# REALTIME CRACK DETECTION SYSTEM IN RAILWAY TRACK

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**Abstract- Rail surface defects such as the abrasion, scratch and peeling often cause damages to the train wheels and rail bearings. An efficient and accurate detection of rail defects is of vital importance for the safety of railway transportation. Surface defects detection on real time basis is the most important challenge in the present scenario of railway industry. According to the requirements of modern railway automatic detection technology on real-time detection and adaptability. This paper presents a method for real-time detection of rail surface defects. In the past few decades, automatic rail defect detection has been studied; however, most developed methods use optic-imaging techniques to collect the rail surface data and are still suffering from a high false recognition rate.**

**Keywords – Abrasion, Scratch, Peeling, Surafce defects, Real-time detection.**

## I. INTRODUCTION

The rail surface defect is an important factor that affects the operation safety of rails. Common rail surface defects such as abrasion, corrugation, scratch, corrosion and peeling would cause damage to the train wheels and the rail bearings, which will not only shorten the service life of train parts, but also bring a potential critical safety crisis to the trains. Therefore, the research and development of automatic methods for rail surface defect detection is very important[1]. At present, the track surface defect detection mainly relies on manual inspection, but this method is labor-intensive, has lower efficiency, and influences results easily; it cannot meet the needs of daily inspection of the modern railway[2]. In time, the ascending wears on the rails bring about the disruption of transportation security, the off-road accidents, the interruption of the harmony between the rails and the wheels [3]. Detection of most critical components for the safe operation of trains is important [4]. The analysis of the rail profile must be repeated at regular intervals in order to prevent these situations and detect early failures that can occur in rail [5]. Nevertheless this process is costly and it needs that the railway track should be temporarily disabled [6]. The developed methods to detect failures in railway as contactless are available in literature and proposed approach in shown in figure 1.

## II. PROPOSED APPROACH

| Image obtaining |
|---|
| |
| Location detection thru GPS |
| |
| Image enhancement |
| |
| Region growing process |
| |
| Noise cancellation |
| |
| Recover the fault |

**Figure 1.** Block diagram of railway track failure detection.

### 2.1 Railway track defects:

Failures in railway track can be expressed as wear, breakage, scour, undulation, headcheck and oxidation [7]. Horizontal and vertical wears occur in surface which rails contact with wheel.

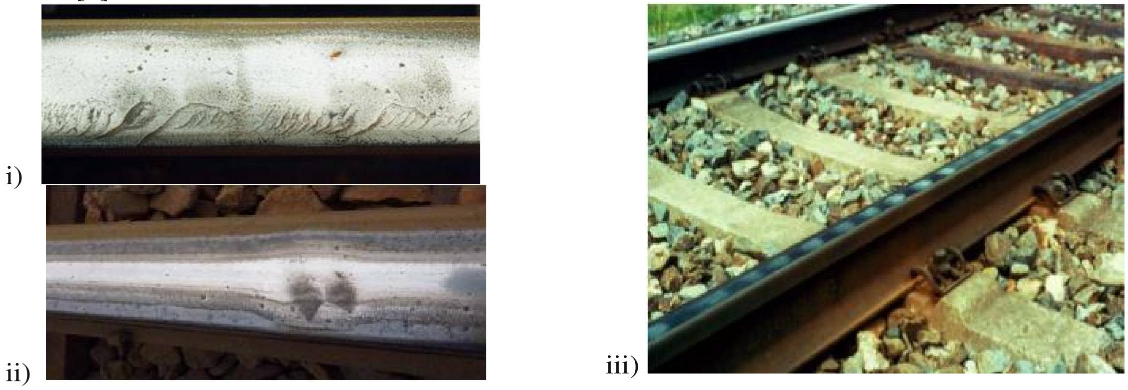


**Figure 2.** An example of i)headcheck failure, ii)undulation defect and iii)scour defect.

Headcheck defect is found around the gauge corner of outer rail and this fault ascending inclines to happen when cracks reach 30 mm in surface length [8]. Figure 2 shows the live defects presence in the track.

Earlier detection of rail defects is important for both preventing accidents that can happen and preventing greater than a costly problem.

