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Railway Crack Detection System

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ABSTRACT

In this world people uses various types of transportation system to travel from one place to another place. Mostly they prefer to use public transportation for cheaper means of travelling. However, the safety of these economic public transportation are always in question. Though the transport departments check out the safety measures implemented in them, they are not efficient. The proposed system is suitable for railways transportation to identify the cracks in the railway tracks earlier and prevent the accidents. The derailment causes several loses in railway accidents. In this paper we use crack detection sensor, this will be placed in a hovercraft vehicle to detect cracks. By this, if some crack is detected on the track the vehicle, starts to slow and stop at respective point automatically and exact place of crack would be given to control room. The proposed system introduces cellular network- based technology, to prevent the trains accident. The cellular network device is installed at each front end of the hovercraft vehicle. If the crack is detected, automatically signal is sent and an alert is given to station. The main aim of the paper is to avoid the train accidents without manual power.

INTRODUCTION

The cracks and other problems with the rails generally go unnoticed due to improper maintenance and irregular manual track line monitoring that is being carried out in the current situation. Nowadays system have some limitations, if the bridge or track damaged, that information goes to railway authority people, they notify and informs to the corresponding trains it will takes more time informing that information. In the literature survey, the commonly employed rail crack detection schemes in foreign countries are usually ultrasonic or eddy current based techniques which are the reasonably good accuracy in most cases. However, the one characteristic which the above-mentioned methods have in common is that they are both expensive, which makes them ineligible for implementation in the current Indian scenario. Also, the ultrasonic can only inspect the core of materials; that is, the method cannot check for surface and near surface cracking where many of the faults are located. 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 [1]. This system is mainly concerned in identifying the cracks in railway tracks and helps to prevent the accidents without manual power. It's not only concentrated on finding damaged tracks but also helpful to find out the derailment and the exact place where it is. In these technical solutions offered by many companies in the detection of cracks in rails involve periodic maintenance coupled with occasional monitoring usually once a month or in a similar time frame. But the robotics possesses the inherent advantage of facilitating monitoring of rail tracks on a daily basis during nights, when the usual train traffic is suspended. Further, that the simplicity of this idea and easy availability of the components make for implementation on a large scale with very little initial investment [2]. The simplicity of this work ensures robustness of operation and also the design has been carefully modified to permit rugged operation. Another disadvantage that can be attributed to the conventional commercially available testing equipment is that they are heavy which poses a practical limitation. This important disadvantage has been rectified in robotics paper as the design is simple and sensible enabling the device to be easily portable. While designing the mechanical parts of the robot, due consideration has been given to the variable nature of the tracks and the unique challenges possessed by the deviations in the Indian scenario. For example, in areas near road crossings the outer part of the track is usually covered with cement. Also, there is always the problem of rocks obstructing the path on the inside parts of the rails. So, the specialized wheels that have been provided in robot that has taken into account and are specifically designed to overcome this aforementioned problem. The railway track crack detection is used to detect the crack whiles the train running on the track. The proposed system is used to detect the crack on railway track before 10km.

This paper presents a design and implementation of a hovercraft based railway track crack detection system. The system making use of ultrasonic sensor detects cracks in the railway track. There are two set of ultrasonic 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 ultrasonic sensor is used to sense the cracks. It is fixed to the front sides of the vehicle with a suitable arrangement. When the vehicle is

Powered On, it moves along the model track. The ultrasonic sensors monitor the condition of the tracks. When a crack is detected by the IR 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. The Latitude and Longitude coordinates received by GPS are converted into a text message which is done by microcontroller. The GSM module sends the text message to the predefined number with the help of SIM card that is inserted into the module. A third ultrasonic sensor is used to detect any obstacle Infront of the vehicle.

The system uses Hovercraft as the base. The basic principle of the hovercraft is that moving an object from the ground using air, then it requires less force to move the object. Because the object does not have any contact with the ground, then the surface tension will get reduced. So, it is easy to move the object. The friction is also reduced in case of smoother surface. If the surface contains rocks or any other obstacles, then it may cause slow down the vehicle, or even damage occurs in the air cushion vehicle. To work efficiently, the hovercraft has skirts which is made up of fabric surrounding their bases. These skirts help to keep the pressurizing air from escaping.

The crack is detected using an ultrasonic sensor. Ultrasonic sensors emit short, high- frequency sound pulses at regular intervals. These propagate in the air at the velocity of sound. If they strike an object, then they are reflected back as echo signals to the sensor, which itself computes the distance to the target based on the time-span between emitting the signal and receiving the echo. As the distance to an object is determined by measuring the time of flight and not by the intensity of the sound, ultrasonic sensors are excellent at suppressing background interference.

