

Design and Fabrication of Automatic Release of Handbrake After the Application of Seat Belt

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Abstract: *Hand brakes are one of the most important components in vehicles. In general, the hand brake is operated manually. In our project we are developing hand brakes when Seat belt is not acquired for safety purposes. Major causes of death in road accidents are carelessness in safety while driving. In 2012, more than half of all people who died on Utah's roadways weren't buckled. Hence wearing seat belts might have reduced serious crash related injuries and saved life. Hence "Driver Assistive Safety System" (DASS) comprises techniques which inculcate the mandatory safety precautions via ignition. This project describes a safety system which ensures that the driver and co-passenger wear a safety seat belt while driving a car. The driver assistive safety system works on 'Hand Brake Release' concept.*

Keywords: Braking System, Seat Belt, Hand Brake of Vehicle, etc.

I. INTRODUCTION

The most important part in the automobile is the handbrake which is also known as a latching brake. It is used generally when the automobile is parked, thus the alternative name that is parking brakes is used to keep the car stationary also called as automobile e-brakes. The most common use of a parking brake is to keep the vehicle motionless when it is parked. The main function of brake system is to decelerate the vehicle, to maintain vehicle speed during downhill operation and finally to park the vehicle stationary either on a flat or slope road condition. In cars the hand brake is a latching brake usually used to keep the car stationary.

Automobile e-brakes usually consist of a cable directly connected to a brake mechanism on one end and to some type of mechanism that can be actuated by the driver on the other end of mechanism is often a hand operated lever, on the floor on either side of the driver, a pull handle located below and near the steering wheel column, or a pedal located far apart from the other pedals. In road vehicles the parking brake also called as hand brake, emergency brake or e-brake is used to keep the vehicle stationary. In normal vehicles a hand brake consists of a cable connected to two-wheel brakes at one end and the other end to a pulling mechanism which is operated by human with hands. Seat belt implemented in cars to ensure driver's safety. The increase in loss of life in accidents due to driver's negligence to wear seat belt though it is strictly enforced by government rules. The aim of our project is to make seat belt wearing compulsory for vehicle movement.

The main purpose of this project is to ensure driver's safety through a modified handbrake in car. A handbrake is an additional braking mechanism installed on all commercial vehicles that's completely separate from foot pedal operated. In cars the parking brake, also called hand brake, usually used to keep the vehicle stationary. Most commonly used to prevent the vehicle from rolling when it is parked. Automobile handbrakes consist of a cable directly connected to the brake mechanism on one end and to a lever at the driver's position. Using your handbrake to stop a moving car can damage the brake system. In this project we have designed the mechanism which is used to operate hand brake using seat belt assist. While removing the hand brake this mechanism or system ensures that seat belt is plugged in by the driver. As the driver acquires seat belt the hand brake gets free and can be removed.

II. LITERATURE REVIEW

Prof. Hemal Patel, Chauhan Abhijeetsinh, Badreshiya Deepak, Patel Harsh:

In this research paper they say, A major causes of death in road accidents are carelessness in safety while driving. In 2012, more than half of all people who died on Utah's roadways weren't buckled. Hence wearing seat belts might have reduced serious crash related injuries and saved life. Hence "Driver Assistive Safety System" (DASS) comprises of techniques which inculcate the mandatory safety precautions via alarm, visual indicator, ignition and speed control. This paper describes safety system which ensures that the driver and co-passenger wear safety seat belt while driving a car. The driver assistive safety system works on 'ignition interlocking' and "speed control" concept.

By viewing and studying all the things we have concluded that for safety of the people seat belt is mandatory but some circumstances make it optional. Seat belts are by far the most important safety feature of your car. No matter what speed you are going, or how far you will be travelling it is extremely important to always have your seat belt on. If you are wearing a seat belt at the time of a crash, your risk of being killed is reduced. Seat belts protect the driver against injury in a collision. They lessen the chance that you or your passengers will be thrown against the dashboard, through the windshield, or out a door that has sprung open in a crash. In addition, seat belts help keep you behind the wheel and in control of the car if you have to swerve, brake abruptly, or are struck by another vehicle.

