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GPS based transmission of information of overloading in heavy vehicles & controlling of vehicles

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Abstract
Sensors are the major sources to sense the physical quantity which either measured or used in various applications. Today we have a serious problem that trucks exceeding the legal mass limits increase the risk of traffic accidents and damage to the infrastructure. They also result in unfair competition between transport modes and companies. It is therefore important to ensure truck compliance to weight regulation. New technologies are being developed for more efficient overload screening and enforcement. Weigh-in-Motion is the new technology in which we use sensors & controllers which allow trucks to be weighed in the traffic flow, without any disruption to operations. Much progress has been made recently to improve and implement intelligent overloading detection system which can contribute to safer and more efficient operation of trucks. This technology not only detects the overloading but also controls the engine ignition according to loads on truck & sends this information to nearest Check Post.

Keywords: GPS, weight, load cell, transistors, relays, capacitors, ADCs, driver (LM293D), controller

Introduction
This project is designed aiming towards the prevention of damage of roads due to overloading and prevents unauthorized, unlicensed driving. Roads are now-a-days play a vital role in every part of the world. We have many more benefits with these roads like it directs the way for communicating to other places, since time is consumed for reaching from one place to another place etc.

Fig 1

Fig 2

1. Roads and streets are the most important transport communication source in the world filling the gaps between villages, cities & states. These transport medium are used by almost everyone on daily basis. Besides these facts, roads are provided for the benefit of the road user, they also play a significant role in promoting economic growth and the living standards of the society. People access this transport medium to go from their home to clinics, hospitals, market, cities etc. Industries also send the heavy goods from one city to another city by means of trucks etc.which move on these roads.
2. But main issue is that, It has been found heavy loaded vehicles cause a relatively small amount of damage to road pavement structures, as opposed to overloaded heavy vehicles which are responsible for approximately 60% of the damage to the road network.
3. Inadequate law enforcement on goods carrier overloading allows some transport operators to overloaded their heavy vehicles, which not only advantageous for them in terms of higher profits but also exposes the law abiding operators to unfair competition.
4. A damage to the road pavements by loads exceeding the legal limit, increases in proportion to the loads: for example, if an axle carrying twice of legal load then it cause 4 to 60 times damage as one legal axle load, depend on the condition of structure and type of roads.
5. The penalty currently imposed by the Court/Government Authorized Officer on those who are convicted of heavy vehicle overloading are in most cases negligible in comparison with the damage caused to the roads and are quite clearly in effective in discouraging overloading. Furthermore, overloaded vehicles become a traffic hazard, especially regarding the heavy vehicle's braking system and additional braking distance involved.
   This situation is aggravated by steep down hill slopes and sharp curves. On steep uphill gradients where no climbing lane is provided, the slow moving heavy vehicle causes traffic disruption.
6. Traffic accidents caused directly or indirectly by overloaded heavy vehicles are normally not included when the total cost to the country, caused by overloading, is calculated.
   a) Overloading and Road Safety Overloading and road safety has been recognized to be both a safety concern as well as a cost concern, and the National department

of transport has incorporated a campaign against overloading in its Road to Safety strategy. Economic growth demands an adequate transport infrastructure. Overloaded vehicles, especially freight vehicles, are destroying our roads, impacting negatively on economic growth the damage caused grows exponentially as the load increases. Damage to roads as a result of overloading leads to higher maintenance and repair costs and shortens the life of a road which in turn places an additional burden on the state as well as law abiding road users who ultimately carry the costs of careless and inconsiderate overloading. If the problem of overloading is not controlled, this cost has to be carried by the road user, which will require significant increases in road user charges such as the fuel levy, vehicles license fees, and overloading fees to mention just a few. Overloading is a safety hazard that leads to leading to unnecessary loss of life, and also the rapid deterioration of our roads, resulting in increased maintenance and transportation cost. The amount which is collected from legal action is not sufficient for maintenance of road.

According to law of Ministry of Surface Transport in subsection (1) of Section 58 Motor Vehicles Act, Central Government specifies that in relation to transport vehicles of various categories which is scheduled below:

Table 1

S. No	Vehicle Category	Gross Vehicle Weight	Max. Axle Weight
A	Rigid Vehicles		
a	2 Axle/1 Tyres on Front & 2 Tyres on Rear	9 Ton	3 on Front & 6 Ton on Rear
b	3 Axle /2 Tyres on Front & 8 Tyres on Rear	25 Ton	6 on Front & 19 Ton on Rear
B	Heavy Vehicles(trucks)		
a	3 Axle Truck/2 Tyres on Front & 8 Tyres on Rear	36 Ton	10.2 Ton
b	2 Axle Trailer/4 Tyres on Front	45 Ton	10.2 Ton

b) Consequences of Overloading: A Vehicle will always have following risks in case of Overloading -The vehicle will be less stable, difficult to steer and take longer to stop.

Vehicles respond not perfect when the maximum weights which they are designed to carry are exceeded. Overloaded vehicles can cause the tyres to overheat and tear - wear rapidly which increases the chance of premature, dangerous and expensive failure or blow-outs.

