Ideation phase- Literature survey

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Paper 1 :Onboard Condition Monitoring Sensors,Systems and Techniques for Freight Railway Vehicles: A Review, IEEE Sensors Journal (Author E. Bernal, M. Spiryagin, C. Cole)

the constant demand for heavier, longer, faster, and more efficient rail freight vehicles, onboard fault detection systems appear as a good approach for enhanced railway asset exploitation. Real-time condition monitoring reduces inefficient preventive and reactive maintenance actions, decreases waste from replacing parts that still have a useful life, and improves availability and safety by real-time rolling stock diagnosis. There have been considerable advances in wayside monitoring applications, but these cannot achieve real-time continuous monitoring. With the price reduction and miniaturization trends of electronic devices, the cost of deploying wireless sensor networks onboard freight trains continues to become more feasible and accessible. On the other hand, the lack of onboard electric power availability on freight wagons appears as the major limitation for the implementation of these technologies. This paper reviews recent onboard condition monitoring sensors, systems, methods and techniques, aiming to define the present state of the art and its potential application for freight wagons without onboard electric power.

Paper 2: Wireless Sensor Networksfor Condition Monitoring in the Railway Industry: A Survey, IEEE Trans-actions on Intelligent Transportation Systems(Author 1V. J. Hodge, S. O. Keefe, M. Weeks, A. Moulds)

In recent years, the range of sensing technologies has expanded rapidly, whereas sensor devices have become cheaper.This has led to a rapid expansion in condition monitoring of systems, structures, vehicles, and machinery using sensors. Key factors are the recent advances in networking technologies such as wireless communication and mobile ad hoc networking coupled with the technology to integrate devices. Wireless sensor networks (WSNs) can be used for monitoring the railway infrastructure such as bridges, rail tracks, track beds, and track equipment along with vehicle health monitoring such as chassis, bogies, wheels, and wagons. Condition monitoring reduces human inspection re-quirements through automated monitoring, reduces maintenance through detecting faults before they escalate, and improves safety and reliability. This is vital for the development, upgrading, and expansion of railway networks. This paper surveys these wireless sensors network technology for monitoring in the railway indus-try for analyzing systems, structures, vehicles, and machinery.This paper focuses on practical engineering solutions, principally,which sensor devices are used and what they are

used for; and the identification of sensor configurations and network topologies.It identifies their respective motivations and distinguishes their advantages and disadvantages in a comparative review.Index Terms—Asset management, condition monitoring, deci-sion support systems, event detection, maintenance engineering, preventive maintenance, railway engineering, wireless sensor net-works (WSNs).

Paper 3: Towards the internet of smart trains: A review on industrial IoT-connected railways, Sensors (Switzerland)(Author P. Fraga-Lamas, T. M. Fern´andez-Caram´es, L. Castedo)

the railway industry is in a position where it is able to exploit the opportunities created by the IIoT (Industrial Internet of Things) and enabling communication technologies under the paradigm of Internet of Trains. This review details the evolution of communication technologies since the deployment of GSM-R, describing the main alternatives and how railway requirements, specifications and recommendations have evolved over time. The advantages of the latest generation of broadband communication systems (e.g., LTE, 5G, IEEE 802.11ad) and the emergence of Wireless Sensor Networks (WSNs) for the railway environment are also explained together with the strategic roadmap to ensure a smooth migration from GSM-R. Furthermore, this survey focuses on providing a holistic approach, identifying scenarios and architectures where railways could leverage better commercial IIoT capabilities. After reviewing the main industrial developments, short and medium-term IIoT-enabled services for smart railways are evaluated. Then, it is analyzed the latest research on predictive maintenance, smart infrastructure, advanced monitoring of assets, video surveillance systems, railway operations, Passenger and Freight Information Systems (PIS/FIS), train control systems, safety assurance, signaling systems, cyber security and energy efficiency. Overall, it can be stated that the aim of this article is to provide a detailed examination of the state-of-the-art of different technologies and services that will revolutionize the railway industry and will allow for confronting today challenges.

