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# Railway Track Crack Detection

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## ABSTRACT

***Railways provide the cheapest and most convenient mode of passenger transport both for long distance and suburban traffic. Also, most of the transport in India is being carried out by railway network. Still, accidents are the major concern in terms of railway track crossing and unidentified crack in rail tracks in Indian railway. About 60% accidents are occurring at railway track crossing and due to crack in railway tracks resulting in loss of precious life and loss of economy. Therefore there is need to think about new technology which is robust, efficient and stable for both crack detection in railway track and object detection. This paper proposes faulty rail track detection and object detection system. This project discusses a Railway track crack detection using image processing and is a dynamic approach which combines the use of GPS tracking system and WIFI module to send alert messages and the geographical coordinate of location. A Raspberry Pi 3 is used to control and coordinate the activities of these devices. This project prevents train derailment by detecting a crack in railway track using internet of things technology.***

**Keyword:** *Raspberry Pi 3, Camera, Image Processing, Ultrasonic Sensors, Crack Detection.*

## 1. INTRODUCTION

This project aims at designing railway track crack detection using Raspberry Pi 3, Image Processing and ultrasonic sensors. The central component of the whole system is a Raspberry Pi 3.When any crack or deformation is detected on the track the location of the crack is identified and the location latitude and longitude coordinates are procured. The GPS module and the WIFI module is used to send these location coordinates in the form of Short Message Service (SMS) to the pre-defied interface device or railway station India has one of the world's largest railway networks, manual Inspection and detecting a crack on these railways tracks is very tedious process and consumes lot of time and human resource.

In all transport systems, particularly in case of railways, safety and reliability are highly considered. There is a view that the current regulatory framework does not provide a full set of tools to effectively deal with railway accidents and main-track derailments. There is also a view that the current framework needs to be modernized and better aligned with safety legislation that applies to other modes of transport in India. In recent years, with the development of railways, the capability of the trains is constantly improving. Rail track inspection is a necessary task in railway maintenance and is required to periodically inspect the rail track by the trained human operator, who is walking along the track & searching for defects. Such type of monitoring system is unacceptable for slowness and lack of objectivity. This inspection will take too much time to recover from faults. Hence to reduce delay our propose system deals with automatic Visual Inspection of Railway track and devoted to numbers of tasks. Automatic vision-based inspection systems enable to analyze the stipulation of rail track. In this way system increases the efficiency of inspection, reduces the required time and giving a more accurate and frequent information of the railway track. To provide the real-time is monitoring and structural condition for railway track using “vision-based”.

### 1.1 Objective of Project

The main aim of the project is to design and develop an automatic railway crack detection system based on image processing technology and obstacle detection system based on ultrasonic sensing technology where in on board robot circuitry can be used to detect crack and obstacle on railway using the camera and ultrasonic sensors. The Indian Railways apparently lacks new technologies, therefore chances of human error are more and it is one of the major causes of rail accidents in India. Reasons, why safety measures are compromised, are a low investment, delay in installing anti-collision devices and shortage in manpower. Image Processing has been used in a number of tasks involving automatic detection and monitoring. In this project, a computer-based methodology has been discussed to automatically detect railway track cracks and inform the authorities to take evasive action in time.

 

The objective of the project is:

- The key takes away from data is that initiatives that the potential for human errors such as automated inspection and asset monitoring techniques, replacement of over-aged assets (tracks, signaling).
- Besides crack detection, this project also aims at detecting obstacles present on the railway track in order to prevent railway accidents.
- Reduces the need for manpower.
- Provides real-time monitoring of and detection of any crack or objects on railway tracks and in case of detection sends information with the location to the receiver side using GPS module via GSM.

**1.2 Scope**

Nowadays in the current railway systems, it is becoming necessary to have safety elements in order to avoid accidents. The causes that can provoke serious accidents is the existence of obstacles on the tracks, either fixed or mobile. This project deals with one of the efficient methods to avoid train collision and obstacle detection. So, this issue becomes our priority to solve it. The system which we are proposing helps to overcome this social problem faced in almost every city of India.

A key aspect of our project is to identify a crack in a track and to alert the office at the very same movement. The system sets an example of how to use sensors and GPS efficiently for railway track crack detection and the technology can be used at domestic and at commercial places with future vision.

Instead of using the manual method of crack detection, the use of this method helps inefficient and fast management of crack detection in track. Also, the respective monitoring office will get instant information about crack detection which will also reduce the unwanted workload on them. And then key aspect to keep our city secured from the accidents caused by improper and unmaintained track.