Thorat Ajit, Kokane Sujit, Kokane Tushar, Jadhav Nilesh, Temgire Sanket:

In this research paper they say, hand brake is one of the most important components in vehicles. In general, the hand brake is operated manually. In our paper we are developing pneumatic operated automatic hand brake when ignition is off for safety purpose. The engagement of hand brake using actuator, controller, motor, battery. Automobiles e-brakes usually consist of a cable directly connected to a brake mechanism on one end and to some type of mechanism that can be actuated by the driver on the other end of mechanism is often a hand operated lever, on the floor on either side of the driver, a pull handle located below and near the steering wheel column, or a pedal located far apart from the other pedals. The automatic parking brake system can be easily implemented in all four-wheeler without any appreciable changes in the existing system of manually operated brakes. The operation of the system is very simple and can be successfully implemented in existing braking systems.

Akash D. Singh, Siddhesh P. Rahate, Amit V. Pawaskar, Ravindra K. Ambekar:

Research paper say, as we know human life are gets busier and more complicated due to their work and development. So, in today's advance technology maximum inventions or research is done to reduce human effort and for providing comfortable life to them. We know in today's vehicles a normal steering system is replace by power steering system for reducing some human effort and providing comfortable ride as compare to normal system. In this paper we are discuss how to reduce a human effort which is required to apply the hand brake while parking of vehicle. In road vehicles the parking brake also called as hand brake, emergency brake or e- brake is used to keep the vehicle stationary.

In normal vehicles a hand brake is consist of a cable connected to two-wheel brakes at one end and the other end to a pulling mechanism which is operated by human with hands. In this case human effort is required to pull the mechanism and apply the brakes. To minimize this human effort is the main aim of our project with help of hydraulic system. In some cases, people are forgetting to apply hand brakes while parking the vehicle which results in moving the vehicle and causes accidents. To avoid this, we develop such system in which hand brakes are control with ignition system of vehicle. Means a hand brake mechanism and ignition system of vehicle is connected each other with simple hydraulic system for applying the hand brake while parking. Developing automatic hand brake system is the most effective solution for reducing human effort which is required for applying manual hand brake. This system can provide highly parking safety and braking effect. It provides quick braking and also simple in operation. It can be developed to use in case of failure of main braking system of the vehicle.

Naveen Kumar, Lokesh Raj, Ramerow Jacob, Santhosh, Ravi Prasad P.S.:

This research paper says that, Seat belt is implemented in car to ensure drivers safety. The increase in number of losses of life in accidents is due to driver's negligence to wear seat belt though it is strictly enforced by law. The aim of our paper is to make seat belt wearing compulsory for vehicle propulsion. We can achieve it by using pneumatic setup along with handbrake. The modification to be done ensures that the driver wears seat belt during driving. Here the seat belt of the car activates the hand brake (parking brake) through a pneumatic cylinder. When the seat belt activates the push button type DC valve an outward stroke is been obtained in the pneumatic cylinder through an air compressor which is used to release the hand brake.

Similarly, during the retracing stroke of the piston, the hand brake is been engaged. Automobile hand brakes consist of a cable directly connected to the brake mechanism on one end and to a lever at the driver's position. Using your handbrake to stop a moving car can damage the brake system. Pneumatics is a section of technology that deals with the study and application of pressurized gas to produce mechanical motion. Pneumatic systems that are used extensively in industry and factories are commonly plumbed with compressed air or compressed inert gases. From our concept we ensure that driver compulsorily wears seat belt while driving. If he tries to run without wearing the seat belt the handbrakes could not be disengaged. By this driver's safety is ensured.

Salvekar Mandar, Sambherao Shivaji, Patil Vishal, Pimpaliskar Shubham:

Research paper say that, according to a survey of leading car manufacturer of India, 75 percent vehicle users in India do not wear seat belt causing 15 deaths and numerous injured every day. Not wearing seat belt causes jeopardize of safety of passengers in vehicle. Passive safety which consists airbags and seat belt has a active role in protecting the safety of a car. With a pneumatic circuit connected to modified handbrake or parking brake, seat belt wearing will be made compulsory for a driver to drive a vehicle and with the help of sensors, co-driver or passenger wearing seatbelt will be made compulsory.

Hence Safety of passengers in car is achieved which satisfies main aim of project that is to assure safety. The main purpose of this project is to ensure drivers safety through a modified handbrake in car. A handbrake is an additional braking mechanism installed on all commercial vehicles that's completely separate from foot pedal -operated. In cars the parking brake, also called hand brake, usually used to keep the vehicle stationary. Most commonly used to prevent the vehicle from rolling when it is parked. Locking sensor or generally buzzer to stop sounding alert of seatbelt not wore on the dashboard of vehicle.

