International Journal of Research in Engineering, Science and Management
Volume-3, Issue-4, April-2020
www.ijresm.com | ISSN (Online): 2581-5792

Crack Detection in Railway Track Using Image Processing

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***Abstract*: Computer vision can provide many potential advantages over manual methods of railway track inspection. Great levels of performance can be achieved through the automation of inspection using computer vision systems, as they allow scalable, quick, and cost-effective solutions to tasks otherwise unsuited to humans. The purpose of this paper is to provide readers with in-depth presentation of the rail track crack detection using MATLAB. This is achieved through a step by step process starting from the basic rail track inspection in railway maintenance. The system provides real-time monitoring and structural condition for railway track using vision-based method and calibration to search the fault location on the track. Inspections include detecting defects on tracks, missing bolts, anchor, tie plate and clips etc. In vision-based method camera we will use to capture the images or videos. In vibration-based method some sensors we will use to detect the vibrations on the railway track. Finally, conclusions are presented. Keywords: Histogram, k means clustering, image processing, data acquisition, railway track inspection.**

***Keywords*: Railway Track, Cracks, Manual inspection, Image Processing, Computer Vision.**

1. Introduction

The railway is the biggest means of transportation in India. Rail transportation is the utmost importance as a component of urban public transport system [1]. Its advantages of fast, punctual and large capacity make to become the most frequent choice for urban inhabitants. However, as a high density, high flow, relatively enclosed public transportation system, rail transportation brings gathered a crowd when encounters the growing problem of urban traffic congestion. The operational security issues have become increasingly prominent [2]. Although the rail transportation is the safest approach to public transportation, rail transportation easily creates gathered crowd both on board and on the platform. There have been cases of late, where due to minor failures a big mishap has happened in the railway. According to the statistics, the accident of rail transportation is mainly caused by vehicle breakdowns, track failures; obstacles appear on the rail, human congestion, vandalism, signal systems failures, etc. The track inspection is done manually by railway employees on a time to time basis.

The railways from a big network of railway tracks in India and as such it's very difficult to monitor the condition of high level of inspection effort involved, the continuing high accident rate raises questions about the extent to which the railway complies with the inspections can help to avert accidents. In a number of cases, the defects in the tracks have resulted in major railway accidents causing loss of lives and property.

In this thesis, Computer Vision and Image Processing have been used in a number of tasks involving automatic detection and monitoring. A computer-based methodology has been discussed to automatically detect railway track cracks and inform the authorities to take evasive action in time. In today's scenario, 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 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, 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 trained human operator, who is walking along the track and searching for defects. Such type of monitoring system is unacceptable for slowness and lack of objectivity.

Fig. 1. Rail crack track

2. Literature review

Mao et al. in paper Crack Detection in Railway Track Using Image Processing [1] proposed the role to build up a sensor blame location conspire for rail vehicle latent suspension frameworks, utilizing a blame discovery spectator, within the sight of indeterminate track normality and vehicle clamors that

are demonstrated as outer aggravations and stochastic process signals [1].

Faghih-Roohi et al. in paper Automatic Identification of Crack Sensing Scheme in Rail Tracking System [2] proposed a profound convolutional neural system answer for the investigation of picture information for the location of rail surface deformities. They looked at the consequences of various system structures described by various sizes and actuation capacities. [2]

Hu et al. in paper Railway Track Crack Detection [3] recognized uneven shine and clamor, the substantial rail surface deformities, as indicated by the qualities of overwhelming rail surface imperfections, in light of the numerical morphology of multi-scale and double structure components. Contrasted and the customary edge identification administrators, the outcomes demonstrate that their technique possesses solid hostile to commotion execution, can identify the little deformity edge precisely. [3]

Shen et al. in paper Automation System to Detect the crack of Railway Track [4] explored the component extraction of the turnout deserts in view of the bogie speeding up estimations. They set that the power otherworldly thickness and all the recurrence area highlights are valuable for distinguishing the poor fit imperfection of the switch point. [4]

The inappropriate upkeep of tracks which have brought about the arrangement of breaks in the tracks has been distinguished to be the primary driver of wrecking. A portion of the imperfections is exhausted rails, weld issues, interior deformities, and head checks, squats, spelling, and shelling. On the off chance that undetected as well as untreated these imperfections can prompt rail breaks and crash. Customarily, this undertaking is physically led via prepared railroad track examiners strolling along the track hunting down visual abnormalities. Tracks that are subjected to overwhelming pull movement require visit assessment and have more escalated upkeep prerequisites, leaving railways with less time to fulfill these reviews. To enhance the manual examination process in a productive and financially savvy way, machine vision innovation can be created as a powerful option [5].

