DESIGN AND FABRICATION OF BRAKE AND ACCELERATOR ON SINGLE PEDAL

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ABSTRACT

The present rate of accidents due to automobile has been increased up to 4.6% compared to previous year's record in these; one of the causes is due to pedal error. The Automotive vehicle has become one of modern Society's deadliest killers. One of the main reasons is pedal error which involves either wrong pressing of pedal or due to the delay in the foot movement between the brake and accelerator pedals. For some drivers it has become a difficulty in removing their foot from one pedal to the other quickly in emergency situations. Hence we have introduced a single foot brake pedal and accelerator pedal movement. It essentially consists of a joint pedal for operating the brake and accelerator, arranged in such a form that its action to affect one or the other function is carried out without the possibility of error, and without one function interfering with the other. The main objective of this innovation is to eliminate the operator's risk of pressing the wrong pedal at the time of emergency and reduction in the driver's reaction time to switch from accelerator to brake or vice versa.

Key words: pedal, brake

1. INTRODUCTION

In the present scenario, safety of the vehicle is more concentrated while fabricating it. As the vehicle becomes more and more advanced, safety becomes a bigger concern. In a conventional pedal system the clutch is to the left, the accelerator to the right and the brake in the middle. The

right foot should be used for pressing the accelerator and brake. Due to confusion during emergencies there would be a possibility of pressing the wrong pedal in the conventional pedal system which will lead to a crash. The time taken to shift the foot from one pedal to the other will lead to an accident. It takes at least 0.2 seconds to move your foot from one pedal to other and hence, at 80 kilometers per hour this adds five meters to vehicle's stopping distance. The rate of accidents is being increased due to the wrong pressing of pedal in an automobile. The National Highway Transportation Safety Administration (NHTSA) reports that an estimated 16,000 accidents resulting from pedal errors occur each year. This number means that, on average, 44 accidents occur each day as a result of the driver confusing the gas for the brake.

The possibility of this error can be reduced with this innovation. This innovation relates to the improvements in the mechanical movements and has a particular reference to a combined foot brake pedal and accelerator pedal movement. It consists of a joint pedal for operating the brake and accelerator, arranged in such a form that its action to affect one or the other function is carried out without the possibility of error, and without interfering one function with the other.

The design of new mechanism aims, to provide a pedal that applies the brakes instantaneously and also permits the operation of accelerator with the same foot. In other words, the vehicle must not accelerate at the time of braking and at the time of acceleration vehicle must not decelerate or stops.

The mechanism enables the driver to control acceleration and braking using one foot, which will lead to reduction in stopping distance, misjudgment and ultimately decrease in number of road accidents that may happen each day. This mechanism can easily be adapted by the driver without any effort. It doesn't enable the possibility of pressing the wrong pedal.

2. LITERATURE REVIEW

Katsuya Matsunaga, Ph.D [1] in her research paper " **NEW BRAKE PEDAL AND ACCELERATOR BAR SYSTEM TO PREVENT THE MISTAKE OF PRESSING DOWN THE ACCELERATOR INSTEAD OF THE BRAKE IN EMERGENCY SITUATIONS"** done an experiment in developing a new brake pedal and accelerator bar system. In this the N system is used which provides a driving control mechanism which permits the quick and smooth

transition from acceleration to braking, without needing to transfer the foot from one pedal to another.

Rickard Nilsson (2002) [2] in his research paper "**Evaluation of a combined brake-accelerator pedal"** has conducted an experiment and concluded that, the transition from the standard pedal to the combined brake–accelerator system is easy and relatively painless. Incorrect driving behaviors quickly abate, mostly before the driver completed 500 km of driving. The goal of his study is to highlight problems that drivers may face when they switch between pedal systems. The results indicate that drivers were able to learn the new combined pedal mechanism quickly and effortlessly and that the number of mistakes was extremely low during the acquisition phase in learning the new system. He also concluded that future experiments of the new combined pedal are desirable.

