International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 03 | Mar 2019 www.irjet.net p-ISSN: 2395-0072

A Review on Safety Parking Brake Arrangement Actuated by Seatbelt

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Abstract - *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, codriver 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.*

Key Words*: *seat belt, hand brake, pneumatic setup, safety, sensors.

1. INTRODUCTION

Seat belt implemented in cars to ensure drivers 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 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. 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.

In our project the pneumatic cylinder itself holds the hand lever through a clamp welded over it so the release button is been disengaged from the hand brake. A clamp is being welded to the body of the handbrake to couple with the cylinder. A pneumatic circuit involving a simple reciprocating circuit is used. Colour sensor and buzzer is connected to a microcontroller to processing of inputs. Colour sensor is used to identify a colour patch provided on the seat belt of passenger so that he cannot wear seat belt from behind one's back (this is generally malpractice used to prevent seatbelt locking sensor or generally buzzer to stop sounding alert of seatbelt not wore on the dashboard of vehicle).

2. LITRATURE REVIEW

[1] Design of seatbelt activated handbrake system in cars, Ramerow Jacob, et.al., (2014): The main purpose of this paper is to ensure driver's safety through modified handbrake in a car. The increase in number of loss of life in accidents is due to driver's negligence to .wear seat belt though it is strictly enforced by law. 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. 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.

[2] Safety belt operated pneumatic handbrake, Ugale V.J., et.al., (2017): Hand brake is mechanism used to hold the vehicle motionless either on the even or gradient road. In order to confirm that vehicle remains stationary when it is a parked the handbrake should apply by driver. The changes to be done in handbrake mechanism and seat belt locking arrangements with the help of pneumatic cylinder. The change to be done to ensures that the driver wears the seatbelt while start to movement of the vehicle. If the driver don't use the seat belt the vehicle hand's brake does not get removed.

[3] Developing safety system for monitoring seat belt and controlling speed accordingly to avoid fatal injuries, Sheth Priyal, et al., (2015):

This paper describes safety system which ensures driver and co-passenger work safety while driving a car. In setup while driving a car Driver assistive safety system is used which comprises of techniques which indicate mandatory safety precautions via alarm, visual indicator, ignition and speed control. This DASS works on 'Ignition Interlocking' and 'speed control' concept. This system reduces the chance of major injuries hence to make sure people wear seat belt. In `highway made if driver unbuckle seat belt then alert will be display through screen and audio system. If driver not buckle seat belt during 60 seconds then speed of the vehicle will be control to 20km/hr. In city mode system limit the speed 20km/hr by controlling quality and quantity of fuel into engine.

[4] Seat Belt Safety Features Using Sensors to protect Occupant Bharadwaj S.D.Rahul, et al., (2014):These papers described about seat belt use and necessity. In case of accidental situations, passenger and drives lives can be saved mostly use of seat belt and airbags in the cars and automobiles. The purpose of designing seatbelt by using sensors and micro controller and locking mechanism. According to this papers, four load sensors are placed at the door to detect open and closed position of doors and speed sensors at wheel. If the speed of vehicle is above zero and seat belt is unlocked then wheel locked (wheel brakes) will be activated and vehicle movement will stop slowly.

[5] Ignition Inducing Seatbelt Using Relay and Microcontrolling Programming Structure for Automobiles, K.Arjun, et.al., (2017): Their innovation is done by placing heartbeat sensor in seat belt and heart beat sensor in seat belt and heart beat sensor is connected to micro controller and micro controller is connected to the ignition coil. When heartbeat sensor senses the heartbeat signal it is transmitted to micro controller which makes ignition coil to ignite and spark plug sparks and car starts. The driver before switching on the engine, he must be in position of contact with the seat belt, as it can detect the heartbeat of the fellow passenger and detect that it has been wears properly. At the time of malpractice, the sensor will be on its play and sends a signal to the micro-controller stating that it hasn't been wear properly, the driver will not be able to switch on the car i.e., engine.

[6] Optimisation of the composing part of hand brake mechanism, Ekinovic S. et.al., (2007): They done the project on Optimization of the composing part of handbrake mechanism. It can be concluded as follows:

a) A variant of construction solution can be obtained by previous making the 3D model, which is an optimal for both reasons - concerning the demands and the aspect of further testing procedure.

b) The produced and experimentally tested prototypes are a basis for further development of the product, with really possible fulfilling the all projected demands.

c) The methodology of development of the product, which consists of a combined use of numerical simulation and experimental testing, is reproducible for other similar products.

[7] Intelligent Control for Brake Systems William K. Lennon, et.al., (1999): They did the work on Intelligent Control for Brake Systems in his work done on There exist several problems in the control of brake systems including the development of control logic for antilock braking systems (ABS) and "base-braking." Here, they studied the base-braking control problem where we seek to develop a controller that can ensure that the braking torque commanded by the driver will be achieved. In particular, they developed two intelligent control system namely a "fuzzy model reference learning controller," a "genetic model reference" for base braking control system.

All the intelligent control techniques performed significantly better at tracking the reference input than the conventional lead-lag controller, especially when the specific torque increased.

