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The Invention of an Automatically Engaging and Disengaging Parking Brake System with Load Cell Sensors

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ABSTRACT:

This research work is related to automobiles which are used to apply/release parking brakes of the vehicle when driver leaves/takes the seat. We use load cell to sense that there is somebody on the driving seat or the seat is empty. A load cell is a kind of transducer which is used to change mechanical force into a measurable electrical output, anything which needs to be weighed probably uses a load cell to do so. The Hand brake lever is coupled with rack and pinion setup (for vehicles with electronic parking brake system there will be no hand brake lever). A motor is also coupled with this rack and pinion setup to apply and release the hand brake automatically when it gets the signal to do so. The motor is driven by the control unit (Micro controller/Arduino) using load cell sensors. Sensors give a signal to control unit whether the seat is empty or there is someone sitting on the driver seat. The whole system is programmed in such a manner that when the set amount of force applied to the load cell decreases (i.e. driver leaving his seat), the electrical signal changes proportionally which will actuate the motor coupled with the brake system to apply/release the parking brake.

Keywords: Load Cell Sensors, Automatically Engaging Parking Brakes.

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1. Introduction

In vehicles with rear disc brake parking brake either actuates the disc calipers or a small drum brake housed within the hub assembly [1-5]. Parking brake can also be used as an emergency stop in case the main hydraulic brakes fail that is the reason why it is also called emergency brake. Parking brake system has a ratchet locking mechanism that will keep them engaged until a release button is pressed. Apart from normal lever type parking brake system there are also electronic parking brakes that work on the same basis but instead of a lever you have to press or pull the button and the motors on the rear brakes will press the pads onto the discs [6-8]. However, these both systems require human interaction to work as either you have to pull the lever or press the switch to apply parking brakes in both the system.

Manual stick lever type parking brake system can only be applied manually by someone pushing or pulling the parking brake lever. In many cases people forget to apply parking brakes causing dangerous incidents. This problem has been taken care as parking brakes will be applied automatically with our invention.

Electronic or push-button type parking brake system still needs a human interaction as you still have to push a button or switch to apply brakes. For this no human interaction needed with our invention. Parking brakes will get engaged as soon as the driver leaves his/her seat.

In Automatic hand brake system, disengagement is done when gear is changed from neutral, this method of parking brake disengagement can be a safety concern if vehicle is parked on a tilted surface or slope. Or there can be cases when the vehicle is already parked in a gear other than neutral. In our invention we have used tilt sensor to detect whether the vehicle has been parked on a slope or not. If yes then it will prevent the automatic disengagement of the parking brakes so you can manually disengage them when needed [9-10].

The traditional hand-braking system is very simple, you apply the hand brakes by pulling the hand brake lever up which pulls two cables. E- Parking brakes replaced this mechanical system with an electrical one. In which by pressing the switch, motors on each brake caliper squeeze the pads onto the disc [11]. Thus, we can see that both manually operated and electrically operated parking brake systems require human interaction. What we are trying to do in our invention is to make hand brake mechanism automatically work when the driver leaves the driver seat. The objective behind this is many times people forget to apply the parking brake while leaving their vehicle which can lead to serious accidents. So, our invention will make this system more convenient as well as it will help the vehicle and road safety concerns.

Traditional parking brake systems in vehicles are manually operated or require at least some kind of human interaction to work like pushing or pressing buttons in electronic parking brake system. Which lead to serious safety concerns because sometimes people do not apply or forget to apply the parking brakes of their vehicle while leaving. in this invention a new way to apply parking brakes of a vehicle is used. In this art there will be load cell/sensors attached to the driver seat of the vehicle which will detect the presence of the driver on the driver seat as he/she takes or leaves the seat [12-13]. The load cell sensors will be coupled with a control unit (Arduino/micro-controller) which will be programmed to receive signals from the load cells and on the basis of these signals it will be controlling the high torque motor coupled with a rack and pinion setup. This rack and pinion setup will be directly

coupled with the hand brake lever mechanism. So as soon as the sensors give signal to the control unit, it will actuate the motor coupled with rack and pinion setup which will result in pulling up the hand brake lever which will further result in application of the parking brakes of the vehicle. A ratchet and pawl mechanism is used to hold the hand brake lever to its position.

