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Crack Detection in Railway Tracks using Image Processing

Mr Balasubramanian S[1], Pooja Rajagopal[2], S. Smrithi[3], Yaashine Sree M [4]

[1]*Associate Professor, Dept. of ECE Engineering, Meenakshi Sundararajan Engineering College, Chennai, Tamil, Nadu, India*

[2,3,4]*UG Student,, Dept. of ECE Engineering, Meenakshi Sundararajan Engineering college, Chennai, Tamil Nadu , India*

Abstract -*Detection of railway track cracks is mandatory nowadays since in most of the cases the railway tracks run in remote places where manual checking of track quality and health condition is not feasible all the time. It is required to monitor the track health condition frequently using an automated crack detection system. The proposed framework focuses on implementing a MATLAB model to detect the railway track cracks through image processing techniques. Gabor filter is used to analyze the depth of the cracks. As an added advantage we also focus to create a separate model which will predict the internal cracks through thermal image processing techniques. The simulated model provides good accuracy and prediction score. MATLAB 2017 is used here for the purpose of algorithm development.*

1. INTRODUCTION

Transport is very important to carry the passenger and goods from one place to another. Better transport leads to more trade. Economic level mainly depends on increasing the capacity and level of transport. The Indian Railways apparently lacks new technologies, therefore chances of human error is more. Track inspection is done manually by railway employees. It is difficult to monitor the condition of tracks manually. The defects in the tracks have resulted in major railway accidents. This paper presents an implementation of an efficient and cost effective solution suitable for railway application.

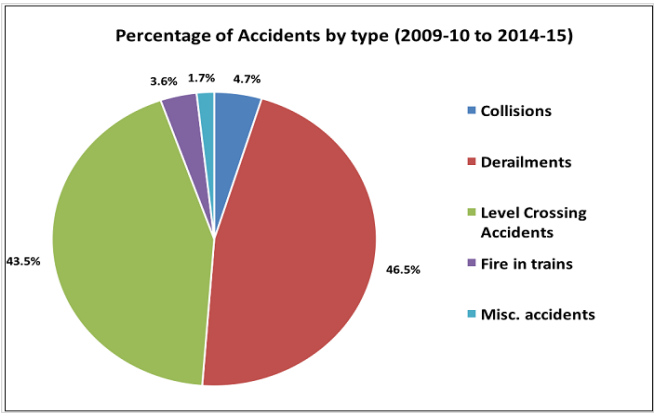

Chart-1: Pie chart depicting percentage of accidents by type

2. LITERATURE SURVEY

2.1 CRACK DETECTION SYSTEM FOR RAILWAY TRACK BY USING ULTRASONIC AND PIR SENSOR

This paper introduces the integration of ultrasonic sensors and PIR sensors for detection of cracks in railway tracks. This project consists of GPS module, GSM modem, IR sensor, PIR sensor for the purpose of communication, crack detection and detection of human beings in the railway track. The GPS module and GSM modem help to find and send geometric parameters of cracks detected to the nearest railway station. In the present day high cost LVDTs are used for measurement of track distance with less accuracy, but for high accuracy, the less cost ultrasonic sensors should be used. According to the recent trends of application the PIR sensors are used to avoid the manual procedures for detection of human beings. This project is applicable for both day and night time detection purpose.

2.2 RAILWAY ROUTE TRACK CRACK DETECTION

This paper proposes a railway crack detection system. This paper presents the detection system that detects any crack in the railway tracks by using a microcontroller. Most of the goods are transferred from one region to another through railways only due to its low transportation cost, fastness, reliability and less chance of accidents. Therefore, it is necessary to provide safety to the railway tracks. Hence an advanced technology capable of locating cracks in the tracks is developed.

2.3 RAILWAY TRACK CRACK DETECTION

This paper proposes a railway track crack detection and object detection system. A Raspberry Pi 3 module is used to control and coordinate the activities of these devices. This project prevents train derailment by detecting cracks in railway track using internet of things technology.

