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Prevention of over loading and under loading of Railway wagons

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ABSTRACT :

The efficient and safe operation of railway transportation systems is paramount in the modern world, where the movement of goods is a fundamental component of economic activities. However, the persistent challenges of overloading and underloading railway wagons have raised concerns related to safety, infrastructure integrity, and economic losses.

In response to these challenges, this project presents a novel approach to address overloading and underloading issues in railway operations. we propose the installation of flux and ir based proximity based spring compression analysis systems beneath the wagons, designed to analyse flux changes and height variation w.r.t to load, facilitating the accurate calculation of height changes in comparison to a reference unloaded wagon.

This system leverages state-of-the-art RF communication and monitoring technology to enable real-time communication between the loader and supervisor, offering a proactive and efficient solution to prevent overloading and underloading. The data collected by the system empowers railway operators to make informed decisions, ensuring that wagons are loaded within safe operational limits.

This project's results demonstrate the feasibility and effectiveness of the proposed solution, with potential benefits in terms of safety, cost reduction, and overall operational efficiency. As railways continue to play a pivotal role in global trade, the implementation of this technology has the potential to make a significant impact on the railway industry.

Keywords— Efficient, safe, economic, safety, coil, spring, Flux, RF, Operational limits, proximity.

Introduction :

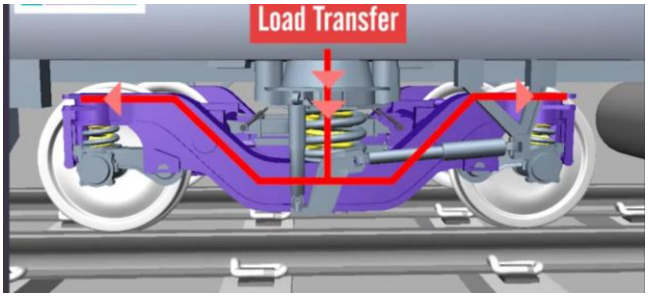
Railway transportation stands as a cornerstone of global commerce, facilitating the seamless movement of goods across vast distances. The efficiency, safety, and reliability of railway systems are of paramount importance in the modern era, where economic activities are tightly interwoven with the timely and secure delivery of freight. However, the persistent challenges of overloading and underloading within railway wagon operations cast a looming shadow over these critical objectives.

The consequences of overloading and underloading railway wagons are far-reaching. They not only jeopardize the safety of rail transport systems and the structural integrity of rolling stock but also impose substantial economic burdens. Overloaded wagons strain infrastructure, lead to derailments, and increase wear and tear on tracks, while underloaded wagons result in inefficient resource utilization and increased costs. In light of these challenges, there is a pressing need for innovative and effective solutions to address the age-old problem of wagon load management.

This project seeks to offer a pioneering approach to tackle overloading and underloading within railway operations. We propose the deployment of proximity based height analysis systems positioned beneath railway wagons. These systems leverage cutting-edge technology to analyse changes in magnetic flux (inductive type proximity sensor) and IR based Proximity sensor within the circuit, providing the capability to accurately calculate height differentials concerning a reference unloaded wagon. The information collected is then used to proactively manage wagon loading, mitigating the risks associated with both overloading and underloading.

The core of this system lies in its ability to harness real-time radio frequency (RF) communication & monitoring system, facilitating seamless data exchange between the wagon loader and the supervisor. This collaborative and data-driven approach enables precise monitoring of the loading process and empowers railway operators to make informed decisions, ensuring that wagons are loaded within safe operational limits. By offering a comprehensive solution to the age-old problem of overloading and underloading, this project has the potential to transform the landscape of railway transportation, enhancing safety, reducing costs, and increasing overall operational efficiency.

As railway systems continue to play a pivotal role in facilitating global trade and economic activities, the implementation of this technology represents a significant stride toward a more secure, efficient, and sustainable future for the industry.



Principle of operation

Objective:

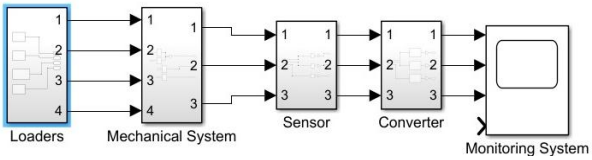
1. The primary objective of this report is to introduce and describe an innovative solution for the prevention of overloading and underloading in railway wagon operations. This solution involves the installation of coil-based height analysis systems beneath wagons.
2. Optimize the utilization of railway resources by ensuring that wagons are loaded within safe and efficient operational limits, thereby reducing wear and tear on tracks, and improving overall efficiency.
3. Minimize economic losses associated with overloading and underloading, such as repair and maintenance costs, and the expenses incurred due to delays and accidents.
4. Enable real-time monitoring and control of the loading process by implementing a robust communication system between wagon loaders and supervisors.