DESIGN OF PROPOSED SYSTEM

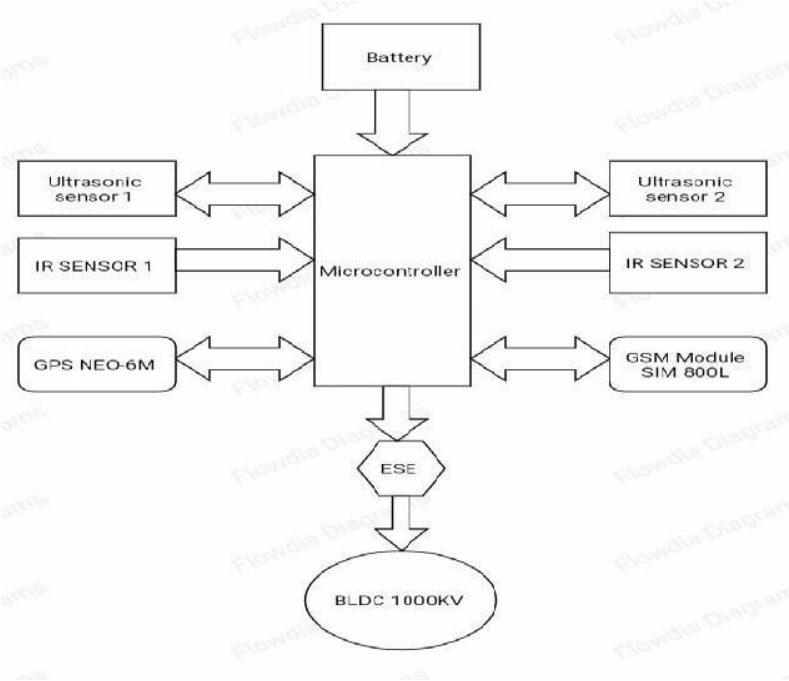

Figure. Block Diagram of Proposed System

The ultrasonic sensor is used to detect the crack that occur in the railway track. An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components:

the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).

In order to calculate the distance between the sensor and the object, the sensor measures the time it takes between the emission of the sound by the transmitter to its contact with the receiver. This distance is used to check for cracks in the railway track. The controller checks the sensor output and when the distance measured by the ultrasonic sensor is greater than the preset value a crack is detected. The IR sensor is used to detect path for the vehicle to travel upon.An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called a passive IR sensor. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation.

These types of radiations are invisible to our eyes, which can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photo diode that is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photo diode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received. Thus, IR sensor helps in keeping the vehicle in course.

In this paper, there are two set of ultrasonic 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 ultrasonic sensor is used to sense the cracks. It is fixed to the front sides of the vehicle with a suitable arrangement. When the vehicle is Powered On, it moves along the model track. The ultrasonic sensors monitor the condition of the tracks. When a crack is detected by the IR 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. The Latitude and Longitude coordinates received by GPS are converted into a text message which is done by microcontroller. The GSM module sends the text message to the predefined number with the help of SIM card that is inserted into the module. A third ultrasonic sensor is used to detect any obstacle Infront of the vehicle. The system uses Hovercraft as the base. The basic principle of the hovercraft is that moving an object from the ground using air, then it requires less force to move the object. Because the object does not have any contact with the ground, then the surface tension will get reduced. So, it is easy to move the object. The friction is also reduced in case of smoother surface. If the surface contains rocks or any other obstacles, then it may cause slow down the vehicle, or even damage occurs in the air cushion vehicle. To work efficiently, the hovercraft has skirts which is made up of fabric surrounding their bases. These skirts help to keep the pressurizing air from escaping. The crack is detected using an ultrasonic sensor. Ultrasonic sensors emit short, high-frequency sound pulses at regular intervals. These propagate in the air at the velocity of sound. If they strike an object, then they are reflected back as echo signals to the sensor, which itself computes the distance to the target based on the time-span between emitting the signal and receiving the echo. As the distance to an object is determined by measuring the time of flight and not by the intensity of the sound, ultrasonic sensors are excellent at suppressing background interference. Virtually all materials which reflect sound can be detected, regardless of their color. Even transparent materials or thin foils represent no problem for an ultrasonic sensor. Ultrasonic sensors can see through dust-laden air and ink mists. Even thin deposits on the sensor membrane do not impair its function. The exact location of the crack is determined by the GPS module (NEO-6M). The working/operation of the Global positioning system is based on the ‘trilateration’ mathematical principle. The position is determined from the distance measurements to satellites. From the figure, the four satellites are used to determine the position of the receiver on the earth. The target location is confirmed by the 4th satellite. And three satellites are used to trace the location place. A fourth satellite is used to confirm the target location of each of those space vehicles. The global positioning system consists of a satellite, control station, and monitor station, and

receiver. The GPS receiver takes the information from the satellite and uses the method of triangulation to determine a user's exact position.

CONCLUSION

By using the autonomous vehicle for the purpose of 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.

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