Design of stable controller attachable Anti Roll System (ARS) for vehicles

S. Prakash¹, Sangeetha krishnamoorthi², Vivek Rai³, Rohan Kumar³, & Suraj Gupta³

¹ Assistant Professor, Department of Mechanical Engineering, Aarupadai Veedu Institute of Technology, Vinayaka Mission Research Foundation, Deemed to be University, Tamil Nadu, India.

² Associate Professor, Department of Mechanical Engineering, Aarupadai Veedu Institute of Technology, Vinayaka Mission Research Foundation, Deemed to be University, Tamil Nadu, India.

³ UG Scholar, Department of Mechanical Engineering, Aarupadai Veedu Institute of Technology, Vinayaka Mission Research Foundation, Deemed to be University, Tamil Nadu, India.

Email: prakash.mech94@gmail.com

Abstract. The most common problem which will be faced in hilly areas or in inclined roads is rolling back of vehicle when it has to be start up and move forward. There are numbers of accident reports happens in hilly regions caused due to rolling back of vehicle. Mostly drivers from the plane areas have to face this type of problem while driving in hilly areas. So we have designed a system which will avoid the rolling back of a vehicle and it will not stop the vehicle from accelerating forward. This function can be achieved by using the ratchet & pawl mechanism. In costly SUVs & automatic cars there is a feature available called “HILL HOLD ASSIST” to overcome this problem but in which it will require number of sensors, it can hold the vehicle only for 2to 3 seconds then after it will start rolling back and again it have to be activated and all the breaking system have to be modified and manufactured from the factory itself increasing its price and so it is available only in expensive cars. But our designed system is fully mechanical without any involvement of any sensors making it simple, cheap and can be attached additionally in any normal vehicles having disc brake system and there is no time limit in our designed system once it is activated it will remain activated unless the driver will not deactivate it. This system will allow the freedom to the driver while driving in inclined road; once the system is activated there will be no rolling back of vehicle and no need of applying breaks while starting it.

Keywords: Anti Roll System (ARS), Design, Analysis

1. Introduction:

When you are driving your car in up hills or in inclined road and stuck in traffic. If you're driving a manual transmission, you step on the clutch with your left foot and move your right foot to the accelerator pedal [1]. At that time there is nothing stopping your car from rolling backward except the engine force, and pressing clutch pedal will remove that as well. Car moves back down the hill, and can hit the car behind you [2]. Traditionally used techniques are like you can control both break and accelerator pedal with right foot by releasing brake pedal and pressing accelerator pedal at the same time or you can use hand break for applying break but both the techniques are risky and requires more experience and skill but still there will be some rolling back of vehicles in many cases [3].

So to avoid this problem and making it possible to avail it in normal vehicles we have designed a system which can be installed in any normal vehicles having disc brake system by simply just doing some modification [4]. This system is designed for and according to the dimensions of
Maruti Alto 800. It will be useful when you are driving in hilly or inclined roads where rolling back of vehicle will be major problem [5]. This system will allow the freedom to the driver while driving in inclined road [6], once the system is activated there will be no rolling back of vehicle and no need of applying breaks while starting it. In layman’s terms, the modern hill-holder function works by using two sensors, in concert with the brake system on the vehicle. The first sensor measures the forward-facing incline (nose higher than tail) of the vehicle, while the second is a disengaging mechanism. The 1930s-1950s used a ball bearing as a check valve in the hydraulic brake line; when the car was on an uphill incline, the ball rolled back and blocked the brake line - when the car was level or facing downhill, the ball rolled away, leaving the line free. The clutch linkage slightly dislodged the ball when the clutch was released, enabling the car to move away from a stop.

