

Overload Detection and Load Tracking System - A Review

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Abstract : Transportation plays a vital role in the growth of a country's Economy. In India, compare to other modes of transportation, around 60% of goods are transported by roads. There is increase in commercial vehicles leads to increase in the movement of goods. In this fastest network of transporting, the problem of overloading and loss of goods is a major issue faced by the common people. Overloading in vehicles would increase wear and tear of braking components, increase the effort of engine, increase of fuel consumption and increase the death rate. This paper reviews the research work carried on the field of overloading detection and tracking in the vehicles and a suitable solution has been suggested to overcome the conventional loading problems and loss of goods during transportation.

IndexTerms - Transportation, Overloading, Tracking and safety

I. INTRODUCTION

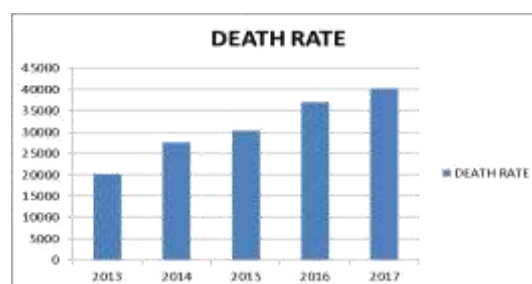
Overloading trucks is a growing industry problem. It leads to unsafe situations and causes injuries and sadly, even fatalities. Statistics show that improperly loaded and overloaded trucks are among the leading causes of truck accidents. Exceeding a vehicles maximum permissible weight is not only a danger to drive the driver but also for the other road users. For their business development, owners of trucks are permitting overloading of their trucks it tends to the damage on the infrastructure and also frame. There are some unwanted impacts of those activities such as road accidents, blockage and so. On the basis of record, 1/3 of the trucks are overloaded and it takes up the 50% of road accidents.

For any business, maximizing efficiency is the key to reducing operating costs and improving profit margins. When transporting payload and reduce overall fuel costs can be a costly mistake. When a vehicle is over loaded the braking distance increases and leads to the driver misjudging the stopping distance. Tire failure increases because the load is increased it runs hotter and the center of gravity is increased; which adds rollover risk. When the vehicle is overloaded, it leads to unbalanced, slips or shifts while moving, the chances of losing control of the vehicle goes up, it significantly increases fuel consumption. Tires are more prone to wear, steering becomes more difficult to control and vehicles take longer to react to braking. Overloaded goods vehicles damage our roads, bridges and underground services producing a massive reduction in predicted road life expectancy and dramatically increasing maintenance costs.

Statistics on road accidents due to overloading

One in every three trucks in the country is overloaded and they are to blame for 50 per cent of road accidents, surveys by the Indian Foundation of Transport Research and Training have found.

Around three-fourths of the annual Rs.550 billion loss from road accidents was attributed to the unorganised truck transport industry. The foundation said over 92,500 people was killed each year in road accidents in the country coming under the wheels of the overloaded vehicles. Delhi leads the metro casualty count. Most trucks were found overloaded by 25-50 per cent.



Year vs. Death rate

The above bar chart clearly depicts fatality over year's increases gradually. It is found that, there is a need of the hour to propose a solution to avoid overloading in vehicles to ensure the invaluable life of humans.

Steps taken to prevent overloading

The government has taken major measures to avoid overloading:

- A high penalty has been proposed in the road transport and safety bill for those who fail to comply with the new rules, with a suspension of permits for one month upon the first offense and cancellation of permits if the offense is repeated
- The national highways authority of India (NHAI) has asked road developers and toll operators to force vehicles off the roads till the extra load is removed at the cost and risk of the transporters concerned.
- In a move to bring major relief to truckers, the road transport ministry has proposed to exempt vehicles carrying excess load up to 5% of the gross vehicle weight from paying hefty fine.

As per the rewritten constitution of India,

The Government has brought in a graded penalty system for overloaded vehicles plying on the national highways. The overloading penalties range from two-to-ten times the chargeable toll depending on the extra weight that a truck is carrying. The new rules came into effect recently. The earlier rules involved charging 10 times the toll fee irrespective of the extent of excess load that a truck was carrying. Overloaded vehicles are asked to pay fines because they tend to damage the roads and are also unsafe, as they topple at times and become a safety hazard.

