Accident prevention & crack detection system for railway tracks

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Abstract*:* Railways give the most cost effective and most convenient mode of traveler transport each for long distance and residential district traffic. Also, most of the transport in India is being dole out by railway network. Still, accidents are the most important concern in terms of railway track crossing and unidentified crack in rail tracks in Indian railway. Most of the train accidents occur in railway tracks because of faults in tracks leading loss of precious life and loss of economy. So there is need of new technology that is strong, economical and stable for track detection in railway track. This paper aims to propose a defected rail track detection system. This project discusses a railway track crack detection using image processing and is a dynamic approach which combines the use of Wheel encoder module to send alert messages of information of location and GSM. A Raspberry Pi 4 is also used to control and coordinate the activities of these devices. This project prevents train derailment by detecting a crack in railway track using image processing technology.

Index Terms – Raspberry Pi 4b ,Pi Camera, Railway track, Rail faults, wheel encoder.

1. INTRODUCTION

The aim of the project is to design a railway track crack detection model using Raspberry Pi 4, Wheel encoder and image processing technology. The main component of the whole system is a Raspberry Pi 4.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 encoder module is used to send information of location   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 case of railways, safety and reliability are highly considered. There is a point 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 point that the current framework needs to be some modifications and better aligned with safety legislation that applies to other modes of transport in India. In current years, with the development of railways, the capability of the trains is constantly improving. Inspection of railway track is a compulsory in railway maintenance and is required to periodically inspect the rail track by the knowledgeable person, 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 defects. 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, reduce manual labor 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 to detect crack on railway using the camera and wheel encoder. The Indian Railways doesn't have new technologies, hence chances of human error are more and it is one of the major causes of rail accidents in India. The reasons for compromising safety measures are low budget, delay in installing anti-collision devices and lack of skilled 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 on time

The objective of the project is:

- The main objective of this project is accident prevention of trains due to cracks in railway track .
- Reduces the manual labour.
- Reduce time consuming.
- To provide real-time monitoring of railway tracks as well as detection of any crack on railway tracks and in case of detection send the information with the location to the receiver side using encoder module via GSM.

1.2 Scope

With respect to current scenario in the railway systems, it is necessary to have safety elements in order to avoid accidents. The main cause of accidents is the existence of cracks on the tracks. This project deals with the efficient methods to avoid accidents due to cracks fault. The main aspect of our project is to identify a crack in a track and to alert the control room at the very same moment. The proposed system sets a benchmark of how to use raspberry pi and encoder module efficiently for railway track crack detection. This technology can be used at all railway tracks in the country. This method is more efficient than manual technique of crack detection.

## 2.   ALGORITHM FOR CRACK DETECTION

The track monitoring vehicle activates the pi camera when it starts. Once it starts it continues to access the images taken by the camera by image processing edge detection method which analyze the image by screening the edge of the track. If the crack is detected the encoder module read the location information and stores the information and send   the information about the crack is known to the supervisor in the railway department. If there is no crack detected then the reader module does not read and the camera continues to capture the images.

