RAILWAY TRACK CRACK DETECTING SYSTEM

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***Abstract*— In the current rail system, it is more necessary to have safety elements in order to avoid accidents. One of the important causes that can provoke serious accidents is the existence of obstacles on the tracks either fixed or mobile and the cracks that are happened to the track. This project deals with one of the efficient methods to avoid train collision and obstacles detection and crack detection. This project aims for the detection of cracks in railway tracks, distance between the tracks and the presence of humans on railway tracks. The design of system consist a Global Position System (GPS) module, Global System for Mobile (GSM) modem, Infrared (IR) sensor and Passive Infrared (PIR) sensor. Now a days, the cracks in the railway track are measured by a high cost Linear Variable Differential Transformer (LVDT) with a less accuracy. In proposed system, the IR sensors are used for detect the crack in the rail track, ultrasound sensors measure the distance between the two track and the PIR sensors are used to detect the presence of humans the track. If any cracks or obstacles are detected on the railway tracks or if any change in the distance between the two tracks, the longitude and latitude of the track location is messaged to the nearest railway station using GPS and GSM modems. The proposed system is compared with the traditional measuring systems, where it stands as an efficient and cost effective system for railway applications.**

***Keywords*— GPS module, GSM modems, IR sensor, PIR sensor, Ultrasonic distance meter.**

INTRODUCTION

Transport is very important to carry the passengers and goods from one place to another. The better transport leads to more trade. Economic level is mainly depends on increasing the capacity and level of transport. This paper presents an implementation of an efficient and cost effective solution suitable for railway application. In this paper we are going to use IR sensor to detect the crack in rail road, when the crack is detected its latitude and longitude values are send as a message to nearby station by using GPS and GSM service. Then Ultrasonic is used for the surveying process. Then other important component is PIR sensor it is used to detect the presence of humans in track.

METHODS

Composite Detection System

The composite detection system consists of a laser source, whose beam is collimated by a suited optic lens into a light plane, two 512X512 -pixel CCD cameras for complete optimum observation of the track, a digital processing system per camera, and a supervision system. The laser beam focused by the cylindrical lens as a thin plane enlightens the upper part of the railway track orthogonally to the track surface. The intersection of the plane is therefore the track profile (in the laser beam plane it is a two-dimensional line) which is observed by the CCD cameras. Each digital processing system performs real-time profile filtering and extraction (in the CCD camera geometrical coordinates) by using a composite approach from images of the corresponding CCD camera. Besides, the profile is approximately lying in a linear direction, i.e., cutting the image in stripes. Only one point of the profile belongs to each stripe. This characteristic allows for parallel processing since each stripe can be analyzed independently to reach 10 ms image processing time without affecting the profile accuracy.

To tackle this application, we tested both traditional filtering techniques with minimum-square approximation and neural network techniques. In the first case, results were quite poor due to the inability of capturing all nonlinearities and distortions. In the second case, the number of pixels to be processed in each column and the variety of the possible maximum light profile positions led to large inaccurate networks that are also difficult to train.

It is worth noting that highly approximate localization of the area of interest in each image is quite trivial for the human observer, even without experience. Track profile localization does not need to take into account all details in the whole column, but only the area around the maximum lighting. Experiments have shown that no information out of a 40-pixel strip centered approximately on the maximum lighting is necessary for accuratereconstruction of the track profile. Besides, this area of interest corresponds approximately to the zone around the highest-intensity Gaussian profile in the column. Such area can be easily found by identifying the maximum correlation of the light profile with the Gaussian reference: correlation can be effectively used. Finer localization of the maximum must deal with all nonlinearities presented above, which are difficult to be captured algorithmically while they are easily described by examples. In the literature, neural networks were proved effective for this kind of task.

The Disadvantages of existing system are noise in input images, cost is high, and output is not accurate.

Crack Detection using Rayleigh wave-like wideband guided Ultrasonic waves

Ultrasonic inspection of rails is usually restricted to low speeds of around 20-30mph, which limits the viability of testing many tracks regularly. Furthermore 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. One of the reasons for slow inspection speeds using conventional NDT is the need for coupling between the transducer and the track using either liquid or dry coupling materials. EMATs have been used 2,3 or suggested 4 to measure both rail tracks and wheels by other workers and the use of non-contact ultrasonic measurements are still being investigated by a number of international research groups.

In this method we discuss the use of EMATs on rail for longitudinal and transverse crack defect detection and depth gauging. Ultrasonic surface waves that are similar in behaviour to Rayleigh waves are an obvious candidate for surface breaking crack detection. If a defect lies between the Rayleigh wave generator and detector then it will to some degree block the Rayleigh wave. The amplitude of a Rayleigh wave displacement decays with depth into the sample and most of the energy associated with a particular frequency lies within a depth equal to one wavelength at that frequency. Almost all of the energy lies within a depth corresponding to two wavelengths.