Rohit Khubalkar, Saurav Kumar, Kishen Jadhav, Vaibhav Regundawar, Aniket Phatangare :

One of the most important safety features in an automobile is brake. A typical automobile consists of two types of brakes, one for retarding the speed of vehicle while it is in motion and other is to hold the vehicle in its place when standing still or parked. The latter is mostly important when the vehicle is parked on slope. It is important to disengage the handbrake before starting the vehicle from rest position. Due to operator errors the conventional handbrake system remained engaged even when the vehicle was moving due to manual operation of the hand lever through which the handbrake is operated. This led the brakes to become ineffective and eventually they failed to serve their purpose. To overcome all the limitation of the conventional system we proposed the new automatic handbrake engagement and release system.

Study takes into account several safety issues and permutations with the hand brake which are listed below as problem statements. The objective of the project is to develop a smart handbrake system that resolve all safety issue and also assist the driver while climbing steep slopes in dense traffic. Study work include the brake effort calculation for given condition of operation design of all components using theoretical method for strength, 3D modeling of components and assembly. The fabrication of the unit is done using suitable process and test carried out on the unit to prove that the above said four features work in the model.

III. IMPLEMENTATION

In road vehicles, the parking brake, also known as a hand brake or emergency brake (e-brake), is a mechanism used to keep the vehicle securely motionless when parked. Historically, it was also used to help perform an emergency stop should the main hydraulic brakes fail. Parking brakes often consist of a cable connected to two-wheel brakes, which is then connected to a pulling mechanism. In most vehicles, the parking brake operates only on the rear wheels, which have reduced traction while braking. The mechanism may be a hand-operated lever, a straight pull handle located near the steering column or a foot-operated pedal located with the other pedals.

The car handbrake is designed to bypass the hydraulic braking system in the event of a failure. When you apply the emergency brake, the metallic cable it is connected to passes through an intermediate lever, enhancing the power of the pulling. Then, comes an equalizer that splits that power evenly between the brakes.

In most vehicles, the disc or drum brakes have a connection to a mechanical lever. If it is the disc brake, the existing caliper piston is likely to have a connection to an additional lever and corkscrew. When you pull the brake on, the lever makes the corkscrew to force against the piston. If it is drum brakes, the metallic cable has a direct attachment to the lever on the brake shoes.

So, you know how handbrake works and its importance in the event of a hydraulic brake failure. But, don't apply it when the foot brake is still operational. It will disrupt the brake's balance and the vehicle may lose control.

In cars, the parking brake, also called hand brake, emergency brake, or e-brake, is a latching brake usually used to keep the vehicle stationary. It is sometimes also used to prevent a vehicle from rolling when the operator needs both feet to operate the clutch and throttle pedals. Automobile hand brakes usually consist of a cable directly connected to the brake mechanism on one end and to a lever or foot pedal at the driver's position. The mechanism is often a hand-operated lever, on the floor on either side of the driver, or a pull handle located below and near the steering wheel column, or a (foot-operated) pedal located far apart from the other pedals.

Although sometimes known as an emergency brake, using it in any emergency where the footbrake is still operational is likely to badly upset the brake balance of the car and vastly increase the likelihood of loss of control of the vehicle, for example by initiating a rear-wheel skid. Additionally, the stopping force provided by using the handbrake is small and would not significantly aid in stopping the vehicle. The parking brake operates mostly on the rear wheels, which have reduced traction while braking but, in some cases, parking brake operates on front wheel, as done in most Citroens manufactured since the end of World War II. The hand brake is instead intended for use in case of mechanical failure where the regular footbrake is inoperable or compromised. Modern brake systems are typically very reliable and equipped with dual-circuit hydraulics and low-brake-fluid sensor systems, meaning the handbrake are rarely used to stop a moving vehicle.