Slope Holder is a call for the tool imagined with the aid of using Wagner Electric and produced with the aid of using Brake Company in South Bend, Indiana. Studebaker and several exclusive carmakers supplied the machine as both discretionary and general hardware for a protracted time. It is a machine that holds the brake till the grip is on the grinding point, making it less complicated to stir up slopes from guide transmission vehicles. It became first supplied in 1936 as an opportunity for the Studebaker President. By 1937 the machine, called with the aid of using, became available on Hudson, Nash, and several exclusive vehicles. Another call for the tool is a slope preserve control [7]. In layman’s terms, the superior slope holder paintings works through making use of sensors, operating collectively with the slowing mechanism at the car. The most important sensor quantifies the front orientated slope (nostril better than tail) of the car, at the same time as the second one is a isolating component. The 1930s-Fifties applied a steel curler as a test valve within side the water powered brake line; whilst the car became on a difficult slope, the ball moved again and obstructed the brake line - whilst the car became stage or confronting downhill, the ball moved away, leaving the road free. The hold close linkage fairly unstuck the ball whilst the grip became added, empowering the car to transport far from a prevent [8].

Improved added device for a slope holder machine used burden sensor related to the wheel brake to stumble on a alternate a wheel slowing down pressure and talk responsively with mechanical brake manipulate machine. On the off hazard that a car is prevent on a slope at the same time as the engine in reality running, there may be applicable opportunity that a few type of slope begin manipulate may be required. A sensor that distinguish a grade of greater than sure sum, 3° or greater, can impart a signal to the slope begin manipulate displaying that the car can likely start moving [9].

Figure 1 shows the car in inclined plane, the most common problem which will be faced in hilly areas or in inclined roads is rolling back of vehicle when it has to be start up and move forward.

![Figure 1 Car in inclined plane/road](image-url)
subsequent end, where the primary ends in urgent mounted to transmission lodging. The second finish of the pawl has a previously calculated segment arranged to deliver the connect at any rate one of the majority of drawing in teeth of the external race as the external race pivots the second rotational way [10].

1.1 Objective of the Project
   a) To provide freedom to the driver while driving in a inclined road.
   b) To avoid rolling back of vehicles while starting in inclined plane.
   c) It can be additionally installed in a normal car.

1.2 Limitations
   - System activates for only 2 to 3 seconds which will be quite challenging for the driver.
   - Thus this system is made up of number of sensors like torque sensor, angle sensor etc., so additional electronic system is required for this making it complicated and costly.
   - Due to its high cost it is available in only expensive cars

2. Working Methodology
   The two main mechanisms which are responsible for working of this system is pawl & ratchet and Retractable pen mechanism.

![Fig 2 Parts of designed Anti Roll System](image)

Refer figure 2 Ratchet is designed according to size of the hub of disc rotor of Maruti Alto 800 Car with 4 keys which can be inserted in slots made in hub so it will arrest the rotation motion of ratchet and rotates along with the disc rotor and to avoid slipping of ratchet away from the hub, ring is attached to it which will lock the ratchet completely when wheel rim will be bolted in hub.

When the vehicle moves forward the direction of wheel will be in anti clockwise and clockwise when moves backward and so the ratchet is designed and attached to the hub in such a way that it will arrest the movement of the wheel only in clockwise direction (backward) when system is activated as shown in figure 3 and allow the rotation in anti clockwise direction (forward).
3. Anti Roll System (ARS) device designed:

The Anti Roll System (ARS) device designed in CATIA Software, in this design Caliper is installed at left side of the disc similarly and opposite to the disc brake, which is a complete assembly of actuator, spring and pawl. Pawl is pivoted into the caliper and which is allow to rotate located just above the ratchet teeth so it can be meshed with it in order to lock the rotation of wheel in backward direction. The elongated part at the top of the pawl is designed so that piston can push it and force it to rotate for certain angle which is 15degree. There is a hole at left side of the caliper where the actuator (hydraulic cylinder) will be installed perpendicular to the pawl. End of the cylinder will be connected with hydraulic hose pipe from which the fluid will come and extend the piston; powered Fluid will come from master cylinder by pressing pedal by driver.