Sahil Arora (2016) [3] in his research paper **"A COMBINED PEDAL FOR BRAKE AND ACCELERATOR**" he concluded that this new mechanism results in avoiding interference of braking during acceleration and vice versa. Moreover, it is advantageous over conventional pedals. This combined pedal mechanism thus provides a driving control which permits the quick and smooth transition from acceleration to braking, without needing to transfer the foot from one pedal to another. The mechanism used for combined brake and accelerator is simple and can be adopted conveniently.

N. Ramachandran et.al (2017) [4] in his research paper "**Design and Fabrication of Brake and Accelerator by using single pedal"** conducted an experiment in order to eliminate the operator risk of pressing the wrong pedal. It involved construction and working of Accelerator and Brake operated by single pedal using on/off and cutoff limit switches for electronic vehicle and this same technique is also applicable to normal vehicles. He concluded that this new mechanism results in avoiding interference of braking during acceleration and vice versa. The rapid increase in number of vehicles on roads day by day, demands an exploration of such mechanism to get rid of driver's effort and reduce road accidents. This innovative project will be useful for physically challenged person in future.

G. Shanmugasundar et.al (2018) [5] in his research paper "**Design and Analysis of Automobile Pedal with Combined Brake and Accelerator"** his study can infer that the various methods for developing and optimizing accelerator and brake pedal. It can also infer that the

importance of composites towards automotive industry. It also shows that the importance of combined brake accelerator pedal system and need to incorporate in commercial vehicles in order to decrease the possibilities of accidents and it has proven low rate of errors and improved transition time between acceleration and braking. There is scope for this system and involves series of development and optimization in order to making into practice.

Pankaj Chhabra et.al [6] in his research paper "**Concurrent Design and Prototyping of Composite Accelerator Pedal"** he studied about the development process of composite accelerator pedal has been carried to replace the existing metallic accelerator for various benefits. It is observed that the composite accelerator pedal weighs 100 g while the reference existing model weighs about 500g, thus gives the weight reduction of 80%. It is produced as a single unit so, gives lower manufacturing complexities, better fit and better finish. His results reveals the feasibility of composite accelerator pedal with glass filled polyamide providing substantial weight saving and better properties than existing metallic pedal.

Netra Prakash Wadhera et.al (1996) [7] in her thesis paper "**DESIGN CONSIDERATIONS OF A COMBINED BRAKE-ACCELERATOR PEDAL SYSTEM"** she has concluded that Brake and accelerator force had little effect on the reaction time within the range considered. The interaction of the brake and accelerator force with the other variables was also very small and her research provides a fairly wide working range to select the values of these variables on criteria of more mechanical nature. Mechanical ease of positioning the shafts, linkage design for brake and accelerator actuation, space constraints, etc., may be chosen to determine the exact values of these variables.

Jake S. Schwartz (2017) [8] in his thesis paper "**DESIGN OF AN AUTOMOBILE ACCELERATOR/BRAKE PEDAL ROBOT FOR ADVANCED DRIVER ASSISTANCE SYSTEMS**" deals with designing an actuator system to control the accelerator and brake pedal to control the speed of an automobile. The actuator system comprises of an electric actuator that controls the accelerator pedal and a parallel linkage that controls the brake pedal. This paper compares the speed control with and without the use of a parallel linkage with respect to overshoot and steady state error.

Hrishikesh. K. Jadhav et.al (2019) [9] in his research paper "**Design of Combined Brake and Accelerator Pedal**" he studied about a mechanism which consists of pedal which can provide

both accelerating and braking function. In this design of pedal system; we can apply brake instantaneously also it help to permit acceleration with same foot. Also both the motions are kept distinct from each other and they do not interfere. With above study we can conclude that this new mechanism result in avoiding interference of braking during acceleration and vice versa. Moreover it is advantageous over conventional pedals.

Versace (1966) [10] at the Human Factors Department at the Ford Motor Company conducted some preliminary studies of dual brake accelerator devices on automobiles but failed to show any "unusual advantage" over the conventional two pedal system.

3. METHODOLOGY

The working of this single pedal is divided into two categories, the first one deal with the braking action and the second one with acceleration action.

3.1 Braking action

In braking action, the brake of the vehicle is applied by imparting complete forward motion of the leg on the pedal. Through the pedal the force is then transmitted to the master cylinder, then to the small cylinder which is caliper by using Pascal's principle, now the caliper pads stop the disc which further leads to the stopping of the automobile.