[8] Automatic pneumatic bumper and break actuation before collision, Shrinivasa Chari, et.al., (2015): This project consists of IR transmitter and Receiver circuit, Control Unit, Pneumatic bumper system and pneumatic braking system. The IR sensor senses the obstacle. There is any obstacle closer to the vehicle (within 3-4 feet), the control signal is given to the bumper activation system and also pneumatic braking system simultaneously. The pneumatic bumper and braking system is used to product the man and vehicle. This bumper and braking activation system is only activated the vehicle speed above 30-40 km per hour. This vehicle speed is sensed by the proximity sensor and this signal is given to the control unit and pneumatic bumper and braking activation system.

[9] Automatic Engagement and Disengagement of Handbrake System Using Pneumatic system, Prof. D. L. Shinde, et.al., (2017): In this paper authors describes that hand brake 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. This system uses electro-pneumatically operated components using solenoid and pneumatic circuits. This system operates depending on the positions of the key. When the ignition switch is turned on the handbrake disengages and engages when the ignition is turned off.

[10] Safety belt buffering device and vehicle safety seat having the safety belt buffering device, Chin-Ming Cheng (2016): In this invention, safety belt buffering device is provided to reduce impact energy because of collision. In this invention, the device (buffering device) is applied to a shoulder type of seat belt. The buffering component consists of accommodating space and block component is situated inside buffering component. Shoulder belt passes through the accommodating space. According to invention, accommodating space includes two lateral walls facing opposite to each other and buffering component includes further two openings communicating with opposite sides of accommodating space.

Hence by this invention the passenger is protected during accident as it reduces impact energy transmitted to the passenger.

[11] Safety system for a vehicle to detect and warn of a potential collision, elimalech et.al., (2018): It is a system mounted in a vehicle in order to provide object detection in the vicinity of vehicle. The system has a camera connected to processor. The camera is located at rear and front of the vehicle. Other cameras are also present in the system. Driver assistance systems (DAS) typically include lane departure warning (LDW), Automatic High - beam Control (AHC), pedestrian recognition, forward collision warning (FCW) and pedestrian detection. Vehicle detection, pedestrian detection and traffic sign recognition algorithms may have a common structure. Obstacle detection may also be performed by using various structure from motion algorithms.

[12] Design and weight optimization of parking brake lever, M. V. Patel, et.al., (2017):

In this paper they have taken a hand brake lever model from maruti 800 car (euro II), according to various values obtained from finite elemental analysis on ANSYS software of the existing parking brake lever, it is seen that front part and end part is subjected to very low amount of stress. In deformation diagram, it is seen that deformation increases from lower end lever to the front end of lever. According to authors, it is observed that the stress and deformation values obtained from the finite element analysis by modifying the design of the lever has increased a bit but are within the yield limit of the material. The values of the equivalent stress and deformation of the optimized lever are slightly greater than the values of the existing lever, but are within the yield limit of the material.

[13] Automatic seat belt for passenger vehicle, R. Prakash, et.al., (2016): Seat belts also stretch slightly so our body doesn't stop abruptly, and they prevent us from colliding with a part of the car or another person. When a passenger sits on the seat, the pressure sensor is actuated followed by a 10 second delay to check whether the seatbelt is locked or not and whether the passenger is still sitting on the seat and then the signal is sent to the Arduino microcontroller after which there is a 5 second delay and then the motor is switched on in forward direction. The belt is carried by the curved ring gear and is locked to the buckle situated on the left hand side of the seat. An IR sensor is located near the lock which senses whether the belt is locked or not. If the belt is locked the sensor sends a signal to the microcontroller which is followed by a 5 second delay and then the microcontroller reverses the direction of rotation.

[14] Vehicle seatbelt having an integral airbag, Robert Cameron, (1990): It is actually a passenger restraint system for vehicles. A pouch containing an inflatable restraint bag is mounted to a seatbelt so that the pouch is positioned in front of a passanger when the belt is worn. There is an opening in the forward side of the pouch for permitting the bag to expand out of the pouch upon inflation. A flexible hose provides a conduit for supplying compressed air to the inflatable bag from a compressed air cylinder mounted to the vehicle body. A valve permits the air to flow from the cylinder through the hose to the bag in response to an impact received by the vehicle, so that the bag inflates and restrains the passenger against forward motion. The bag may be made of Kevlar™, or may be provided with Kevlar™ facings. The valve may be a lid positioned in the neck of the air bottle and held place by a pin and a hinge. The pin may be withdrawn by a solenoid actuated by a deceleration sensor so as to re lease the lid. Alternatively, an actuating member positioned in a bore may strike an end of the actuating member in response to the impact so as to move the actuating rod forward and out of the receptacle.

[15] Seatbelt Anchorage Locations Optimization to minimize Occupant Injury in Frontal Crash, K Vinnith Kumar Reddy, et.al., Altair Technology Conference, (2017): In this paper, authors have described optimising of anchorage of 3 point seatbelt system. Injuries are sensitive to the mounting locations of these 3 [points in the seat belt design in a case of impact. They created their model in MADYMO model buildup snd tested in Hyperstudy workflow, Meta model Buildup and did optimisation at the last. Their output showed chest injury improvement in optimised design. They rooted out human error in seatbelt design system.