According to the new rules, for carrying extra load of 0-20 per cent over the total permitted weight, vehicles will have to pay twice the toll fee. For carrying 20-40 per cent excess load over permitted limit, the penalty becomes four times the toll charges that a trucker is supposed to pay. For carrying 40-60 per cent extra weight, the toll charges that a trucker will have to pay is six times, while for carrying 60-80 per cent excess load, the penalty is eight times the toll charges. For carrying any extra weight over 80 per cent, the toll fee becomes 10 times. The earlier rules also involved offloading the extra load close to the toll plaza where overloaded trucks were caught plying, before allowing them to move forward. Road developers had difficulty in implementing the rules.

II. LITERATURE SURVEY

The paper work done by **Libo Zhoua et.al**, [1] discuss about an overloaded truck detect system called ITMD to help traffic department automatically identify the engineering transport vehicles (commonly known as 'dirt truck') in CCTV and determine whether the truck is overloaded or not. They build the ITMD system based on the Single Shot MultiBox Detector (SSD) model. SSD model had been used to carry out 12,000 iterative trainings on training set. The trained network get a mAP of 83.01% on which the average accuracy of the non-overloaded truck is 83.63% and for overloaded truck is 79.39%. It pointed out the shortcomings of basic ITMD system and design an optimized version. The optimized version get a mAP of 78.05% on which the average accuracy of non-overloaded truck increase to 88.77% and overloaded truck to 83.59%.

Shanzhen XU et.al, [2] suggested the solution for the problem of overloading in passenger vehicles. They designed a vehicle-mounted overloading control system. The system included sensor circuit, sensor control circuit and interface circuit with AT89C51 microcontroller. Based on the actual number of passengers, starting of the vehicle was controlled by the control of the amount of fuel injection. Compared with the traditional control methods, this control system saves a lot of manpower, material and financial resources.

To overcome the problem of overloading H.D. **Kattimani et.al** [3], designed a vehicular overload detector. It is an integrated device that can detect conveniently vehicle load to prevent overloading of vehicle and improve vehicle safety and it can effectively reduce heavy work of the vehicle load testing station and improve work efficiency in transport sector.

Tariku Sinshaw [4] had addressed the issue of overloading of passenger in public transport of Ethiopia. Even though, it had a monitoring station police at different locations for manual checkups. This paper includes GSM modem, liquid crystal display (LCD) and buzzer alarm as output from microcontroller and passive infrared ray (PIR) sensor as input. If the number of people inside the bus is above the required, the buzzer alarm starts sounding. The GSM modem automatically sends the message to the bus station module and bus stop module, and so the driver will punish according to the rule.

One important factor which lowers the mileage of the bike is overload. When a bike is overloaded its mileage and performance will be decreased. So that **Vinoth.A et.al**, [5] made a design and fabrication work on overload detection system in automobiles. This project mainly focuses on improving the mileage and performance with the help of overload indicator. The model made up with a spring arrangement and LED to indicate the overload condition in the bike. Thus by avoid overloading the fuel consumption gets reduced and the performance of engine gets increased which results in better mileage.

Bernard Jacob et.al, [6] concurred about the direct enforcement of the weigh in motion. None of the existing WIM system matches this accuracy for 100% of the vehicles. Therefore the objective is to set up some sorting criteria and algorithms, eliminating the weighing outside these tolerances. The project is divided into 5 WPs, to characterize WIM sensor response under controlled environment and loading conditions and to develop fiber optic WIM sensors, to assess the capability of multiple sensor (MS-) and bridge (B-) WIM systems to meet the requirements, to carry long term road tests and to develop type approval procedures for direct enforcement. This paper presents results gathered on the accelerated pavement testing facility of IFSTTAR in 2014 with 10 WIM sensors. Some results of B-WIM systems are also reported.

Franziska Schmidt et.al, [7] suggested a methodology to investigate truck weights and dimension using WIM data. This work reports a study carried out by IFSTTAR about the use of HCVs in France. The large amount of WIM data analyzed, i.e. almost 3 millions of weighed HCVs over a year on 3 sites (2 motorways and one highway) provided interesting results about the payload intensity, its split on the different axles and the longitudinal location of the CoG. This study also open the way for further investigations about HCVs loading and use which could be of interest for many professionals, manufacturers, OEMs and transport companies.

The Norwegian Public Roads Administration focus on issues to improve weight controls, and the quality of statistic weigh data. An important part of the project is field tests of different methods and equipment for collecting. **Torbjørn Haugen et.al**, [8] conducted several tests over a three years period. Two different WIM sensors technologies from four different manufacturers have been tested. This paper concludes the following results, there will be short life time for sensors, WIM systems need temperature

correction due to sensor temperature drift and the accuracy of the sensors decrease over time, for one system the error increased about 15% over a period of 6 months, in other system had increased to 15% in three months and after calibration the error increased to 15% in just over one month.