In the vehicle with electronic parking brake system we will directly use our control unit to control the motors on the brake calipers of the rear wheels, which presses the brake pads onto the brake discs after getting signals. And parking brakes will be disengaged automatically in case of electronic parking brake system as the driver presses the clutch or accelerate the vehicle.

And for the disengagement of the parking brakes, when the driver will take his/her seat the load cells will detect the weight value and give signal to the control unit and it will actuate the motor to run in reverse order to disengage the parking brakes. But we have also used a tilt sensor which will detect whether or not vehicle has been parked on a tilted surface. So, it will prevent the automatic disengagement of the parking brakes when vehicle has been parked on a slope and the driver takes the driver seat because it produces safety concerns if vehicle is on a slope and brakes get disengaged automatically. So, in that case you can manually disengage the parking brakes when needed.

2. Working

The idea can be used in automobiles to make the parking brake system automatically work without any human interaction. The traditional systems still require human interaction to activate them. So, this invention can be very helpful to make the vehicles more convenient to use and much safer as it can deal with the carelessness of the driver also. In coming years, this idea may be developed more by addition of few of the supplementary parameters and also this system can be used in all types of vehicles at low cost as it has a simple, effective and easy mechanism.

The parking brake systems which are currently used, all require a human interaction (i.e. are needed to activated or applied by humans in any way like pulling a lever or pressing buttons or switches). But our invention will make this operation automatic by engaging or disengaging the parking brakes when the driver takes or leaves the driver seat, by this we can make our vehicles a little more convenient and safer to use. As you do not have to worry about whether you applied the parking brakes or not while leaving your vehicle or in case you really forgot to apply the parking brakes.

2.1 components

Parking braking system is one of the most vital part of any automobile. traditionally the hand brake is operated manually (either by a hand lever or an electronic switch), But with our idea we are developing parking brakes that will be applied/released automatically when the driver leaves the driver seat of the vehicle without the need of any human interaction. The engagement/disengagement of parking brakes is done with the help of load cells and a simple rack & pinion mechanism coupled with a motor.

Main components of this invention are:

- Load cell sensors
- Control unit
- DC motor
- Rack and pinion setup

- Locking setup
- Inclination or tilt sensor/inclinometer

2.2 Load cell sensors: A load cell converts mechanical signals into electrical signals proportionally.

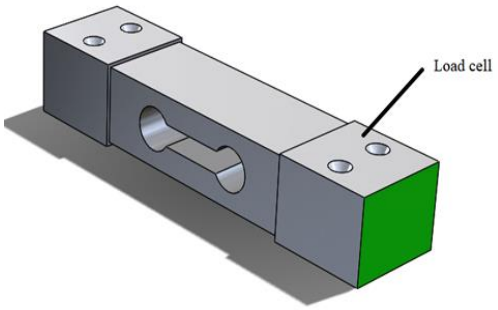

Figure1. Placement of load cells

In our invention we will use these load cell sensors to detect whether the driver has left the driver seat or not. To do so we will be attaching the load cell sensors within the driver seat and with the mountings of the seat so as we can get proper signals of changing weight. So, the load cell sensors are the main and the first component that will actuate the operation of our invention.

2.3 Control unit: A micro-controller or also known as embedded controller is a solitary chip microcomputer used to control the functions various embedded systems in robots, motors, vehicles. Arduino boards are micro-controller development boards which consist of micro-controller as a part of it along with USB ports and GPIO pins etc. We are using micro-controller or Arduino as control unit in our invention to control the DC motor coupled with our parking brake system. As it will be programmed to receive signals from the load cell sensors connected to the driver seat. As the driver will leave his/her seat the control unit will read the change in readings of the load cell sensors and it will actuate the motor to start working. The Arduino/micro-controller will be programmed in such a way that when the weight reading will decrease up to a fixed limit (i.e. equal to the weight acting when there is no one on the driver seat) only then it will actuate the motor coupled with our parking brake system to apply the parking brake.