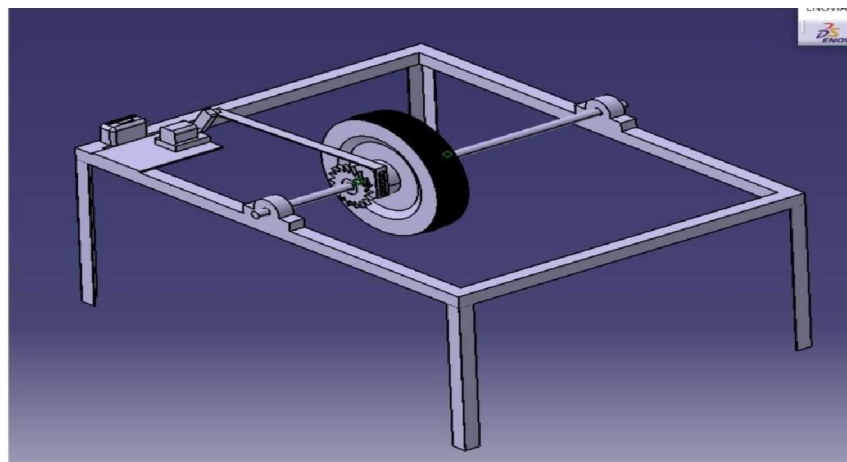


Figure 1: 3D CATIA Model for Seat Belt Assisted Hand Brake Lever

Conventional parking brake actuation involves the human interference. Without pulling or pushing the lever, the parking brake will not work. Also, sometimes due to negligence or in emergency conditions, we humans often forget to apply parking brakes. This may lead to rolling of vehicle in case of slopes and collision with other vehicles in parking area. Constant enhancements in active safety and improvements with respect to the reliability and comfort of operation mean that mechanical handbrakes are increasingly being replaced by electromechanical systems.

This gave birth to ideas of electric parking brake techniques. The fundamental function of the electric parking brake (EPB) is to activate and release the parking brake when the vehicle is at a standstill. In first generation of electric parking brake fitted, a switch on the instrument panel replaces the traditional handbrake lever used to operate the mechanical parking brake. This switch utilizes an electronic control unit (ECU) to trigger electromechanical actuators within the wheel brakes or central actuator that operates the rear wheel brake via a Bowden cable. Further, for reducing drivers' effort and reminding for application of parking brake, there was a demand for a completely automated parking brake system, which will be fulfilled by the upcoming ideas of mechatronic. This paper is based on the development of one such system, involving the concepts of automobile, mechanical and electronics, known as Electromechanical parking brake.

Hence, there is great demand for an electronic applied mechanism, with automation for actuation of the parking brake. It should also save space, reduce overall weight, complication in linkages, less mechanical parts prone to wear and tear, good responsive technique, high durability, very less or no involvement of human, easy to repair and economic. The EMPB system helps to enhance driving safety and comfort and provides greater freedom in interior design and packaging. EMPB eliminates the need for a parking brake lever or pedal and improves vehicle styling, space management and crashworthiness. The EMPB system is composed of one electromechanical actuator integrated into the disc brake caliper and a controller with redundant connections to the power supply, which is controlled inside the vehicle's cabin by a simple rocker switch. EPB is electronically controlled, and features can be designed easily through software giving an enhanced level of freedom for driver comfort and safety functionality.