LITERATURE REVIEW:

Currently there isn't any big technological advancement in the field of wagons loading monitoring system, the conventional way is to use of load cell for the weight monitoring of unloaded and loaded wagons, which is not accurate as well as in efficient, railway authority also uses Static Weigh Scales in there facility as well as nearby facility to cross check the weight of wagons after loading and penalties as per the situation.
There is also an system by the{CRRC Shandong Co Ltd} (1.3) where they use pole mounting near wagons to measure the height difference before and after loading by means of laser beam method.

PROPOSED METHODOLOGY:

"In this IEEE paper, we present a novel methodology utilizing proximity sensors for real-time detection of height variations in railway wagon springs. Our approach aims to accurately identify and mitigate instances of overloading and underloading, thereby enhancing the safety and efficiency of railway operations through proactive load monitoring in the most efficient and economical way".



Here is our MATLAB Simulink Model for the device.

There is more underlying sub models and sensors

Here is the variation of loads on different springs set on a wagon, expressed in tons using three proximity sensor which is placed in below the wagons and by applying the triangular law of vector addition we are computing height displacement with load variations giving different conditions of loading parameter of wagon.
Allowable load/wheels is 9 tons max.

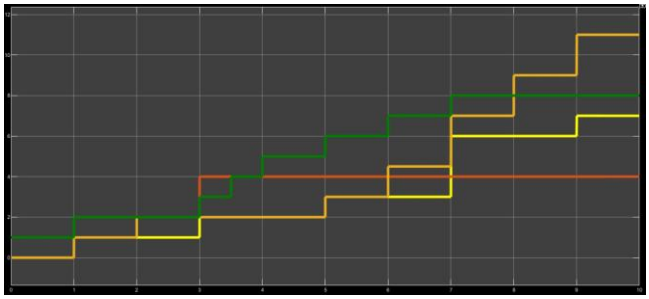


Fig1.load in tons /unit time at each wheel of wagon responsible for displacement of height. Unit- Ton/unit time

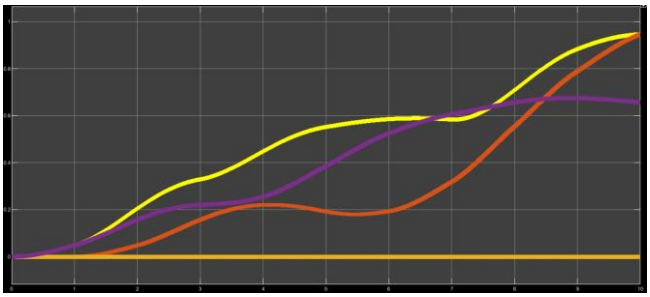


Fig2. Here the below graph is representing the height displacement of wagon spring set during loading with reference to Fig1. Unit-ton/mm

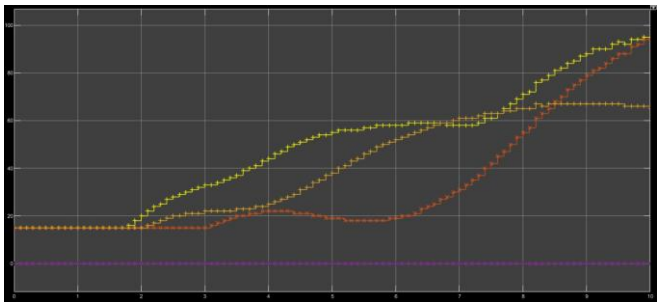


Fig3. Here is the graph based on the values detected by the proximity sensor for height variation of wagon. Unit-mV/mm

The Height variation even the minimal can be detected by the proximity sensor, which then will compute the data and displays the result in real time. This will allow us to fully control the loading period and can work autonomously with any intervention on his own, the accuracy is also much higher than the conventional method of monitoring and weighting of wagons with nominal tolerance %.

Working

Generally, there is an absence of uniform loading in wagons or uniform distribution of load/coal throughout the wagons which results in shifting of center of gravity, breakage, disbalance, alignment disturbances, inaccurate weighting of wagons and many more so to cope up this situation we are using three proximity sensor(the proximity sensor with range of 2 m can be used with max tolerance of 2-3% which result to 20-30% in load variation i.e for 1 tons we have error of 20kgs which is quite negligible) placed one in center and other two on the side body of the wagons which will detect the height change accurately and also detect the un equal load distribution and will calibrate and provide the instruction as per the situation.

Our device will scan the serial no of wagons and will fetch all the necessary details about it which will be used to get the total capacity of the wagons, type of wagon, spring constant and many more. As the load keeps on increasing the spring will compress and sensor will sense the changes and will give the reading in voltages which then will then amplified and goes into our model which will compute the data collected by the three sensor and the will compare the data with the unloaded or reference data and will provide the result if it's a case of underloading, over loading, unequal weight distribution and etc., hence will instruct the operator for the best possible way.
This device can be the perfect example for "**Prevention is much better than cure".**

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