The driver's control and operating space in the overloaded vehicle get vanished, leading the chances for an accident.

The overloaded vehicle can't accelerate as normal – making it difficult to overtake.

At night, the headlights of an overloaded vehicle will tilt up, blinding oncoming drivers to possible debris or obstructions on the roadway.

Brakes operate harder due to 'the riding of brakes'. Brakes get overheated and lose their controllability to stop the car.

With overloading, seat belts are often not used as the aim is to pack in as many persons as possible into the vehicle. –

The whole suspension system comes under stress and, over time, the weakest point can give way. -By overloading your vehicle you will incur higher maintenance costs to the vehicle – tyres, brakes, shock absorbers and higher fuel consumption.

Insurance cover on overloaded vehicles may be void as overloading is illegal. Overloading is an International problem and companies like Central Weighing provide an invaluable service to many countries introducing this new technology and offering extensive technical support to ensure its effective use whether for prosecution or defense.

A significant goal of Artificial Intelligence research is to reduce human loss of life and injury. In principle, intelligent systems can warn humans and protect them from potentially dangerous situation. Evolutionary algorithms have the potential to identify danger where it might otherwise not be apparent by learning about dangerous situations through experience.

According to Survey the no. of Road accidents due to Overloading increases rapidly.

Table 2

DIP IN DEATHS IN DELHI IN 2016

City	Accidents		Death		Severity	
	2016	2015	2016	2015	2016	2015
Delhi	▼ 7,375	8,085	▼ 1,591	1,622	▲ 21.6	20.1
Chennai	▲ 7,486	7,328	▲ 1,183	886	▲ 15.8	12.1
Jaipur	▲ 3,004	1,894	▲ 890	476	▲ 29.6	25.1
Bangalore	▲ 5,323	4,834	▲ 835	713	▲ 15.7	14.7
Kanpur	▼ 1,451	1,496	▲ 684	665	▲ 47.1	44.5
Mumbai	▲ 24,639	23,468	▼ 562	611	▼ 2.3	2.6
50 million-plus cities	▼ 89,835	1,11,024	▲ 17,797	16,513	▲ 19.8	14.9

In this paper, artificial neural networks are evolved to warn drivers in principle; learning may eventually help save lives.

Survey-Sawai Madhopur, Rajasthan December 2017

Vehicle carrying pilgrims to shrine near Sawai Madhopur swerves off bridge and plunges into Banas River

At least 33 people have died in the western Indian state of Rajasthan after a bus swerved off a bridge and plunged into a river, according to local police.

Seven others were injured and taken to hospital in Sawai Madhopur district, 235 miles (375km) south of Delhi.

The bus had been trying to overtake another vehicle when it careered into the barrier and fell 20 metres into the Banas River.

The driver's body is reportedly among the 33 so far accounted for. Unconfirmed reports in the Hindustan Times claimed that an untrained minor was at the wheel at the time of the crash.

Fig 2

Tripura September

Overloading menace in commercial vehicles comes to the fore following Sunday's accident near Udumalpet, in which two passengers of a van and its driver were killed. The van was carrying 2.5 times the stipulated load, police sources said.

While police said that the van owner will face the law, the state transport commissioner ate assured that permit of vehicles that overload will be cancelled to increase the vigil during the festival season.

The 13-seater van was carrying as many as 35 people, including the driver, during its travel from Meenakshipuram when it crashed into an omnibus. The head-on collision left three people dead and injured 32. The passengers in the van were mostly agricultural and construction labourers working in Kerala. They had hired the van on the interstate border to reach Dindigul

Objective of the project

The prominent aim of this project is to prevent the overloading damage of human life and infrastructures.

Prominent features

The heavy load vehicle does not start in case of over loading, When-ever it cross the load limit, it will not start. Along with it, it initiate a message which transmit the Location of that Vehicle to nearest Check Post.

Working principle

In this we are dealing with a four wheel vehicle which is run by the DC motor. On each tyre & on Centre of Mass of the Vehicle, we installed a Half Bridge Strain Gauge. The whole weight of the vehicle is lie on the Strain Gauge Bridge.

The circuit below the whole implementation have following devices:-

Load Cell

Strain Gauge is a piezeo resistive transducer which implies that whenever force exert on it then deformation occur, which changes the strain of material. If this strain gauge is used in Wheatstone Bridge (Transduction Circuit) then under no load Condition, bridge said to be balanced, but whenever load exert on the strain gauge then bridge get unbalanced & we get a net voltage difference.

A load cell is a transducer that is used to change an electrical signal whose magnitude is directly proportional to the force being measured. If 4 strain Gauges used in bridge then it becomes Load Cell.

The various load cell types include hydraulic, pneumatic, and strain gauge

A load cell usually consists of four strain gauges in a Wheatstone bridge configuration. Load cells of one strain gauge (Quarter Bridge) or two strain gauges (half bridge) are also available.

