International Journal on Emerging Technologies (Special Issue on NCRIET-2015) **6**(2): 224-228(2015)

ISSN No. (Print) : 0975-8364
ISSN No. (Online) : 2249-3255

Analysis of Overloading Prevention System in Trucks

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(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: 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 technologies 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.

Keywords: Weight, Transistor, electric motor. Relays, sensors, resistors etc.

I. INTRODUCTION

This project is prepared purely for the purpose of prevention of damage of roads and prevent unauthorized, unlicensed driving. Roads now-a-days play a very important role in every part of world. We have many more advantages with these roads like it directs the way for communicating other places, time is consumed for reaching from one place to another place etc[1]. Roads and streets are the most important transport communication medium in the country and are used by almost everyone on a daily basis. Besides the fact that 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 population. By means of roads, people have access to markets, places of work, clinics and hospitals, educational institutions, places for sport and leisure activities and vacations [2].

It has been found that legally loaded heavy 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].The fines currently imposed by the courts on those 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 [4].

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. [5] Overloading is a safety hazard that leads to unnecessary loss of life, and also the rapid deterioration of our roads, resulting in increased maintenance and transportation costs.

B. Overloading A Vehicle Will Pose The Following Risks

-The vehicle will be less stable, difficult to steer and take longer to stop. Vehicles react differently when the maximum weights which they are designed to carry are exceeded.

-Overloaded vehicles can cause the tyres to overheat and 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 is diminished, escalating the chances for an accident.

-The overloaded vehicle cannot 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 have to work harder due to 'the riding of brakes' and because the vehicle is heavier due to overloading. Brakes overheat and lose their effectiveness 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[6].

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

Objective of the Project

The main aim of this project is to make the system on the vehicle by which it will stop the overloading on vehicles automatically so that overloaded vehicle damaging the roads is reduced or avoided, and accidents avoided.

Salient Features

-Four wheel vehicle with drive mechanism being powered by DC motor without steering mechanism.

-Overloading on the trolley of the vehicle will trigger the micro-switch to indicate the overloading on the dash board and also trigger the buzzer so that he driver can control the overloading during loading itself.

-The enforcing authority vehicle or the check post or the police station is having the radio frequency transmitter which is received by the overloaded vehicle when it passes near by the enforcing authority which triggers the control circuit to put on the siren within the vehicle.

II. WORKING PRINCIPLE

In this we are making a four wheel vehicle being moved by the DC motor drive through chain sprocket with trolley and cabin, load carrying trolley which is having coil spring cushioning and the cushioning is set for the particular load and if overloaded, will activate the micro-switch to trigger the control circuit to indicate the small light on the dash board and sound a buzzer so that the driver come to know the overloading, so that the overloading is controlled. If the driver tends to move the vehicle with overload, the buzzer sounds continuously which is heard by the driver only. When the vehicle is moving on road and when it comes across the police station or outpost, it is sensed by the vehicle through radio remote frequency receiver circuit within the vehicle (radio remote frequency are continuously transmitted by the check post or police station or police vehicles of the same frequencies) which is received and the control circuit will trigger the siren on, drawing the attention of the police enforcer or authorities to stop the vehicle and penalize and force to unload the extra load. The vehicle is moved by DC motor to show the demonstration.

A. Main Parts of Vehicle

Components	**Specifications**	**Nos.**	Price
1.Chassis frame	Mild steel	1 set	1000Rs
2.Front axle	C30 steel	2Nos.	800Rs
3.Rear axle	C30 steel	1 set	800Rs
4. 15mm diameter ball bearing houses	Mild steel	4 Nos.	1400Rs
5. 15mm diameter Ball-bearings	Mild steel	4 Nos.	600Rs
6. Wheel holding plates	Mild steel	4 Nos.	500Rs
7. Wheels	Plastic	4 Nos.	500Rs
8. Motor holder	Mild steel	1 set	300Rs
9. Drive motor	12V,DC,3amps, 32rmp	1 set	600Rs
10. Sprockets	C30 steel	2 set	200Rs