3. METHODOLOGY

In this project we will use a pi camera which will capture the images of the railway track and It will send to the raspberry pi camera interfacing module. From there it reaches the raspberry pi, and then it checks for the crack if it is present it activates reader module from where we get the location and then it send the information of location to the concerned person. Here, all the track images are detected from the pi camera and the image processing occurs. If any crack is recognized, the location is identified by the wheel encoder and gets the information of location access to the supervising section and uses it for the rectifying purposes. In this way, a lot of time is saved, it reduces manual labor and also this is highly securing process. No crack missed from the image processing. Location information is maintained on the server so anyone can access it for purposes like servicing and verifying. Firstly, the image captured by the camera is opened using the tool open from raspberry pi camera module. The images from camera are configured in a pixel by pixel manner. Each image is compared with the database images in the raspberry pi and the location message is stored in the server. And then the information of location is send to the raspberry pi through wheel encoder and the raspberry pi sends this location to the mobile.
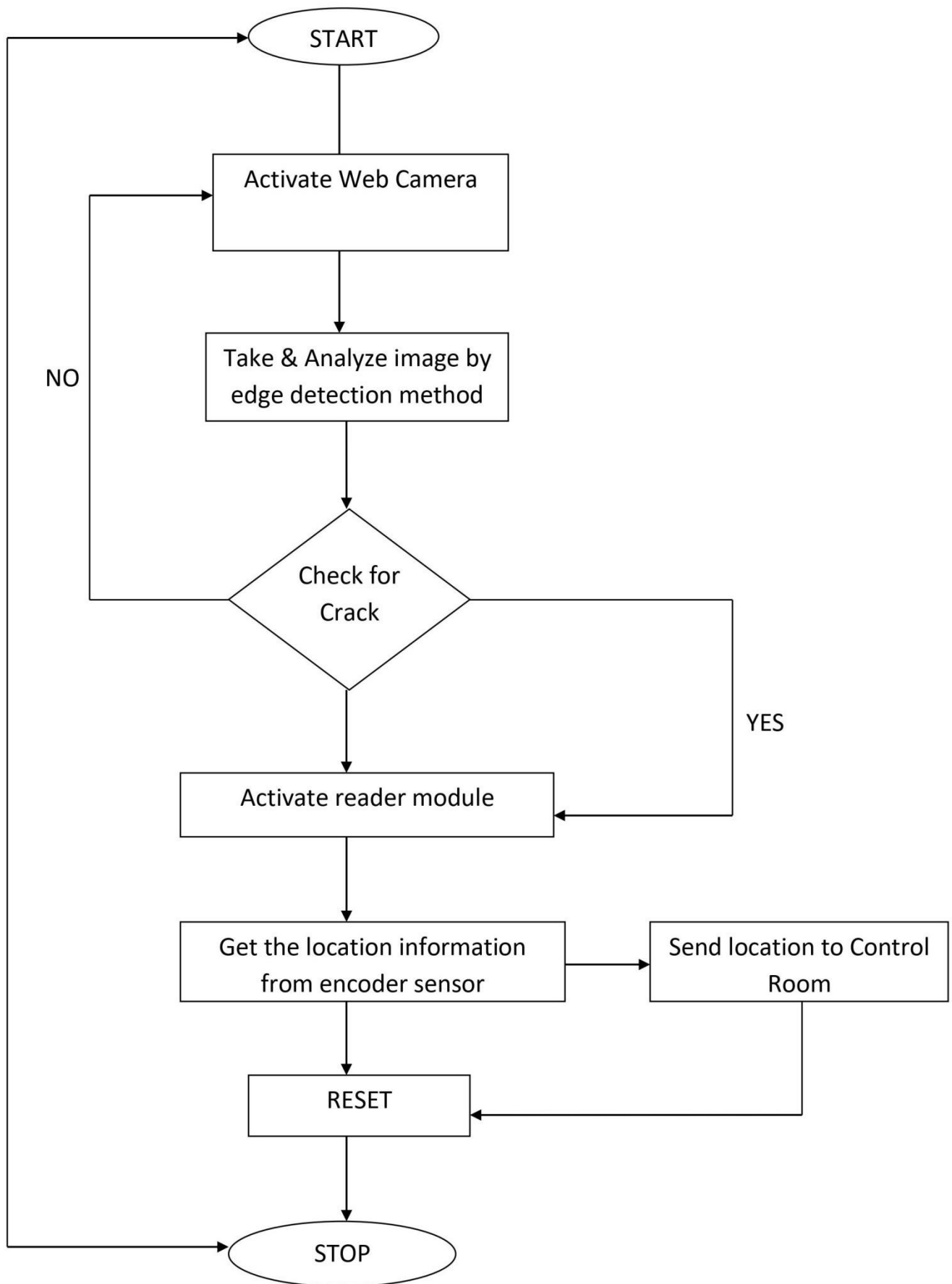
4. BLOCK DIAGRAM
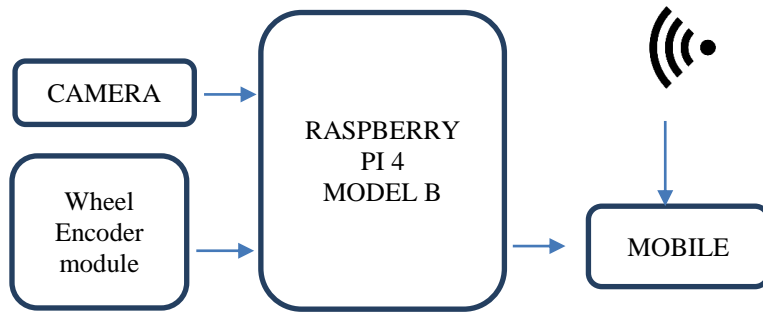
5. SECTION DETAILS