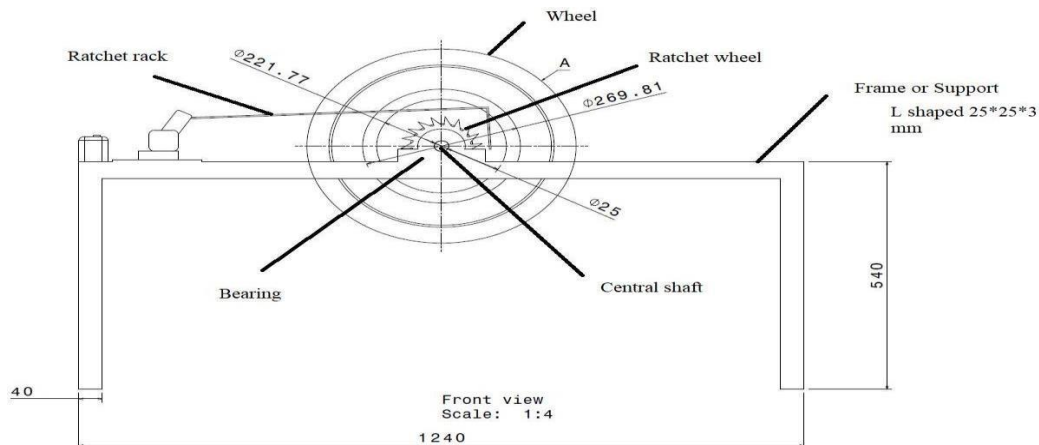


Figure 2: Construction of Seat Belt Assisted Hand Brake Release

It usually operates on the rear wheels; they suffer reduced traction compared to the front wheels while braking. The emergency brake is instead intended for use in case of mechanical failure where the regular footbrake is inoperable or compromised, hopefully with opportunity to apply the brake in a controlled manner to bring the vehicle to a safe, if gentle halt before seeking service assistance. Modern brake systems are typically very reliable and engineered with fail safe (e.g., dual-circuit hydraulics) and failure-warning (e.g., low brake fluid sensor) systems, meaning the handbrake is no longer often called on for its original purpose.



Figure 3: Fabricated Images in Workshop

The most common use for an automobile emergency brake is to keep the vehicle motionless when it is parked, thus the alternative name, parking brake. Car emergency brakes have a ratchet locking mechanism that will keep them engaged until a release button is pressed. On vehicles with automatic transmissions, this is usually used in concern with a parking pawl in the transmission. Automotive safety experts recommend the use of both systems to immobilize a parked car, and the use of both systems is required by law in some jurisdictions, yet many individuals use only the "Park" position on the automatic transmission and not the parking brake. It is similar to manual transmission cars: These are recommended always to be left with the handbrake engaged, in concert with their lowest gear (usually either first or reverse).

The use of both systems is also required by law in some jurisdictions. However, when parking on level ground, many people either only engage the handbrake (gear lever in neutral), or only select a gear (handbrake released). Some cars with automatic transmissions are fitted with automatically releasing parking brakes. Later models require the foot brake to be depressed before the car's transmission can be moved from park. When reverse or drive is selected, the parking brake automatically releases. Earlier models would release the parking brake when the gear selector was placed in a forward or reverse gear without requiring any input on the brake pedal at all. These earlier automatic release systems were a safety hazard, since there would be no protection against accidentally knocking the transmission into gear.

In cars with rear drum brakes, the parking brake cable usually actuates these drums mechanically with much less force than is available through the hydraulic system. In cars with rear disc brakes, the parking brake either actuates the disc calipers (again, with much less force) or a small drum brake housed within the hub assembly (the inner circumference of the disc is often used instead of a separate drum). Hudson automobiles used an unusual hybrid hydraulic-mechanical dual-brake system which operated the rear brakes through the otherwise conventional mechanical emergency-brake system when a failure of the hydraulic system allowed the pedal to travel beyond its normal limit.

A number of production vehicles, light and medium duty trucks, and motor homes have been made with a separate drum brake on the transmission output shaft; called a driveline parking brake. This has an advantage of being completely independent of other braking systems. This is effective as long as the drive train is intact propeller shaft, differential, and axle shafts. In many vehicles, this type of parking brake is operated by either a foot pedal or a hydraulic cylinder controlled by the transmission gear selector, or by both. The EMPB system is a semi-automated system in which motor rotates as per the signals from an ECU.

Considering engine ignition is on and vehicle is at rest, as soon as the engine is turned off, microcontroller senses this and sends actuating signal to motor relay. As the motor starts to rotate (Anticlockwise), the rotary speed of motor is reduced, hence torque is increased using gear trains and its output is supplied to lead screw which rotates in a nut, in turn converts rotary motion to linear motion, hence pushing the brake pad against the disc and parking brake is hence applied.

In other hand, when engine is started, the microcontroller senses this and actuates the motor to rotate in opposite direction (Clockwise), hence releasing the parking brake. The HOLD and release functions also works in an acceptable manner. It is seen that the average response time of the EMPB system is 600-700 Ms.

IV. CONCLUSION AND DISCUSSION

In this paper, we conclude that we have designed and developed our modal in CATIA v5 software. We also have successfully calculated the components required to construct our project ex: their failure and forces at certain point by assuming certain values. As per the availability in the market, we have purchased the components which are necessarily required to build our project. After many trials and experimental practice, we finally have assembled the prototype modal and checked whether it works as per the idea we have thought. By making some alterations and minute corrections, the model which we built is successfully running as per the requirement. In the near future, we will extend this work and create a more refined as well as advanced model which would also consist a few more updates and a function.

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