### 2.2 Defect detection system

Rail defect detection technology mainly uses magnetic induction, ultrasonic technology, laser measurement technology and image processing technology. Many research works have been done and many achievements made on this aspect. In recent years, image recognition technology has been widely used to detect defects based on local spatial patterns of intensity; for instance, the Gabor filter [9] and wavelet transform [10]. Mandriota [11] and Marino [12] compare three filtering approaches (Gabor filter, wavelet transform and Gabor wavelet transform) based on texture analysis of the rail surface to extract texture features for rail corrugation detection. The track surface defect detection model includes five parts: image acquisition; target area location; image enhancement; defect detection; and human–computer interaction [13].

### 2.3 THE PROPOSED METHOD

A contactless vision based image processing algorithm is recommended in order to detect and classify defects that can happen on the rail surface. The outline of the proposed real time model of the fabrication is shown in the figure 3.

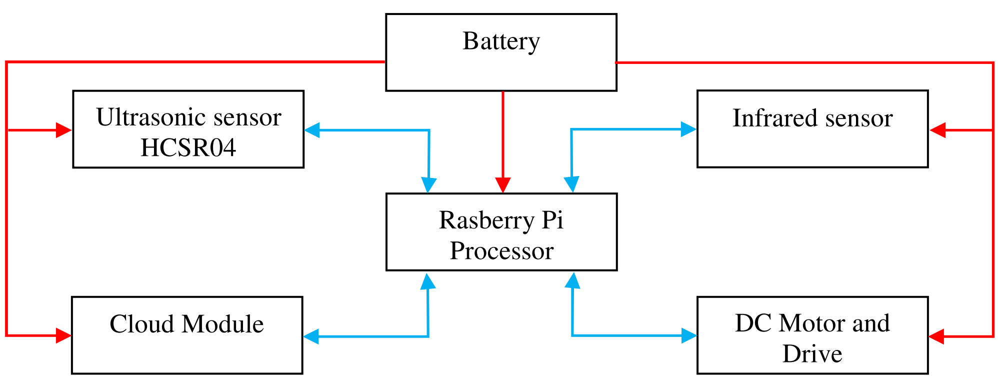


**Figure 3.** Block diagram of proposed method.

## III. EXPERIMENTAL RESULTS

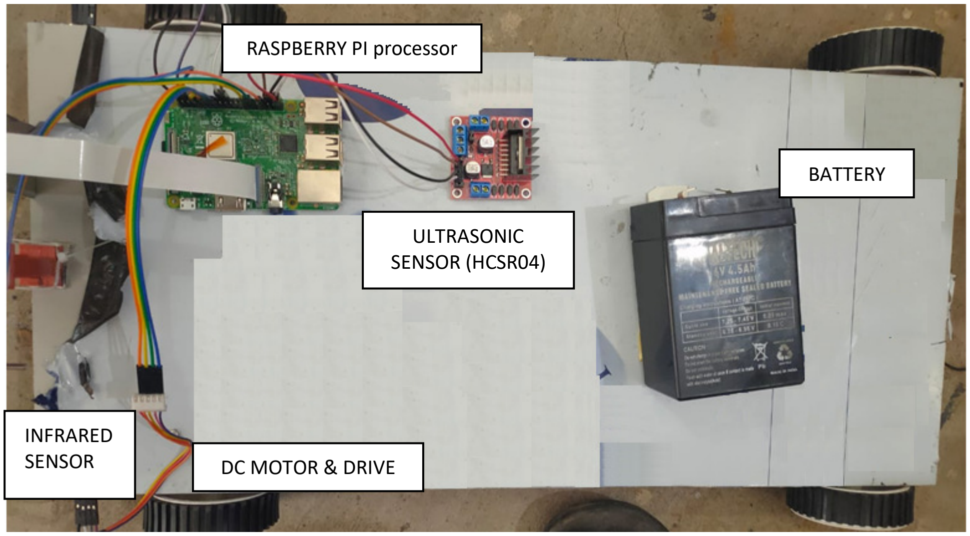


**Figure.4** Model of defect detection system.

It consists of Battery, Raspberry pi processor, Ultrasonic sensor, DC motor drive, Infrared sensor and portable trolley as shown in Figure.4. Target area can be extracted accurately is very important to the detection system and because the portable track defect visual inspection system is mainly used for outdoor rail inspection[14].