Components	**Specifications**	**Nos.**	Price
11.Sprocket bush for motor	Mild steel	1 set	500Rs
12. Sprocket bush for axle	Mild steel	1set	300Rs
13. Vertical tray supports	Mild steel	4 set	600Rs
14. Tray fixing base	Mild base	4 Nos.	300Rs
15. Rear extensions	Mild steel	2 set	200Rs
16. Cabin front holder	Mild steel	2 set	400Rs
17. Cabin rear holders	Mild steel	2 set	300Rs
18. Rear assembly holder	Mild steel	1 set	300Rs
19.Transformer holder	Mild steel	1 set	300Rs
20.Transformer with mains cord & diodes	Electrical item	1 set	300Rs
21. Battery holder	Mild steel	1 set	300Rs
22. Batteries	6V DC,4.5 AH	2 Nos.	600Rs
23. Circuit & switch holder	Mild steel	1 set	200Rs
24. Limit switch holder	Mild steel	1 set	300Rs
25. Cabin	Zinc steel sheet	1 set	700Rs
26. Tray	Zinc steel sheet	1 set	700Rs
27. Springs	Spring steel	4 Nos.	300Rs
28. Control circuit for activation	Electronic parts	1 set	1500Rs
29. Radio frequency transmitter and receiver	Electronic parts	1 set	1000Rs
30. Labour charges			1000Rs

B. Manufacturing Process Of Various Parts

Chassis frame: This is made out of mild steel angel being cut from the size of 2m x 25mm x 5mm of length 350mm- 1nos, 280mm-1nos, 495mm-2nos. All are hammered for flattening and then ground to remove the cutting burr and then joined by arc welding to make the chassis frame as per the sketch on which other assemblies are welded.

Front axle:-This is made out of C30 steel round bar being cut from the diameter of 20mm of length 70mm and then turned on lathe machine to make the diameter as 15mm to suit the ball bearing inner diameter for the entire length and then step turned at one end to make the diameter as 12mm for 4mm length to suit the wheel holding plate hole diameter and faced from the other side to make the total length as 69mm. such two number of axles are made for this project

Battery holder:-This is made out of mild steel flat being cut from the size of 12mm x 3mm of length 340mm---1nos, 200mm---1nos and then flattened by hammering and then 340mm is bent to make the rectangle of outside size 100mm x 70mm and joined by arc welding and second flat is bent to U shape with 50mm legs and is joined to this rectangle frame to make the box to hold the battery as per the requirement

Circuit and switch holder:-This is made out of mild steel flat being cut from the size of 12mm x 3mm of length 150mm and then flattened by hammering and marked for the holes at the different distance as required to drill 4mm diameter holes and then ground to remove the cutting and drilling burr and this is welded on the chassis frame.

Limit switch holder:-This is made out of mild steel flat being cut from the size 20mm x 3mm of length 190mm---1nos, 90mm---1nos. both are hammered for straightening and then 90mm flat is marked for the limit switch fixing holes at the distance of 10mm from one side and 25mm from first hole to drill 4mm diameter holes and then this is welded in right angle to the 190mm length flat as per the sketch and then welded on the chassis frame .

Springs: These are the standard compression springs used of required lengths. Such four number of compression springs which are made out of spring steel are used in this project. … Etc, like this we have to manufacture different components required for us.

C. Manufacturing details of various electrical parts.

MOTORS: There are variety of types of motors used in robots, they include dc servomotors, stepper motors and ac servomotors among these motors we have used dc servomotors. The main components of dc servomotors are rotor and the stator.

Fig. 1. Final project after assembling all the manufactured parts .

There are a variety of motors used in the modern robots, they include DC motors, DC screw-motors stepper motors and AC screw-motors. These motors find a variety of applications in various robots, field of application as per the design and consideration of the person who uses them. In the model we have used the DC motors. The main components of the motor are the "rotors" and the "stators". Usually the rotors include the armature and the commutator assembly and the stator includes the permanent magnet and the bushes assembly. The current is made to flow through the windings of the armature; it sets up a magnetic field opposing the field set up by the magnets. This produces a torque on the rotor. This causes the rotor to rotate.

D.C. Motor principles: DC motors consist of rotor-mounted windings (armature) and stationary windings (field poles). In all DC motors, current must be conducted to the armature windings by passing current through carbon brushes that slide over a set of copper surfaces called a commutator, which is mounted on the rotor. The commutator bars are soldered to armature coils. The brush/commutator combination makes a sliding switch that energizes particular portions of the armature, based on the position of the rotor.

