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LOAD SENSING AND OVERLOAD PROTECTION SYSTEM

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Abstract *— Truck overloading is still a major issue in the transportation sector, as it raises the risk of accidents, shortens vehicle lifespans, increases road damage, and generally results in inefficient operations. Conventional manual weighing techniques take a lot of time, are not continuous, and are frequently impractical when in transit. The design, development, and deployment of an on-board, real-time load sensing and overload prevention system utilizing load cells, HX711 amplifiers, microcontrollers, and alert mechanisms are presented in this paper. The system improves vehicle efficiency and road safety while providing continuous load monitoring and instant alerts upon overload detection. The methodology, literature review, system design, implementation, outcomes, and potential areas for future development are all covered in the paper.*

Keywords *— Truck Overloading, Load Sensing, Overload Prevention, Real-Time Monitoring, Load Cells, HX711 Amplifier, Microcontroller (Arduino), Road Safety, Vehicle Efficiency, Embedded Systems*

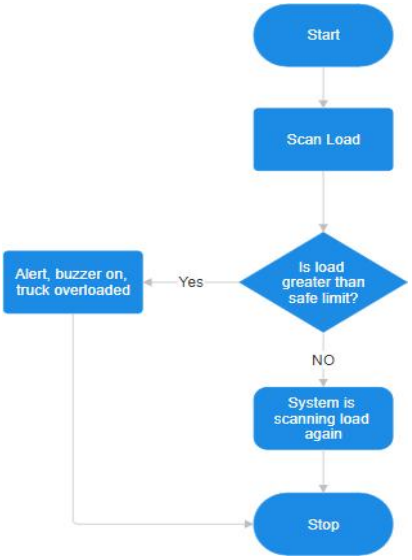
Introduction-

The smooth movement of goods over great distances is made possible by the transportation sector, which forms the foundation of contemporary economies. Trucks are very important when it comes to maintaining the supply chains, whether they are moving consumer goods, agricultural products, or raw materials. However, truck overloading is one of the major problems which this industry is facing. A number of issues, such as accident rates are increasing, early mechanical failures, reduced fuel efficiency and significant damage to public infrastructure like roads and bridges, are greatly exacerbated by overloaded trucks. In addition to putting lives in danger, these issues have a significant financial impact due to the need for infrastructure upkeep, auto repairs, and legal penalties.

Despite the implementation of strict government regulations and manual load inspection procedures at weigh stations, overloading remains a widespread issue. Traditional weighing methods are limited as they typically provide only spot-checking capabilities at designated checkpoints. Once a truck passes these points, it may still be susceptible to overloading during its journey, especially in industries where multiple loading and unloading events occur along the route. This gap highlights the urgent need for a more dynamic and continuous approach to load monitoring.

To address these limitations, there is a growing necessity for an on-board, real-time load detection and alert system that can function effectively throughout a truck's operation. By employing advancements in smart sensor technology and microcontroller-based systems, it has become possible to monitor the vehicle's load continuously. Such systems can detect unsafe load conditions as they occur, allowing immediate corrective action by alerting the driver or fleet management in real time.

The project proposed here seeks to design and implement a Load Sensing and Overload Prevention System (LSOPS) that is not only technically reliable and accurate but also cost-effective and scalable for widespread adoption. The system is intended to enhance operational safety, extend vehicle life, improve overall fleet efficiency, and support regulatory compliance, ultimately contributing to safer roads and more sustainable transportation practices.



Results and Discussion-

To check how system works in different conditions, we tested in a small scaled vehicle with 3 different load conditions.

1. Underload Condition: The load is significantly below the threshold. The system accurately reads the load and remains in monitoring mode.
2. Normal Load: The load is close to the threshold but within safe limits. The system continues monitoring without triggering alarms.
3. Overload Condition: When load exceeds the threshold, the system immediately triggers the buzzer/LED for driver alert.

CONCLUSIONS-

This research presents the systematic design, development, and implementation of a Load Sensing and Overload Prevention System (LSOPS) for commercial trucks. Overloading of heavy vehicles remains a critical concern in the transportation sector, contributing to increased accident rates, premature mechanical degradation, diminished fuel efficiency, and accelerated damage to public infrastructure. Despite regulatory efforts and manual inspection procedures, the absence of real-time monitoring systems has allowed overloading practices to persist. This study addresses these challenges by proposing an embedded solution that continuously monitors vehicle load conditions during operation.

The LSOPS employs load cells in conjunction with HX711 amplifier modules and a microcontroller unit (Arduino UNO) to measure and process load data in real time. The system is calibrated to detect when the applied load surpasses legally permissible or mechanically safe limits. Upon detecting an overload condition, the system provides immediate feedback to the driver via visual indicators (LCD display and LEDs) and audible alarms (buzzer). This real-time alert mechanism facilitates prompt corrective action, thereby reducing the likelihood of accidents and mechanical failures.