a) Pi CAMERA: Pi camera is used to take pictures of the railway track . Pi camera module is a camera which can be used to take picture and high definition video. It can be connected with Raspberry pi using either through camera module or USB cable. The captured image from the camera will have the resolution of 5MP.It can capture wide still (motionless) images of resolution 2592 x 1944 pixel CSI Interface enabled. The pi camera module can attach to the raspberry pi CSI port using 15-pin ribbon cable. CSI bus is capable of extremely high data rates. it was especially designed for interfacing to cameras. It is fully compatible with raspberry pi. Raspberry pi is interfaced with webcam through USB.The image taken by the webcam is subjected to the edge detection method .In this edge detection method the image get scanned and indicate if the crack is present .This camera has night vision ability.
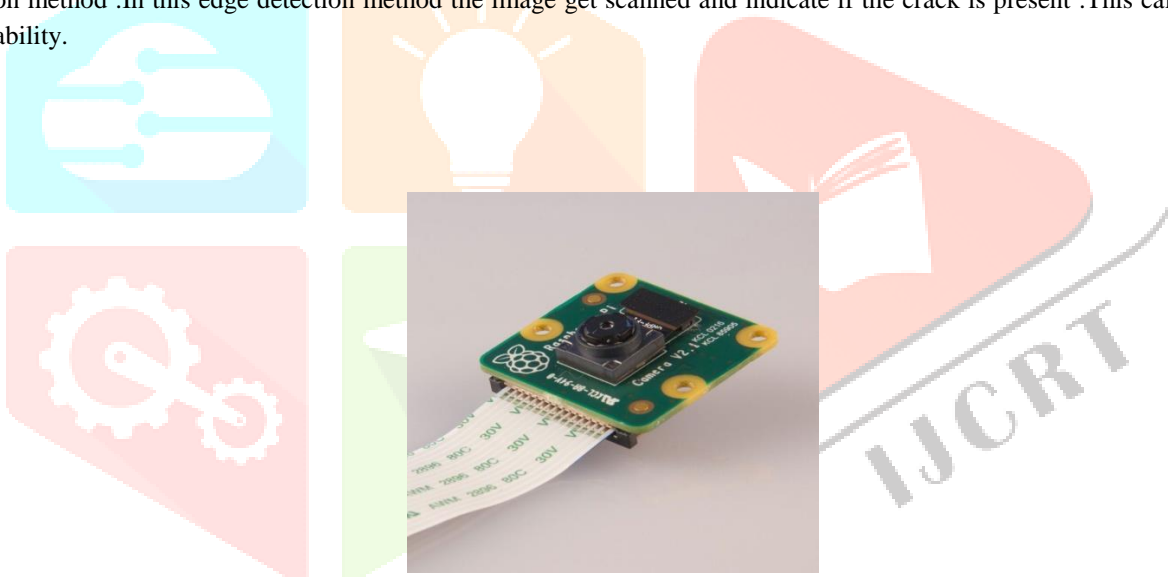

Fig.1 Pi Camera

b) RASPBERR PI 4 B: Raspberry pi 4 B is the minicomputer. It acts as the central component which we are using to interface all the devices. In this project Raspberry Pi 4 Model B is the latest product in the popular Raspberry Pi range of computers. It offers ground-breaking increases in processor speed, multimedia performance, memory, and connectivity compared to the prior-generation Raspberry Pi 3 Model B+, while retaining backwards compatibility and similar power consumption. For the end user, Raspberry Pi 4 Model B provides desktop performance comparable to entry-level x86 PC systems. comparatively higher than the rest of the model This product's key features include a high-performance 64-bit quad-core processor, dual-display support at resolutions up to 4K via a pair of micro-HDMI ports, hardware video decode at up to 4Kp60, up to 4GB of RAM, dual-band 2.4/5.0 GHz wireless LAN, Bluetooth 5.0, Gigabit Ethernet, USB 3.0, and PoE capability (via a separate PoE HAT add-on). The dual-band wireless LAN and Bluetooth have modular compliance certification, allowing the board to be designed into end products with significantly reduced compliance testing, improving both cost and time to market. It has Standard 40-pin GPIO header (fully backwards-compatible with previous boards). Raspberry pi GPIO pins are most commonly used for pythons. It has an inbuilt WIFI and Bluetooth technology.