Specifications:-

Ratings:

System voltage: 12 V

Operating temperature: 20°C to +90°C

Characteristics: Typical light running current: 3.8 Amps

Rated torque at output gear: 18 to 25 Nm at 12V

Operating speed: 32 rpm.

BATTERIES:

Voltage: 6 V

Current: 3.8 Amps

The motor is a geared dc motor with the main spindle working at 200rpm mounted with the worm gear driving a worm wheel reducing the speed to 32rpm and also changing the direction.

The worm wheel is mounted with the axle which is rotating driving the main axle.

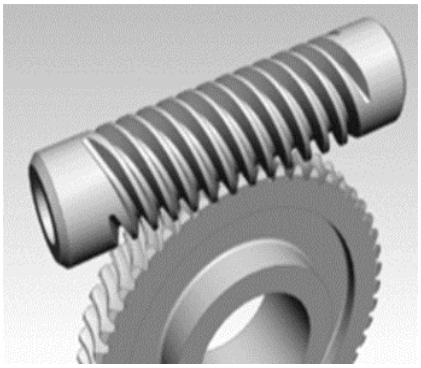

Fig. 2. Worm wheel connected to 12V DC motor.

SENSORS:-Sensors are important components in work-cell control and in safety monitoring systems.

Tactile sensors:-These are the sensors, which respond to contact forces with another object. Some of these devices are capable of measuring the level of force involved.

Like this different electrical components we use

RADIO FREQUENCY: Frequency is the rate at which the cycle of a periodic disturbance repeats. The fundamental unit frequency is Hertz equivalent to one cycle per second. Wave disturbances in the EM spectrum can have frequencies ranging from less than 1 Hertz to trillions of Tera Hertz. The audio frequency (AF) range, at which the human ear can detect acoustic energy, ranges from about 20 Hz to 20 KHz. The radio spectrum, or radio frequency (RF) range, extends from a few KHz up to many GHz.

Since it is having following advantages, it is widely used

- Grater gains, i.e., better sensitivity.
- Improved image-frequency rejection.
- Improved signal-to-noise ratio.
- Better selectivity.
- Better coupling of receiver to antenna.

III. METHODOLOGY

A. Overloading intimation circuit

In this we are providing the micro-switch below the material holding tray or trolley which is held on springs on the chassis. The trolley holds the material properly for the particular weight material and if in excess will close the micro-switch which gives the high state input voltage to IC, UM-606 pin number 7 to give the inverted output at pin number 6 which triggers the transistor BC547 to connect the relay to give the LED glowing and putting on the buzzer and also putting on the radio remote receiver circuit.

B. Circuit for putting on the siren when enforcing authorities appear

There is a transmitter being provided at the enforcing authorities, whether at vehicle or police station, which will be transmitting radio frequency signals all around.

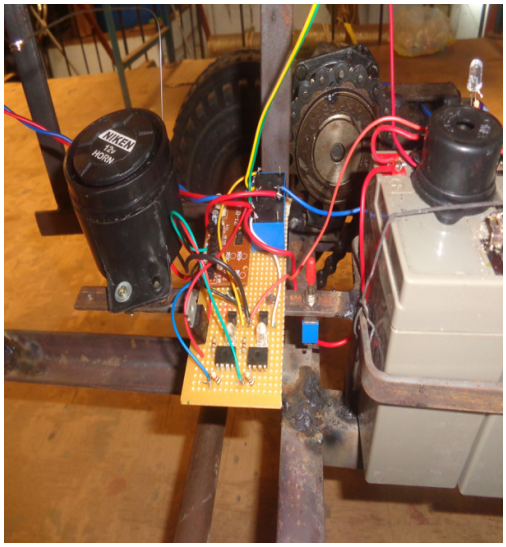

Fig. 3. Circuits used to detect overloading.

When the overloaded vehicle is moving in the vicinity, the overloading circuit which has already put the receiver circuit on, will receive the 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 received signals being received by the receiver circuit which is brought from the market, which triggers the transistor S-1904 two numbers one is NPN and another transistor S-1904 is of PNP, to connect the relay to put on the siren and also if siren is put off, will put off the drive motor. We are using 40Mhz frequency in this project.

IV. 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 use of police officers' time. A reduction in overloaded trucks is also conducive to a reduction in crashes. There are still issues and challenges for thistechnology 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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