## 2. LITERATURE REVIEW

•The paper "Review Paper on Rail Track Flaw Detection Using Matlab" [1], according to the author is a more reliable and less time-consuming mode of crack detection on the railway track. In vision-based method camera, we will use to capture the images or videos. In this method, the device will capture an image of railway track component using the vehicle-mounted camera, image enhancement using image processing and assisted automation using a real-time tracking algorithms. In visual inspection system, a high-speed digital camera, which is installed under a test train, is used to capture an image of rail track and then the obtained images are analyzed automatically using a customized image processing software.

**Advantages**

A detailed description of image processing using Matlab. DISADVANTAGES

There is no description about obstacle detection in railway track.

- The paper "Efficient Automated System of Crack Detection in Rail Network for Surveying Purpose" [2] according to the author is suitable for Indian railway system. This paper used to detect the fault in rail track automatically without any human intervention. IR sensor is used to finding the cracks and damage of tracks. Ultrasonic sensors are used detect any obstacle presented in rail track. Very accurate detection and also getting accurate output compare to the existing system. In normal condition, the motor, LDR, Serial transmission is in the initial stage. When the battery power supply supplies the microcontroller then it's starting the motor in the forward direction and serial transmission is used to send the messages to the microcontroller. LDR is used presence or absence of a crack in railway line.

**Advantages**

Detailed description of design phases of each module.

**Disadvantages**

Limited information about software requirements.

**3. METHODOLOGY**

In this study, a new computer vision based method is proposed for analyzing the rail of railway systems. There is image processing based several techniques in the literature. The rails are determined by means of image processing techniques using the proposed method. This project also concentrates on the use of ultrasonic sensors which are used to detect humans or any object being pursuing on the track. If any crack or objects occur in the track means longitude and latitude of the place are messaged to the nearest station GPS and WIFI module. The recording and sending of coordinates are done by GPS and WIFI module. The activities of various devices are controlled by a Raspberry Pi 3.

 

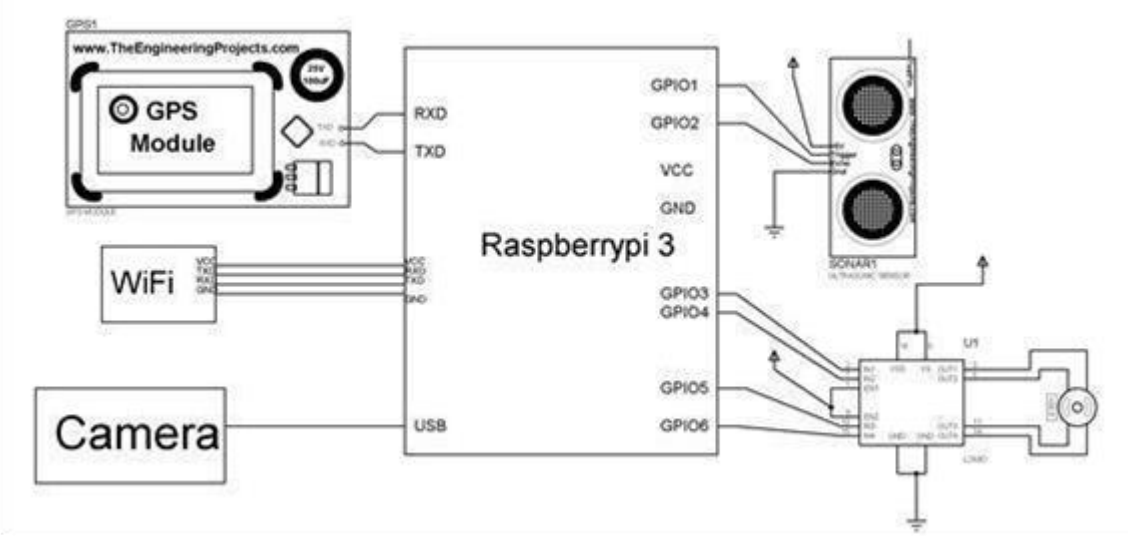


**Fig-1: Circuit Diagram**

**Crack Detection System**

This section provides the basic architecture for the crack detection using the image processing technique. The crack detecting system is software that extracts and computes the numerical information of cracks from the image data. The major advantage of the image based analysis of the crack detection is that by using the image processing technique it provides accurate result compared to the conventional manual methods. The processing difficulty of the crack detection completely depends on the size of the image. Recent digital cameras have the image resolution beyond 10 megapixels. This increase in resolution enables the acquisition of detailed images of concrete surfaces. By using the trendy cameras of commercial purpose, a wide range of a concrete surface can be acquired in a single shot. For inexpensive applications, a wide range image can be used for the practical crack detection.

