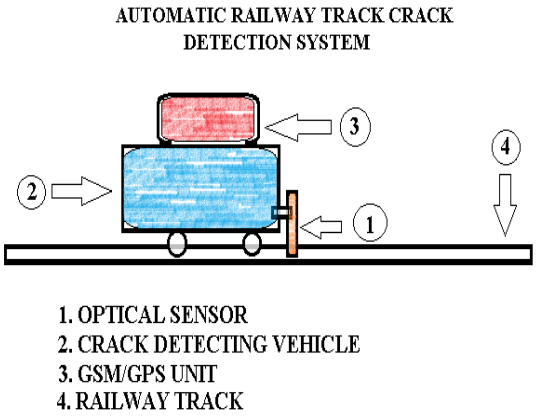

Fig 1: Automatic Railway Track Crack Detection System

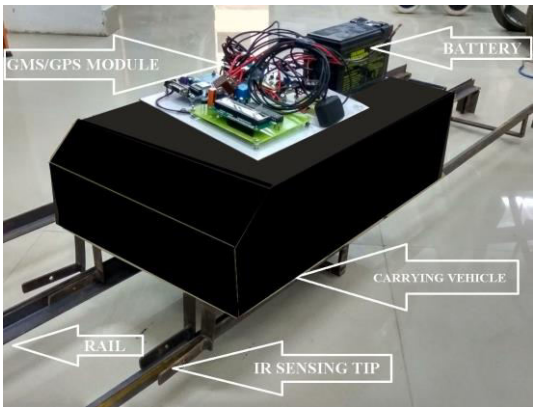

Fig 2: Fabricated Model of Automatic Railway Track Crack Detection System

5. Working Principle

In our project, there are two set of IR sensor units fitted to the two sides of the vehicle. This unit is used to activate/deactivate GSM transmitter unit when there is any cracks in the track.

The IR transmitter and IR receiver circuit is used to sense the cracks. It is fixed to the front sides of the vehicle with a suitable arrangement.

5.1 At Normal Condition:

The IR transmitter sensor is transmitting the infrared rays with the help of 555 IC timer circuit. These infrared rays are received by the IR receiver sensor. The Transistors are used as an amplifier section. At normal condition Transistor is OFF condition. At that time relay is OFF, so that the vehicle running continuously.

5.2 At Crack Condition:

At crack detection conditions the IR transmitter and IR receiver, the resistance across the Transmitter and receiver is high due to the non-conductivity of the IR waves. So the output of transistor goes from OFF condition to ON stage. In that time the relay is ON position. In that time, the motor power supply is disconnected and switch on to the GSM transmitter unit. The GSM receiver is fixed to the nearest station master, so that the alarm signal is given to the station master.

6. Advantages

- The auto crack detection method is more efficient in the technical field
- Quick response is achieved
- Simple in construction
- Easy to maintain and repair
- Cost of the unit is less when compared to other
- No fire hazard problem due to over loading

- Comparatively the operation cost is less
- Continuous operation is possible without stopping
- Automatic alert system to the station master
- The signal transmission is wireless transmission.

7. Application

- Automatic crack checking:-

The vehicle draws power from the battery. The IR sensor is used to detect the crack in the railway track. Suppose any crack in the track, the vehicle automatically stop and activates the GSM transmitter circuit.

- Cordless identification to the station master:-

This unit can also be used to intimate the nearest railway station. The GSM receiver circuit is fixed in the room of the station master.

8. Disadvantages

- The signal transmission is bellow 50 feet
- The vehicle operated in battery power, so rechargable battery is used to drive the vehicle.

9. Conclusion

By using this automatic vehicle for purpose of railway track inspection and crack detection, it will 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 pre-defined 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. The addition of solar panel is an added advantage, which also helps conserving the power resource.

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11.References

[1] Rao M., Jaswanth B. R., 2014. Crack Sensing Scheme in Rail Tracking System. IJERA4(1).

[2] Parrilla M, Nevado P., Ibanez A., Camacho J., Brizuela J., Fritsch C., 2008. Ultrasonic imaging of solid railway wheels. IEEE(08).

[3]The Hindu Official Website.2012, Ultrasonic railway crack detection system. Available from: <http://www.thehindu.com/todays-paper/tp-national/tp-kerala/students-develop-device-for-detecting-cracks-on-rail-tracks/article3916920.ece>

[4]Jian-hua Q., Lin-sheng L., Jing-gang Z. Design of rail surface crack detecting system based on linear CCD Sensor.

[5] Sharma K., Maheshwari S., Solanki R., Khanna V., 2014. Railway Track Breakage Detection Method using Vibration Estimating Sensor Network.IEEE(14).