Due to the lack of an existing rail line that contains continuous scars and crack defects, select different lines, respectively, at different speeds through the defect area, to detect the accuracy of statistics. Among them, 20 of the scar defects and 20 crack defects weretestedby0.5m/s,1m/s,2m/s,4m/s,and6 m/s to get the best detection speed and the detection accuracy of the rail surface defects. The experimental results (are shown in Table 1) show that the portable track defect vision detection system can work under the speed of 2 m/s (that is consistent with the people normal walking speed of 5 km/h), realizing the real-time detection of track defects.

**Table 1.** Rail surface defect detection results.

**Defect Observation details**

| Velocity of the Defect detecting device (m/s) | Number of Cracks | Number of Scars |
|---|---|---|
| 1 | 19 | 46 |
| 2 | 15 | 40 |
| 3 | 12 | 38 |

## IV.CONCLUSION

This paper proposes a rail surface real-time visual detection method. LabVIEW was used to write the algorithm program to achieve a portable track defect visual inspection system. The portable track inspection car is used to carry out the field experiment. Headcheck, undulation, scour and fracture defects were detected on the rail images. Rail track was identified with detected line segments. After the defect detection was done, the classification of rail defects was performed. the importance degree of faults can be determined.

## REFERENCES

[1] Zhimin Xiong, Qingquan Li, Qingzhou Mao and Qin Zou, "A 3D Laser Profiling System for Rail Surface Defect Detection", https://www.mdpi.com/journal/sensors.

[2] Yongzhi Min,et al.. "Real time detection system for rail surface defects based on machine vision", EURASIP Journal on Image and Video Processing, 2018.

[3] M. Sun, Y. Wang, X. Zhang, Y. Liu, Q. Wei, Y. Shen and N. Feng, "Feature selection and classification algorithm for non-destructive detecting of high-speed rail defects based on vibration signals", In Instrumentation and Measurement Technology Conference (I2MTC) Proceedings, 2014 IEEE International, pp. 819-823, May 2014.

[4] L.F.M. Camargo, E. Resendiz, J. Hart, J.R. Edwards, N. Ahuja and C.P.L. Barkan, "Machine Vision Inspection of Railroad Track", USDOT Region V Regional University Transportation Center Final Report, 2011.

[5] Y. Santur., M. Karaköse, E. Akin and I. Aydin, "IMU based adaptive blur removal approach using image processing for railway inspection", In 2016 International Conference on Systems, Signals and Image Processing (IWSSIP), pp. 1-4, May 2016.

[6] I. Aydin, E. Karaköse, M. Karaköse, M.T. Gençoglu, E. Akin, "A new computer vision approach for active pantograph control", In Innovations in Intelligent Systems and Applications (INISTA), 2013 IEEE International Symposium on, pp. 1-5, 2013.

[7] Y. Santur, M. Karaköse, E. Akin, "Chouqet Fuzzy Integral Based Condition Monitoring and AnalysisApproach Using Simulation Framework for Rail Faults", In 14th IEEE International Conference on Industrial Informatics (IEEE INDIN 2016), Futuroscope-Poitiers, France, 18-21 July 2016.

[8] R.P.B.J. Dollevoet, Design of an Anti Head Check profile based on stress relief, University of Twente, 2010.

[9] Kumar, A.; Pang, G.K. Defect detection in textured materials using Gabor filters. IEEE Trans. Ind. Appl. 2002, 38, 425–440.

[10] Toliyat, H.A.; Abbaszadeh, K.; Rahimian, M.M.; Olson, L.E. Rail defect diagnosis using wavelet packet decomposition. IEEE Trans. Ind. Appl. 2003, 39, 1454–1461.

[11] Mandriota, C.; Nitti, M.; Ancona, N.; Stella, E.; Distante, A. Filter-based feature selection for rail defect detection. Mach. Vis. Appl. 2004, 15, 179–185.

[12] Marino, F.; Stella, E. ViSyR: A Vision System for Real-Time Infrastructure Inspection; INTECH Open Access: Rijeka, Croatia, 2007.

[13] M Sonka, V Hlavac, Image Processing, Analysis, and Machine Vision ( Tsinghua) (University Press, Beijing, 2011).

[14] Papaelias, M.P.; Lugg, M.; Roberts, C.; Davis, C. High-speed inspection of rails using ACFM techniques, NDT E Int. **2009**, 42, 328–335.