2.4 DC Motor:

The hand brake lever is also coupled with this rack, so the linear motion of the rack will also pull up or down the hand brake lever. The motor will be controlled by a micro-controller which will be programmed to actuate the motor according to the signals received from the load cell sensors. The source of current is obtained from the 12v battery of the car.

2.5 Rack and pinion setup

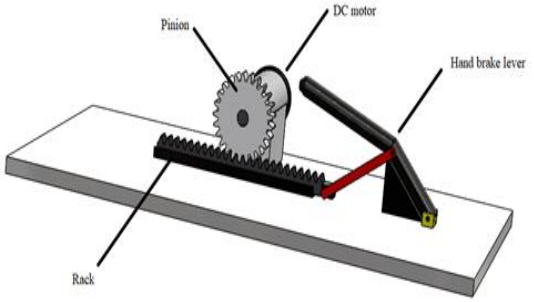

Figure2. Rack and pinion setup

Above is the just basic visual representation of how the rack and pinion setup will be controlling the hand brake lever. However, in electrical parking brake system we will directly use our control unit to control the motors that push pads onto the brake discs.

In our invention the hand brake lever is coupled with rack and pinion setup. A DC motor is also coupled with this setup. This motor is controlled/driven by the control unit (Micro controller) using load cell sensors. The Sensors give a signal to control unit when the there is no weight on the driver seat. Control unit then actuates the dc motor to start working and as it is coupled with the rack and pinion setup to which hand brake lever is also coupled it will result in pulling up the hand brake lever and which will result in the automatic and smooth application/release of the parking brakes.

2.6 Locking setup

In our invention we are using ratchet and pawl mechanism to lock the hand brake lever at its position when it gets applied. In this mechanism a pivoted curved bar or lever called pawl whose free end engages with the teeth of a ratchet so that the ratchet can only turn or move in one direction.

So, when the parking brake gets applied automatically with the help of this mechanism, we will lock the hand brake lever at its position and it will be kept applied.

When the automatic disengagement of the parking brakes will happen, a secondary motor will pull the pawl back and our main DC motor will be actuated to work in reverse direction when the load cells detects the driver taking his seat. So, this will lead to disengagement of the parking brakes automatically when the driver will sit on the seat.

2.7 Inclination or tilt sensor/inclinometer:

Inclinometers or also known as tilt sensors are the sensors designed to measure the angle of an object with respect to force of gravity. These sensors measure the pitch or roll angles and give output in the form of a electric signal.

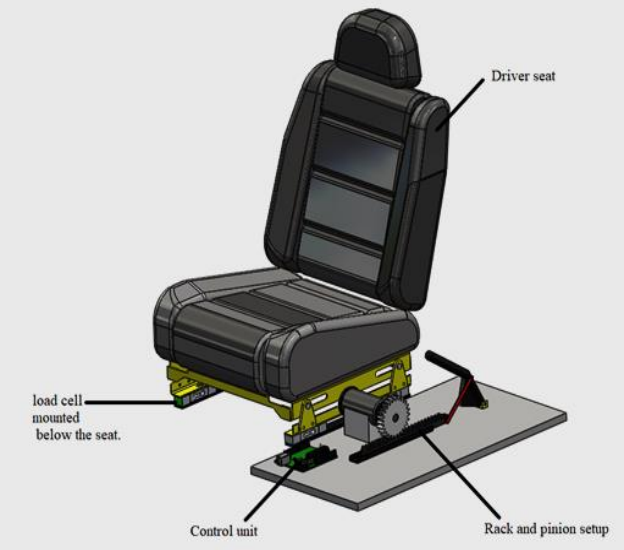

Figure3. Load cell and other mountings arrangement

In our invention we are using a tilt sensor to determine whether the vehicle is standing on a slope or not. If it detects that the vehicle has been parked on a slope then it will prevent the automatic disengagement of the parking brake because it can be dangerous in that situation to disengage the parking brakes automatically when the driver takes his seat. So, this feature will be able to solve the problem in present inventions related to automatic disengagement of parking brakes when vehicle is parked on a slope.