Signal conditioning circuit

The electrical signal output obtained from bridge is typically in the order of a few millivolts and requires amplification by an instrumentation amplifier.

So we use Op-Amp for amplification purpose which is called Instrumentation Amplifier.

The gauges themselves are bonded onto a beam or structural member that deforms when weight is applied. In most cases, four strain gauges are used to obtain maximum sensitivity and temperature compensation.

Two of the gauges are usually in tension can be represented as T1 and T2,and two in compression can be represented as C1 and C2, and are wired with compensation adjustments. The strain gauge load cell is fundamentally a spring optimized for strain measurement. Gauges are mounted in areas that exhibit strain in compression or tension. When the weight is applied to the load cell, gauges C1 and C2 compress decreasing their resistances.

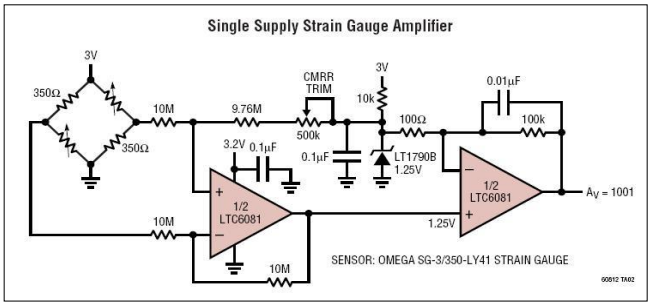

Fig 3

Simultaneously, gauges T1 and T2 are stretched increasing their resistances. The change in resistances causes more current to flow through C1 and C2 and less current to flow through T1 and T2. Thus a potential difference is felt between the outputs or signal leads of the load cell. The gauges are mounted in a differential bridge to enhance measurement accuracy.

When the weight is applied, the strain changes the electrical resistance of the gauges in proportion to the load. Other load cells are fading into obscurity, as strain gauge load cells continue to increase their accuracy and lower their unit costs.

Analog to digital conversion

Since we are using a microcontroller for controlling the overloading, we require a digital input. Sensor or Transducer output goes to the Amplifier which give analog output**.**

So this amplified analog output have to be converted in to digital with the help of Analog to Digital Convertor.

In electronics, an analog-to-digital converter (adc, a/d, or a-to-d) is a system that converts an analog signal, such as a sound picked up by a microphone or light entering a digital camera, into a digital signal.

An ADC may also provide an isolated measurement such as an electronic device that converts an input analog voltage or current to a digital number representing the magnitude of the voltage or current. Typically the digital output is a two's

complement binary number that is proportional to the input, but there are other possibilities.
There are several ADC architectures. Due to the complexity and the need for precisely matched components, all but the most specialized ADCs are implemented as integrated circuits (ICs).
Here weight is excess then we take a high resolution ADC near about 24 bit.
A digital-to-analog converter (DAC) performs the reverse function; it converts a digital signal into an analog signal.
This digital Signal act as a Hexa decimal number for Microcontroller.

Microcontroller
Microcontroller is a semiconductor device fabricated on a single chip which is used for controlling operation and consists of various devices like processor RAM, ROM, ports etc**.**
When we provide digital signal input to the Controller then according to the Program Stored it give the excitation signal**.**

Driver (LM293D)
Since the output current of Microcontroller is very less. So we require to make it large so that it drive the external circuits. L293D is a dual motor H-bridge driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors.
L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively.
Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their inputs. Similarly, when the enable input is low, that driver is disabled, and their outputs are off and in the high-impedance state.

Relays
Relay is a electromechanical switch that is controlled by other switch such as a computer as a power train control module. Relays allow a minute current flow circuit to control a high current. Basically now-a-days the relays are use 3-pin, 4-pin,5-pin,6-pinor dual switches.

Methodology
Overloading intimation circuit
In this, we are providing a load cell its upper portion is attached with the direct vehicle weight.
We use Half Stain Bridge Circuit on 4 Tyres.
Let after transduction circuit they give x,y,z,w volt respectively under normal load. Now if load increases on any tyre then either any one of them x,y,z,w increases. As a result its Corresponding Hexa decimal value also increases.
The analog output is supplied to the ADCs converter which convert the analog signal to digital signal. The converted signal supply to the controller which control the signal (Voltage).
Controller observe the increased hexadecimal value and compare it with standard load equivalent hexadecimal. If it is large then it give a High Pulse which goes to the driver IC.
At the same time GPS chip get initiated and give the location to the controller in digital format.
The driver IC give desired current to Relay & Relay get Trip from & disconnect the Supply from Battery to Engine.
At the same time this GPS information transmitted by Zigbee Module or RF Transmitter to nearest Check Post.

Conclusions
Overloading prevention system is a useful tool to contribute towards more compliance with mass regulation. It could help to reduce the number of overloaded trucks, and contributed to the more efficient and effective. A reduction in overloaded trucks is also conducive to a reduction in crashes. There are still issues and challenges for this technology and application which require more research and development work. New applications of these systems are expected, both for traffic and heavy vehicle regulation enforcement.

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