The steps in the image processing technique are as follows:

- Initially collect the image of the structure which will be subjected to the crack detection process using the camera or any sources.
- After the image acquisition, the collected images are pre-processed within which the methodologies like segmentation are done there by making it an efficient one for the image processing procedure.
- In the image processing, some of the techniques are employed to process the deducted image sample.
- The crack detection will be noticed here on the structure using the result of the processed image.
- Crack feature extraction is the step in which the detected cracks are separated based on the width, depth and the direction of propagation of the crack.
- Once the crack is detected the alert message with the location using GPS via WIFI module is sent to the station point.

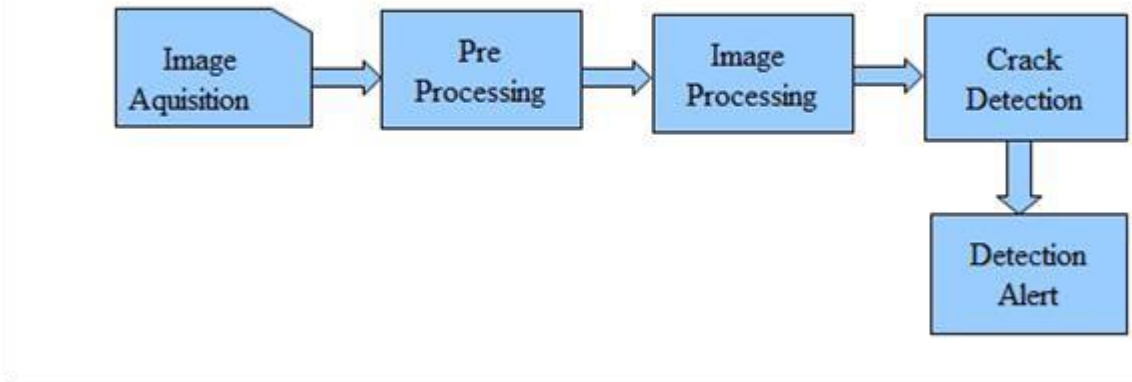


**Fig-2: Block Diagram of Image Processing**

**Object Detection System**

In the obstacle detection module, redundant ultrasonic sensors are used to increase detection resolution and sensor data reliability. A microcontroller is used to achieve the desired operation. The sensor detects objects by emitting a short ultrasonic burst and then listening for the eco. Under control of a host microcontroller, the sensor emits a wave of certain frequency, This wave ventures or travels through the air, hits an article and after that bounces once again to the sensor. The sensor provides an output pulse to the host that will terminate when the echo is detected. Hence the width of one pulse to the next is taken into calculation by a program to

 

provide result in distance of the object. Once the object is detected the alert message with location using GPS via WIFI module is sent to the station point.

Advantages of Proposed System:

- Establish management structure based on performance evaluation and monitoring process.
- Enhance the percentage of efficiency.
- Facility to send alerts/warnings to particular train drivers on possible collisions, derailment through the system.

## 4. FINDINGS

In order to evaluate the usability of the proposed algorithm, we used the surface image of a temporary railway track setup. Images were acquired under the different illumination and background conditions. Image size composed of RGB color. In the process, total frames of a live video are processed using the image processing techniques and then features such as object size and its ratio of the axis are obtained. Among images used in training, the number of cracked image and that of the non-cracked image are compared. In this training stage, we need to set the reference output whether the corresponding image contains crack or not. In the image processing once the crack is detected the GPS along with WIFI module send the location of crack to the station point. The ultrasonic sensor, once the object is detected the alert message with the location using GPS via WIFI module is also sent to the station point. The major advantage of the project includes efficiency, fast to access and uniqueness. There is a lot of scope for improvement in the detection system in the future days.

## 5. CONCLUSIONS

This project discusses the critical safety techniques for high-speed train operation environment based on the train control system. In this paper, a method to detect cracks in railway tracks has been presented using image processing techniques. The method replaces manual inspection of the track section, by automatic inspection. This will help to detect cracks immediately and reduce the possibilities of any mis happening. Since the system would be automatic and will require less manual intervention, the utmost efficiency of the system can be ensured. In order to ensure safe operation of trains, we propose a wireless network access framework according to the monitoring network of surrounding environment and the deployment of transition network to avoid collision of trains and obstacle detection. The system has the ability to pin point the location and other attributes of an operational train in an economical accurate manner. The goal of this work is to design and implement a cost-effective and intelligent full-fledged and wireless-based Train Anti Collision and Detection System to avoid an accident. This will help to detect cracks immediately and reduce the possibilities of any mishappening. Since the system would be automatic and will require less manual intervention, the utmost efficiency of the system can be ensured. However, this system finds difficulty in sensing an internal crack in the railway track. The idea can be implemented in large scale, in the long run, to facilitate better safety standards for rail tracks and provide effective testing infrastructure for achieving better results in the future.

## 6. REFERENCES

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