3. Conclusions

Hand brake is one of the most important components in vehicles. Traditionally the hand brake is operated manually (with a lever mechanism or electrically by a switch system) in our project, we are developing Automatic Hand Brake System for safety purpose. The hand brake engagement is done with the help of load sensors connected with the driver seat which when driver takes or leaves the seat, will signal the motor coupled with rack and pinion setup to apply or release the parking brakes. There is no need to driver to push any button or lever to engage the brake. We just leave the seat and handbrake will be applied automatically.

- So, our invention will helpful for both convenience and safety of the vehicles. It will solve the problem of people forgetting to apply the parking brakes of their vehicle while they leave their vehicle which is a serious safety concern.
- This system is simple and yet very effective, so it can be developed and provided at a very low cost. Also, its maintenance and repair will be a lot easier to do.
- This invention can make our vehicles more convenient to use.
- This invention can help in dealing with vehicle safety concerns.
- It is an automatic system so, no need to worry about whether you applied the parking brakes or not while leaving the vehicle.
- This invention is simple in working using simple methods and mechanisms thus giving a low-cost product.

4. References

1. Limpert R 1999 Brake Design and Safety 2nd ed. (Warrendale, Pa: Society of Automotive Engineers, Inc). 525.

2. Young Ok Lee Novel clamping force control for electric parking brake systems Mechatronics 21 (2011) 1156–1162
3. Wang N. Electric brake actuator. 2002. US patent app. 10/216,078.
4. Jung HM Development of electric parking brake system. In: Proceedings of the KSAE autumn conference, Deoksan, Korea; 2007.p. 962–7.
5. Hyun. Study on a dynamic braking algorithm for an electronic parking brake. In: Proceedings of the KSAE autumn conference, Deoksan, Korea; 2007. p. 950–5.
6. U.S. National Highway Traffic Safety Administration 2005 Light Vehicle Brake Systems FMVSS 135 (United State:National Highway Traffic Safety Administration)
7. L Xiaojing 2012 Braking performance study for automobile with numerical simulation. Applied Mechanics and Materials 155-156 1159-63
8. Tirovic M, et al. 2011 Structural analysis of a commercial vehicle disc brake caliper Journal of Automobile Engineering 226 613
9. Hwang P, X Wu, and Y B Jeon 2009 Thermal--mechanical coupled simulation of a solid brake disc in repeated braking cycles Journal of Engineering Tribology 223 1041
10. Koylu H , 2012 Experimental design of control strategy based on brake pressure changes on wet and slippery surfaces of rough road for variable damper setting during braking with activated anti-lock brake system Journal Automobile Engineering 226(10) 1303–24.
11. Zhang Z, J Chen, and BofuWu 2012 The control strategy of optimal brake energy recovery for a parallel hydraulic hybrid vehicle Journal of Automobile Engineering 226(11) 1445–53.
12. McKinlay A J, et al. 2004 The mystery of vehicle rollaway. in Braking 2004: Vehicle Braking and Chassis Control (Leeds, United Kingdoms: IMechE)
13. McKinlay A J, P C Brooks, and D C Barton. 2006 A Study of Vehicle Handbrake Rollaway: Thereotical, Numerical and Experimental Assessment. in Vehicle Braking Technology IMechE).
14. Dewetron Data Acquisition Instrument, http://www.dewetron.com, Retrieved 23 July 2013
15. Kukreja, V., & Sakshi. (2022). Machine learning models for mathematical symbol recognition: A stem to stern literature analysis. Multimedia Tools and Applications, 81(20), 28651-28687.
16. Kukreja, V., & Ahuja, S. (2021, September). Recognition and classification of mathematical expressions using machine learning and deep learning methods. In 2021 9th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions)(ICRITO) (pp. 1-5). IEEE.