Some of the research done by researchers is presented in this section. Mao et al. [6] built up a sensor blame location conspire for rail vehicle latent suspension frameworks, utilizing a blame discovery spectator, within the sight of indeterminate track normality and vehicle clamors that are demonstrated as outer aggravations and stochastic process signals. [6]

Faghih-Roohi et al. [7] proposed a profound convolutional neural system answer for the investigation of picture information for the location of rail surface deformities. They looked at the consequences of various system structures described by various sizes and actuation capacities. [7]

Hu et al. [8] recognized uneven shine and clamor, the substantial rail surface deformities, as indicated by the qualities of overwhelming rail surface imperfections, in light of the numerical morphology of multi-scale and double structure components. Contrasted and the customary edge identification administrators, the outcomes demonstrate that their technique possesses solid hostile to commotion execution, can identify the little deformity edge precisely under clamor. [8]

Shen et al. [9] explored the component extraction of the turnout deserts in view of the bogie speeding up estimations. They set up the ordinary turnout demonstrate and defective turnout show in light of SIMPACK and afterward dissected the increasing speed motion in the time-recurrence area. The outcomes demonstrated that the power otherworldly thickness (PSD) and all the recurrence area highlights are valuable for distinguishing the poor fit imperfection of the switch point. [9]

Vijayakumar and Sangamithirai [10] built up a technique that distinguishes the surface deformity on railheads. The proposed strategy utilized Binary Image Based Rail Extraction (BIBRE) calculation to extricate the rails from the foundation. The extricated rails were upgraded to accomplish uniform. [10]

The paper “Review Paper on Rail Track Flaw Detection Using MATLAB” [10], 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 algorithm. 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 [10].

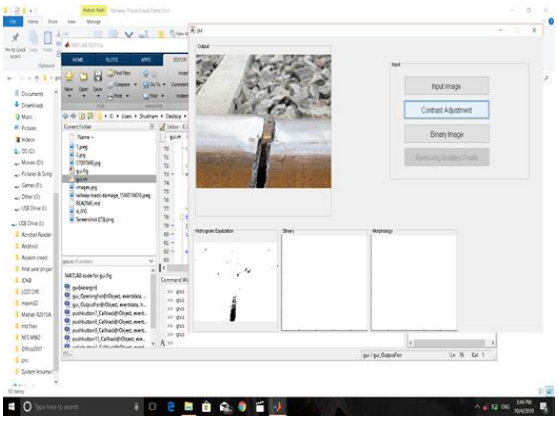

Fig. 2.

3. Proposed work

The image is acquired from a section of the railway track. This can be done using a camera rolling stock continuously monitoring the railway track. For detecting the crack, the image of rail track and it must contain the top view of the track. 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.

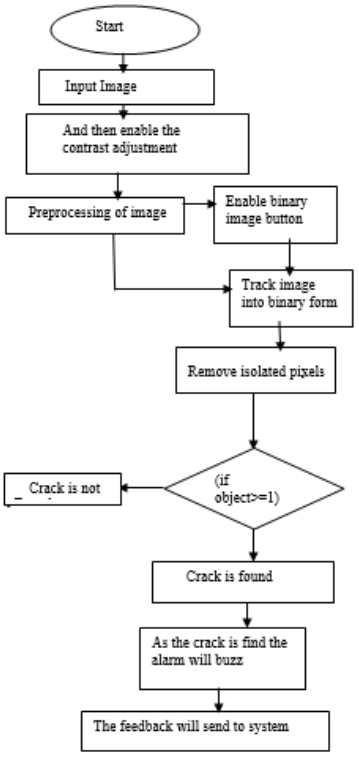

Fig. 3. Flowchart

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.