3. PROPOSED SYSTEM

The proposed framework focused on implementing a MATLAB model to detect the railway track cracks through image processing techniques. Gabor filter is used to analyze the depth of the cracks. As an added advantage we also focused on creating a separate model which will predict the internal cracks through thermal image processing techniques.

3.1 COMPONENTS OF IMAGE PROCESSING

Image Processing System is the combination of the different elements of digital image processing. Digital image processing is the processing of an image by means of digital computers. Digital image processing uses different computer algorithms to perform image processing on various digital images.

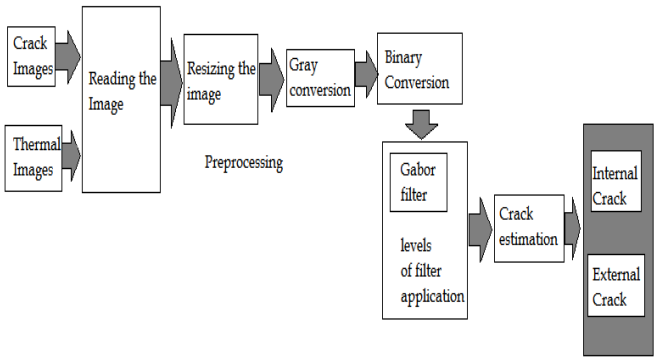

Fig -1: Block Diagram

Crack images of the rails or the thermal images are the inputs fed into the MATLAB software, where the images are read. Resizing of the image is done in order to get uniform small sized images. Conversion of images from gray to binary is done in order to find the region of interest, i.e, the portion of an image that undergoes further processing. Gabor filter is used to analyze the depth of the cracks. As an added advantage we also focus to create a separate model which will predict the internal cracks through thermal image processing techniques. The simulated model provides good accuracy and prediction score.

It consists of following components:-

IMAGE SENSORS:

Image sensors are used to sense the intensity, amplitude, and other features of the images and pass the result to the hardware.

IMAGE PROCESSING HARDWARE:

Image processing hardware is the dedicated hardware which is used to process the instructions obtained from the image sensors. It passes the result to the general purpose computer.

COMPUTER:

Computers used in the image processing systems are the general purpose computers that are used by us in our daily life.

IMAGE PROCESSING SOFTWARE:

Image processing software is a software that includes all the mechanisms and algorithms of an image processing system.

MASS STORAGE:

Mass storage stores the pixel images during the processing.

IMAGE DISPLAY:

An image display includes the monitor or display screen that displays the processed images.

NETWORK:

The connection of all the above elements of the image processing system constitutes a network.

IMAGE SEGMENTATION TECHNIQUES

The process of partitioning a digital image into multiple segments is called image segmentation..

3.2 PHASES OF IMAGE PROCESSING

1. ACQUISITION– It mainly involves converting an image into a digital form. The main work involves: i) Scaling ii) Color conversion (RGB to Gray or vice-versa)

2. IMAGE ENHANCEMENT–It is used to extract some hidden details from an image and is subjective.

3. IMAGE RESTORATION– Restoration is based on mathematical or probabilistic models or image degradation.

4. COLOR IMAGE PROCESSING– It deals with full color image processing.

5. WAVELETS AND MULTI-RESOLUTION PROCESSING– It is the process of representing images in various forms.

6. MORPHOLOGICAL PROCESSING-It deals with tools that are very useful in description of shape.

7. SEGMENTATION PROCEDURE-It includes partitioning an image into its integral components.

8. REPRESENTATION & DESCRIPTION- It transforms raw data into processed data.

9. OBJECT DETECTION AND RECOGNITION-It labels an object based on its descriptor.

4. CONCLUSION

Thus the efficient design and implementation of railway track crack detection is being evaluated and simulated using MATLAB 2017 and the results are plotted. The ultrasonic sensors are fixed at the engines, and once detected the train automatically applies brakes to stop. Then an alert is given to the driver and an emergency brake control is applied. If this system is brought in railways, the accidents could be controlled and the place of damage could be sent automatically to the control room and since it's a completely automated system it can be used in village areas by which man power is reduced and time is saved.

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