Ms.Renju K et.al, [9] made a review work on all the existing video surveillance system to detect overload in vehicle. In Intelligent transportation systems, automated vehicle detection plays an important role in detecting overloaded vehicle, identifying abnormal or suspicious behavior of vehicle, traffic congestion, and counting the number of vehicles for traffic analysis and security. A comparison of different Weigh in motion sensors are assessed in this survey and reached to a conclusion that WIM sensors are effective in detecting overloaded vehicle in motion compare to other methodology.

Raj Reddy [10] made an analysis of overloading prevention system in trucks. New technologies are being developed for more efficient overload screening and enforcement. He developed a prototype which has overload intimation circuit and circuit for putting on the siren when enforcing authorities appear. When the vehicle gets overload, the system switch ON the LED, buzzer and radio remote receiver circuit. When the overloaded vehicle is moving in the vicinity, the receiver circuit will receive the transmitting signals and automatically put on the siren within the vehicle. If the driver tries to put off the siren switch, the drive will be blocked.

The research undergone by **Anthony Nkem Ede [11]** examines the devastating effects of truck overloads on the road pavement failure in Nigeria. This research analyses the axle loads of heavy vehicles on Lagos-Ibadan Expressway to see how they influence the state of the road's pavement condition. The expected pavement load was quantified through equivalent single axle loads (ESALs). The axle load measurement showed that most of the heavy vehicles were overloaded resulting in high vehicle damage factors of up to 11.12 and 9.39 for the North-bound and South-bound vehicles respectively. This shows a high growth rate in the percentage of heavy duty vehicles from 13.5% to 18.41% between 1998 and 2009. Through the analysis she concluded the impact of overloaded heavy vehicles to Nigerian Roads and its economy.

Mohamed Rehan Kari et.al, [12] made the study that , the weigh-in-motion (WIM) system has been used to function as a vehicle weight sorting tool to complement the existing static weigh bridge enforcement station. The results of this study summarize that there is a significant percentage of violation involving overloaded commercial vehicles in a developing countries such as Malaysia, the effectiveness of existing static weigh station is rather low as compared to the actual number of GVW violation cases and WIM systems is an appropriate tool in assisting enforcement agencies.

Jun Li et.al, [13] made a research work on the Vehicle Load Control System Integration Device. This paper demonstrates the feasibility of vehicle load control system from the above problems. Through the pressure sensors installed in the vehicle suspension, the single-chip microprocessor receives the information transmitted by the pressure sensors, and calculates the total weight of the vehicle load; if overweight, the single-chip microprocessor will send commands to the ignition system, to stop the ignition system working.

K.R. Prasanna and M. Hemalatha [14] suggested an idea of using GPS and GSM based logistics vehicle load balancing and tracking mechanism Logistics management is very important aspect in real time applications. They address the problems in cargo loaded vehicles such as the delayed delivery of goods, overloading on vehicles, and identification of vehicle location and misplacement of goods. The proposed system uses RFID tag to identify the goods to avoid misplacement and Weight sensor is used to avoid the overloads of goods in vehicle. The GPS and GSM are used to track the vehicle and also send the details of goods to source periodically.

Bernard Jacob Véronique et.al, [15] had studied the Potential of weigh-in-motion technology for the improvement of truck safety. In this paper, he discussed about the various WIM technologies and sensors installed on different countries. Thus, Weigh-in-Motion (WIM) technologies allow trucks to be weighed in the traffic flow without any disruption to operations. It is a useful tool to contribute towards more compliance with mass regulation.

III. CONCLUSION

The outcome of this study shows the magnitude of the overloading problem in vehicles and its huge impact. It also discussed about all the existing systems like video surveillance, using shock absorbers, GPS and GSM based logistics systems, system using WIM data etc., to control overloading and also to employ tracking in vehicles. Thus, it concluded by proposing a methodology to implement a vehicle mounted overloading detector and the system also comes with an integrated tracking module. The uniqueness about implementing the overloading detectors on the commercial vehicles is, the asymmetric bending of the vehicle carriage can be avoided and it will reduce the risk of wear and tear of the structural components and death rate due to accidents. The integrated tracking module helps to measure the load continuously that acting on the vehicles chassis which avoid loss of goods due to any misshapen or theft.

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