Fig.2 Raspberry pi 4B

c) WHEEL ENCODER: It an encoder is used to measure rotational speed of wheels. An encoder is a sensing device that provides feedback. Encoders convert motion to an electrical signal that can be read by some type of control device in a motion control system, such as a counter or PLC. The encoder sends a feedback signal that can be used to determine position, count, speed, or direction. An encoder is classified into four types: mechanical, optical, magnetic, and electromagnetic induction types. There are four types of information necessary to rotate the motor with high accuracy: rotation amount, rotational speed, rotational direction, and rotational position. There are two different types of encoders: linear and rotary. A linear encoder responds to motion along a path, while a rotary encoder responds to rotational motion. Encoders translate rotary or linear motion into a digital signal. That signal is sent to a controller, which monitors motion parameters such as speed, rate, direction, distance, or position.
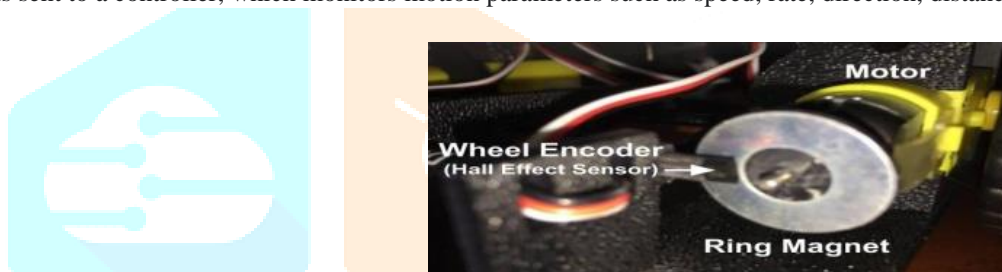

Fig.3 Wheel Encoder

5.1 CRACK DETECTION SYSTEM

This section provides the system 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 main advantage of the image based analysis of the crack detection by using the image processing technique is that it provides accurate result compared to the old 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. 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:

- Collection of the image of the structure which will be subjected to the crack detection process using the camera or any sources.
- Once the image is acquired, the collected images are pre-processed with the methodologies like segmentation and 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 reader module is sent to the station point
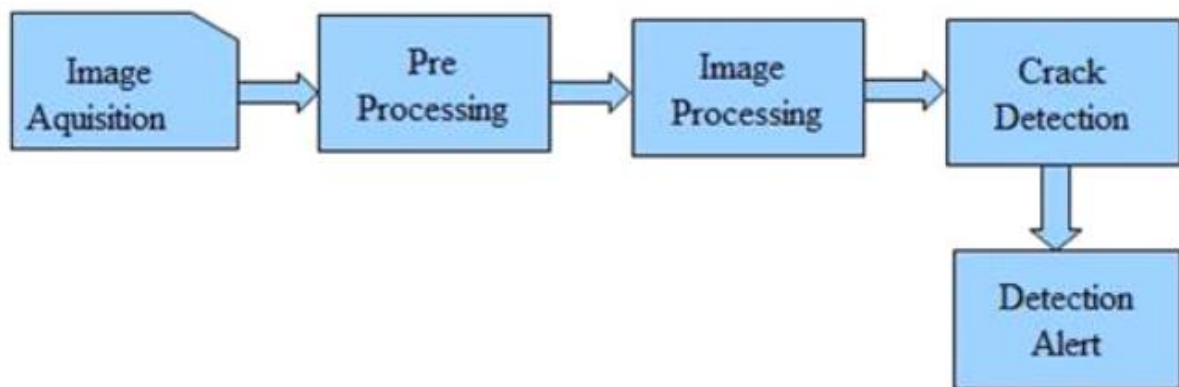
6. CONCLUSION

This project aims to detect crack present in the railway track. In this paper crack is detected by image processing technique and get the location of the crack through encoder sensor. This method replaces the manual inspection of the track section by automatic inspection. It reduces manual labor, time consuming, and human error and provide more accuracy in detecting the crack in the railway track. This idea can be implemented in the large scale, in the long run to facilitate better safety standard for rail tracks. By using this technique, we can achieve better results in future.

7. REFERENCES

[1] E. Dhivya. 2020. Railway crack detection system using RASPBERRY PI 3. International Journal of Applied Engineering and Technology ISSN: 2277-212X.

[2] Rijoy Paul. 2018. Railway Track Crack Detection. International Journal of Advance Research and Development .

[3] Parvathy A. M. 2017. Automatic Rail Fault Track Detection for Indian Railways. International Conference on Communication and Electronics Systems. ISBN:978-1-5090-5013-0

[4] B.S.Sathish. 2019. Advanced Automatic Detection of Cracks in Railway Tracks. International Conference on Advanced Computing & Communication Systems, ISBN:978-1-5090-5013-0

[5] A.Indhuja.2017.IN-SERVICE RAIL TRACK MONITORING AND FAULT REPORTING. International Conference on Innovations in Information, Embedded and Communication Systems.