3. COMPONENTS

It consists of following components;

1.1 Frame:

The frame is of MS material. The frame of our machine is basically used to support the all components of system.

1.2 Double acting cylinder:

Cylinders are linear actuators which convert fluid power into mechanical power. They are also known as jacks or rams. Hydraulic cylinders are used at high temperature and produce large forces and precise movement. For this reason, they are constructed of strong materials such as steel and designed to withstand large forces. Because gas is an expensive substance, it is dangerous to use pneumatic cylinders at high pressures so they are limited to about 10 bar pressures., Materials used for cylinders are lighter materials such as aluminum and brass. The basic theory for hydraulic and pneumatic cylinder is same. Parameters consider during the design of cylinder.

Fig-1: Double acting cylinder.

1.3 Pneumatic pipe fittings:

Pneumatic tubing is also available in a number of other materials both with and without reinforcement for use in standard applications. SMC fittings incorporate a positive tube seal while the fitting is under pressure which allows polyurethane tubing to be used. This can be used for connection of pneumatic system with assemble.

Fig-2: Pneumatic hoses and fittings.

1.4 Hand brake set:

Fig -3: Hand brake set.

1.5 Seat belt and lock clamp:

Fig -4: Seat and seat belt lock.

1.6 Solenoid type 5/2 dc valve

A valve is a device that regulates the flow of fluid (gases, liquids, fluidized solids or slurries) by opening and closing or partially obstructing passage ways. A 5/2 way directional valve from the name itself has 5 ports equally spaced and 2 flow positions. It can be use to isolate and simultaneously bypass a passage way for the fluid which for example should retract or extend a double acting cylinder. There is variety of ways to have this valve actuated. A solenoid valve is commonly used, a lever can be manually twist or pinch to actuate the valve.

1.7 Timer

The repeat cycle timer was developed to control solenoid valves or other components that require periodic energization. This simple control unit will periodically energize a solenoid valve to allow flow of a liquid or a gas for an adjustable period of time. The interval between energization of the valve is called the “dwell time” and is adjustable from 0.1 sec to 10 hours. The “energize time” of the solenoid valve is also adjustable from 0.1 sec to 10 hours.

Fig -5: Timer

1.8 Buzzer:

Buzzer is used in our system to indicate the off position or removal of seatbelt from lock.

4. WORKING

The inlet port of the 5/2 pneumatic Solenoid valve is been connected to the compressor, The 5/2 valve is been integrated within the seat belt locket in such a way that the seat belt end activates the push button, Double acting cylinder is been clamped along the body of the hand brake .The end of the piston rod is bolted with the clamp connecting with the hand brake A Solenoid valve type pneumatic valve is integrated within a seat belt locket. When the seat belt is been locked it activates the Solenoid valve. By this pneumatic cylinder is been activated. The pneumatic cylinder is been welded with the clamp connected with the hand brake lever. During the forward stroke of the piston the lever of hand brake is been pushed down and the brake is released.

On return stroke the lever is brought to its initial position and the brake is engaged.

Handbrakes are purely mechanical braking tools, relying on a series of levers, cables and screws to activate a car's wheel brakes When the handbrake is applied, the brake cable passes through an intermediate lever, to increase the force of your pull; this force is then split evenly between your brakes by an equalizer A mechanical lever is added to the existing disc or drum brakes on the car. In drum brakes, the handbrake cable runs directly to a lever on the brake shoes. In disc brakes an additional lever and corkscrew is added to the existing caliper piston. When the handbrake is pulled, the lever forces the corkscrew against the piston, which would normally be activated by the hydraulic foot pedal system. So when the pneumatic cylinder setup is been integrated with the hand brake, a driver should activate the 5/2 Solenoid valve by using the seat belt otherwise the arm of handbrake will not be lowered if he tries to apply the hand brake without wearing the seat belt the force of the pneumatic cylinder prevents Solenoid is DC Valves stands for Directional-Control Valves. Directional control valves are one of the most fundamental parts in hydraulic machinery as well and pneumatic machinery. They allow fluid flow into different paths from one or more sources. They usually consist of a spool inside a cylinder which is mechanically or electrically controlled. The movement of the spool restricts or permits the flow, thus it controls the fluid flow. In our project we use a Solenoid valve 5/2 valve. A 5/2 directional control valve would have five ports and two spool positions

Hand brakes have a ratchet locking mechanism that will keep them engaged until a release button is pressed. This is used to prevent the lever of hand brake from falling down when it is been engaged. In our project the pneumatic cylinder itself holds the hand lever through a clamp welded over it so the release button is been disengaged from the hand brake. A clamp is being welded to the body of the handbrake to couple with the cylinder.

5. CONCLUSION

We ensure that driver will compulsorily wear seat belt while driving. If he drives without wearing the seat belt the handbrakes could not be disengaged. Wearing seat belt rightly is made compulsory.

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