Histogram enhancement of the image is performed because the track is brighter than the background due to reflection. Thus, the track section of the image is clearly identified. The enhanced image is then converted to binary image form. Connected components are obtained from the complete area of the track image. If there is discontinuity, then there is crack otherwise no crack. The algorithm has been implemented using MATLAB 2013 a software tool. A GUI (Graphical User Interface) has been developed for easy usage of the algorithm.

It has It has two axes one shows the enhance image other one shows the black and white of image with only track and one Edit Box for showing the result. 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. Here we propose an innovative approach to detect railway track crack as this system detects crack based on image processing. Many image preprocessing steps is used to detect railway track crack. As image is prone to noise. System converts image to grayscale image and uses filtering to remove noise from image. Noise removal helps to detect crack more accurately. Image luminous level is increased and image is converted to binary image.

This helps system to detect only crack and helps to remove other unwanted objects. Image once converted to binary image holes are filled by using image processing method this helps to reject all smaller objects which are not required for crack detection. Intensity value is used for accuracy purpose. Blob analysis method is used to detect large blobs. System detects crack based on number of connected components. System detects crack based on number of blobs involved and mentions whether crack exist or not. Using bounding box functionality, system displays rectangular box around the blob. This system used during railway track inspection. The proposed system is able to detect deeper cracks with 80% success rate and minor cracks with 50-60% accuracy.

The main aim of the project is to design and develop an automatic railway crack detection system based on image processing technology. 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.

Inspections on railway track are done by conventional method or manual detection. The exact location of the crack cannot be found by using the conventional method of crack detection.

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4. Conclusion

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. The image of the track and then it can be input to the suggested system to detect any cracks in the track section.

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 intervention, the utmost efficiency of the system can be ensured. It is 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 mishappening. Since the system would be automatic and will require less manual intervention, the utmost efficiency of the system can be ensured.

Acknowledgement

We extend our special thanks to our project guide Prof. A. D. Gotmare sir, all the teaching faculty for their valuable guidance and encouragement.

References

[1] Yuvashree G, S. Murugappriya," Railway Track Inspection System for Railbolt and Crack Fault Detection", IJEEE, Volume 07, Issue 01, Jan-June 2015.
[2] S. Wender and K. Dietmayer, "3D vehicle detection using a laser scanner and a video camera," Intelligent Transport Systems, IET, vol. 2, pp. 105-112, 2008.
[3] H. J. Zhao, Y.Z. Chen and R. Shibasaki, "An efficient extrinsic calibration of multiple laser scanners and cameras' sensor system on a mobile platform," in Intelligent Vehicles Symposium, IEEE, pp. 422-427, 2007.
[4] J. Roberts and P. Corke, "Obstacle Detection for a Mining Vehicle using a 2D Laser," Australian Conference of the Mining Device, vol.5, pp. 104-109, 2000.
[5] Fatih Kaleli and Yusuf Sinan Akgul, "Vision-based railroad track extraction using dynamic programming", 12th International IEEE Conference on Intelligent Transportation Systems, pp. 1–6, 2009.
[6] Q. Li, and S. Ren, "A visual detection system for rail surface defects.", IEEE Transactions on Systems, Man, and Cybernetics, Part C (Applications and Reviews) Vol. 42.6, pp. 1531-1542, 2012.
[7] B. Sambo, A. Bevan, and C. Pislaru, "A novel application of image processing for the detection of rail surface RCF damage and incorporation in a crack growth model.", The International Conference on Railway Engineering (ICRE) 2016, pp.1-9, 2016.
[8] Z. Mao, Y. Zhan, G. Tao, B. Jiang, and X.G. Yan, "Sensor Fault Detection for Rail Vehicle Suspension Systems with Disturbances and Stochastic Noises", IEEE Transactions on Vehicular Technology, Vol. PP, Issue 99, pp. 1-1, 2016.
[9] S. Faghih-Roohi, S. Hajizadeh, B. D. Schutter, "Deep Convolutional Neural Networks for Detection of Rail Surface Defects", 2016 International Joint Conference on Neural Networks (IJCNN), pp. 2584-2589, 2016.
[10] G. Hu, L. Xiong, and J. Tang, "Heavy rail surface defects detection based on the morphology of multi-scale and dual-structure elements.", Chinese Automation Congress (CAC), 2015. IEEE, pp. 2126 – 2129.