3.2 Acceleration action

Here the vehicle can be accelerated by applying the force on the pedal through our foot. The pedal which is connected with the acceleration cables, which upon applying the force sends signal to the motor

4. DESIGN

The components are designed and assembled in Solidworks designing software.

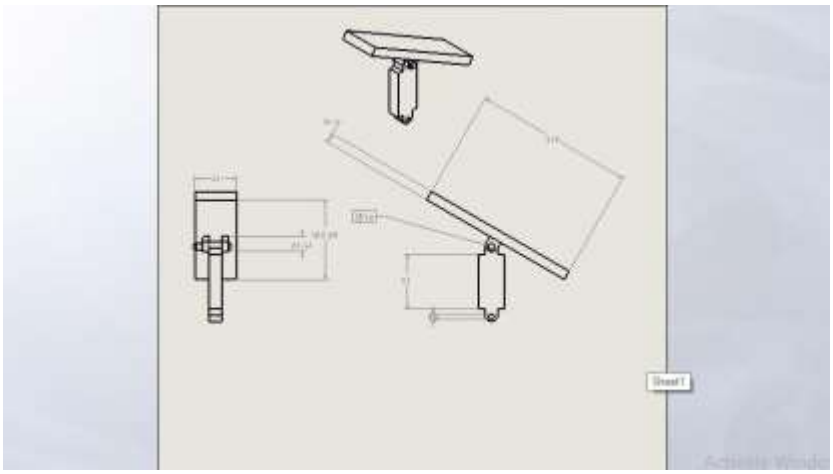

FIG 4.1: SINGLE PEDAL (2D MODEL)

4.1 FABRICATION

The main components used in this prototype making are base frame, pedal, spring (tensile), master cylinder, disc brakes, acceleration cables, motor, shaft. A motor is used to drive the shaft and braking assembly was mounted on the frame which carries the complete assembly.

4.1.1 Frame base

The frame base is a flat rectangular plate with dimensions length- 540mm; breath- 340mm. The material used for making the frame base is carbon steel. This component supports the entire pedal mounting. This part has been designed in solid works software.

4.1.2 Pedal

A pedal is a flat base which is used for controlling the power and the speed of the car. The pedal is designed in the solidworks. The pedal is designed with the following dimensions length- 310mm; breadth- 84mm; thickness- 4mm The material used in making the pedal is mild steel plate.

FIG 4.2: FABRICATED SINGLE PEDAL

4.1.3 Spring

The helical spring specifications are overall length- 36.5 mm, ring diameter - 5mm. The helical spring has been designed in solidworks software with the following dimensions. The material with which the spring made is steel alloy.

4.1.4 Motor

It is the main power source of the complete equipment. The type of motor we used is DC motor. A DC motor converts direct current electrical energy into mechanical energy. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic; to periodically change the direction of current in part of the motor.

4.1.4 Disc brake

The braking system used is disc type, the disc brake has been selected as it offer greater stopping power, which can be helpful on long descents and it can remove dust particles trapped by themselves. The specifications of the disc brake are 160mm the material used for disc is cast iron and for the caliper cast iron is used and we used brake fluid of type DOT 3.

FIG 4.3: SINGLE PEDAL WITH MASTER CYLINDER

4.1.5 Shaft

A circular hollow shaft has been used. This hollow shaft is of 20mm radius. The hollow shaft is made up of cast iron.

FIG 4.4 : FABRICATED SINGLE PEDAL SETUP

FIG 4.5: SINGLE PEDALWITH BRAKE

5. CONCLUSION

The main objective of the work is to reduce the accidents caused due to the pedal error. For this we have made some modifications in the pedal from which we got these following conclusions.

- A modified mechanism is introduced in a single pedal accelerator brake.
- With the above study we can conclude that this new mechanism results in avoiding interference of braking during acceleration and vice versa.
- This mechanism provides simultaneous acceleration and brake, which is necessary during uphill.
- This mechanism reduces reaction time which directly influences the braking distance and braking time.
- This mechanism has wide range of applications in rally cars.
- This can also act as an emergency pedal when implemented along with conventional braking system.

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