The different frequency components will effectively probe to different depths below the sample surface. In a measurement where we attempt to propagate a Rayleigh wave through a region containing a surface breaking crack, the crack depth can be estimated by the amount of Rayleigh wave energy or amplitude that is transmitted through or underneath that region. Closed or partially closed cracks can obviously complicate the analysis and increase the amount of Rayleigh wave energy transmitted through the crack compared to an open crack.

Electromagnetic acoustic transducer (EMAT) : The EMATs used in this paper have been designed and built in the Department of Physics at the University of Warwick 13. In our initial tests we have used pitch-catch type geometry where one EMAT generates a Rayleigh wave that propagates down the length of the sample as shown in figure 1 or around the rail head as shown in figure 2, to be detected by a second EMAT. The EMATs are held fixed relative to each other providing a constant path difference between them on a flat surface.

Proposed System

In proposed system our project are detect the rail road crack, measuring distance for two rail road and also measure the pursuing human in the railway track. when IR sensor are used for detect the crack in the track and ultrasound sensor measure the distance between the two track and also PIR sensor are used to detect human being pursuing in the track. If any crack are occurred in the track means longitude and latitude of the place are messaged to the nearest station and ultrasonic sensor are measure the distance between the two track if any small variance means they detect and message to the nearest station using GPS and GSM modem. when PIR sensor are detect the human being and animals on the railway track, if any one pursuing on the track means they stop the surveying work after crossing rail road they are detect the track.

DESIGN

The three main components used in the block is IR sensor, Ultrasonic, PIR sensor.IR sensor is used to detect the crack in railway track. 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 is received by the receiver then it is taken as crack is detected. When the crack is detected the latitude and longitude value is send as a message to nearby station. Passive Infra-Red sensors (PIR sensors) are electronic devices which measure infrared light radiating from objects in the railway track. PIRs are often used in the construction of PIR-based motion detectors. Ultrasonic wave is used to measure the track distance. Then the LCD display is used to view the result.

Required Components

Microcontroller: ATmega162 The ATmega162 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega162 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed.

GPS: GPS stands for Global Positioning System. The GPS is used to receive the position data from the vehicles and display on a digital map. It too will have the interface to the communication link. Enhanced features include video features, trace mode, history track, vehicle database, network support.

GSM module: The GSM net used by cell phones provides a low cost, long range, wireless communication channel for applications that need connectivity rather than high data rates. It is used to send the SMS to mobile phone.IR sensor Infrared 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.

Passive Infrared Sensors (PIR) Passive Infra-Red sensors (PIR sensors) are electronic devices which measure infrared light radiating from objects in the field of view. PIRs are often used in the construction of PIR-based motion detectors, see below. Apparent motion is detected when an infrared emitting source with one temperature, such as a human body, passes in front of a source with another temperature, such as a wall.

DC Motors To traverse a distance of 22 Km in 4 hrs, an average speed of 1.5 meters/sec is needed. The proposed design uses 4 DC motors. DC motor works according to relay operation.

- When relay 1 is in the ON state and relay 2 is in the OFF state, the motor is running in the forward direction.

- When relay 2 is in the ON state and relay 1 is in the OFF state, the motor is running in the reverse direction.

WORKING PROCESS

- We have divided our project into two.

  They are :

  1.Transmitter

  2.Receiver

- The transmitter is the sensors used for checking the given conditions and send those respective outputs to the controller.
- The receiver is the micro controller where it is interfaced with the motor drives to activate the motors.
- And it is also interfaced with the MAX232 IC go control the GSM.

RESULT

The project “railway track cracking detecting robot “ was designed such that to design locating system without using GPS communication module. Project presents an automotive location position very soon after the detection of the crack in the railway track and also in the times of obstacle detection. The system permits localization of the detection using base station network through GSM modem tower signals and transmitting the position to the microcontroller the controller takes the responsibility to transmit the location using the GSM_SMS services.

- The controller checks for the conditions which are fed to it and acts according to the code.
- The controller makes the motor driver activated and the motors moves on the track.
- Then the GPS is activated and sends the message to the nearest stations.
- The sensors get activated and will be constantly checking for the crack or obstacles.
- If any crack is detected then the robot displays a message that “the crack s detected” .
- After the message is displayed then the robot stops moving on the track.
- The GPS module is activated and the message is sent to the nearest stations.

CONCLUSION:

Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC’s with the help of growing technology, the project has been successfully implemented. Thus the project has been successfully designed and tested. Cracks in rails have been identified to be the main cause of derailments in the past. Hence, owing to the crucial solution of this problem, we have worked on implementing an efficient and cost effective solution suitable for this application. This system automatically detects the faulty rail track without any human intervention. There are many advantages with the proposed system when compared with the traditional detection techniques. The advantages include less cost, low power consumption and less analysis time. By this proposed system, the exact location of the faulty rail track can easily be located which will mended immediately so that many lives can be saved. By using LED-Photodiode assembly for railway track crack detection system we got accuracy up to 80%.

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