Paper 4:3D rail modelling and measurement for rail profile condition assessment (Author V. Rikhotso, N. Steyn, Y. Hamam,)

To ensure safety and reliability, compliance to rail regulations and efficient predictive maintenance, regular condition assessment needs to be carried out on the railway infrastructure. The consequence of not carrying out condition assessment measurement results in poor knowledge of track conditions that should trigger maintenance and rehabilitation interventions. With the introduction of higher speeds, safety requirements for freight and passenger trains, track occupation limitation, cost and productivity improvements in maintenance requirements, more efficient condition assessment and maintenance systems are required. Rail profile measurements and visual inspection of rails are some of the fundamental condition assessments requirements for determining the wear rate and surface defects on rails. This paper proposes the use of 3D image acquisition and modelling to extract the condition of rails (through rail profile measurements) and detection of surface defects. This is supplemented by manual measurement methods to validate and confirm the accuracy and reproducibility of the

vision based approach. Various image processing techniques are reviewed, and a selection criterion taking into consideration external influences such a variation in lighting, vibrations on the railway track environment, amongst other conditions are discussed.

Paper 5A: real time interface for vision inspection of rail components and surface in railways, in: IDAP- Iternational Artificial Intelligence and Data Processing Symposium,IEEE(Author C. Tastimur, O. Yaman, M. Karakose, E. Akin)

The importance given to the safety of railway transportation and the maintenance of railway components is also increasing as railway transportation is widespread all over the world. The most basic measure is to take to reduce railway accidents is to check the railway components at regular intervals. The identification of railways with advanced technology, unlike traditional methods, has made a great demand in recent years. Regular inspection of rail, railway component, traverse, turnout crossing and level crossing at regular intervals will prevent possible accidents. In this study, it has ensured that railway components have been diagnosed using contact image processing based techniques. The proposed approach consists of preprocessing, morphological feature extraction, fault and deficiency detection steps. The railway component which is missing after the fixing of the connecting element and the rail line is determined. The lack of railway components can jeopardize the safety of railway transportation. After the rail track has been detected, the existing faults on the rail surface have been determined. The operations applied in rail surface diagnosis include image padding, average filter, difference of images, feature extraction and defects labeling. The proposed method is performed through the interface created with Emgu CV library in Visual Studio and high accuracy results are obtained.

Paper 6: A High-Precision Loose Strands Diagnosis Approach for Isoelectric Line in High-Speed Railway, IEEE Transactions on Industrial Information(Author Z. Liu, L. Wang, C. Li, Z. Han)

With the rapid development of deep learning technologies, researchers have begun to utilize convolutional neural network (CNN)-based object detection methods to detect multiple catenary support components (CSCs). The literature has focused on the detection of specified large-scale CSCs. Additionally, CNN architectures have faced difficulties in identifying overlapping CSCs, especially small-scale components. In this paper, a unified CNN architecture is proposed for detecting all components at various scales of CSCs. First, a detection network for CSCs with large scales is proposed by optimizing and improving Faster R-CNN. Next, a cascade network for the detection of CSCs with small scales is proposed and is integrated into the detection network for CSCs with large scales to construct the unified network architecture. The experimental results demonstrate that the detection accuracy of the proposed CNN architecture can reach 92.8%; hence, it outperforms the popular CNN architectures. INDEX TERMS High-speed railway catenary, catenary support component detection, deep learning architecture .

Paper 6: Rail and turnout detection using gradient information and template matching, in: IEEE ICIRT- Proceedings: IEEE International Conference on Intelligent Rail Trans-portation, IEEE(Author J. Corsino Espino, B. Stanciulescu, P. Forin,)

This paper presents a railway track and turnout detection and turnout classification algorithm.The railway track extraction is based on an edge detection using the width of the rolling pads. This edge detection scheme is then used as an input to the RANSAC algorithm to determine the model of the rails knowing their gauge. The turnout detection scheme is based on the Histogram of Oriented Gradient (HOG) and Template Matching (TM). The turnout classification is based on HOG. The detection results show (i) reliable performance for the railway track extraction scheme and (ii) a correction rate of 97.31 percent for the turnout detection scheme using a Support Vector Machine (SVM) classifier. The turnout classification has a correction rate of 98.72 percent using SVM.

Paper 7: Automatic Fastener Classification and Defect Detection in Vision-Based Railway Inspection Systems IEEE Transactions on Instrumentation and Measurement(Author , +3 authors Long Chen)

The detection of fastener defects is an important task in railway inspection systems, and it is frequently performed to ensure the safety of train traffic. Traditional inspection is usually operated by trained workers who walk along railway lines to search for potential risks. However, the manual inspection is very slow, costly, and dangerous. This paper proposes an automatic visual inspection system for detecting partially worn and completely missing fasteners using probabilistic topic model. Specifically, our method is able to simultaneously model diverse types of fasteners with different orientations and illumination conditions using unlabeled data. To assess the damages, the test fasteners are compared with the trained models and automatically ranked into three levels based on the likelihood probability. The experimental results demonstrate the effectiveness of this method.