Pedal which will be used for activating and deactivating the system will works under retractable pen mechanism consist of several parts a thrusters, two cams, a guide pin and a spring which is loaded and it is retracted when pressed and it will not come back or extend unless it is pressed again, so when it is pressed again then only it will extend or come back. Here Pedal is connected with the piston in cylinder filled with incompressible fluid so when the pedal is pressed piston will push the spring and it will retract or extend it in the retractable pen mechanism system. Piston is connected to master cylinder which will then increase the fluid power and transfer it to hydraulic actuator and piston into it will be pushed located at caliper when it is pressed. Fig 4 & Fig 5 shows the ARS design assembly and exploded view.
4. Result and Discussion:

The overall performance of this managed gadget is examined for numerous trajectories on an experimental car whose parameters. The favored trajectory is reconstructed from the information factors saved in a information report containing the coordinates of some of knot factors that outline the favored path. The fundamental characteristic of the steerage controller of an automatic car is to offer correct steerage attitude command indicators to the front wheels primarily based totally at the size and processing of the relative mistakes in function and orientation.

In this section, the comparative analyses that are performed to decide on a correct finite element anti roll bar model are presented in table 1 analysis results for Anti Roll System (ARS)

| Section Number | Cylinder – Activated Mode | Cylinder – Deactivated Mode |
|----------------|---------------------------|----------------------------|
| Stiffness      | 52.4                      | 58.5                       |
| Max. Principal Stress (MPa) | 454.1                  | 447.6                      |
| Max. Principal Stress (MPa) | 550.0                  | 560.3                      |

As visible from the above table, Its growth the cost whilst evaluate to the activated mode, the evaluation of cylinder is first finished with this default cost at activated mode, then repeated with de spark off mode. The first pattern evaluation is finished with a stable cylinder anti-roll machine. Moment-unfastened bushings and round joints at cylinder ends are used for connections. The outcomes acquired on this evaluation can be used for demonstrating this system outputs. Also, the identical anti-roll cylinder geometry can be used with activated and deactivated of anti-roll performance. In pattern evaluation (i), the primary traits of an anti-roll machine are acquired. The bending strain at the bar, begin from zero and growing as much as its most cost on the activated portion. The torsional shear strain is most and make contact with among the bushings, with the mixture of those strain is correspond to the spring connect to ratchet and rotation of the wheel.

Increasing the bushing obviously improves the anti roll system stiffness by resisting deformations with the retractable mechanism, this method seems to be the easiest way of obtaining higher roll stiffness without changing the antiroll system.
4.1 Activated mode (ON)

Fig 6 shows the ARS in activated mode, when the system is in activated mode there will not be any load being applied in the spring of retractable mechanism system which means no fluid pressure is being applied from master cylinder to the hydraulic actuator in calliper and hence piston is not in extended position which gives some space and allow the pawl to rotate freely. Thus the pawl can rotate freely therefore the spring connected to the end of the pawl with calliper will push the pawl towards the ratchet to be engaged with the ratchet teeth and hence resisting the rotation of wheel in backward direction i.e., clockwise. Thus spring connected to pawl is open type therefore it will be compressed by pawl when wheel will rotate in anticlockwise direction allowing the car to move forward.

![Fig 6 ARS in activated mode (ON)](image)

4.2 Deactivated mode (OFF)

Fig 7 shows the ARS in deactivated mode, when the system is in activated mode pawl will be engaged with the ratchet teeth resisting the rotation of wheel in clockwise direction. At this moment there will be huge force acting on a pawl due to the wheel torque holding all the weight of the car along with passenger. So to deactivate the system pawl has to be disengaged with ratchet teeth which will require some force. Pedal is pressed and spring is retracted and locked in retractable pen mechanism system. Thus which will supply the fluid power from master cylinder to the hydraulic actuator which will extend the piston and rotates the pawl and hence pawl is disengaged from the ratchet teeth. System is deactivated.

![Fig 7 ARS in deactivated mode (OFF)](image)
5. Conclusion:

The Project entitled “Attachable Anti Roll System for vehicles” has been successfully designed in CATIA software, designing of a anti roll system is done which can be installed additionally to other normal vehicles. The main objective of this project was to design a compact device for rolling back of vehicles in inclined road which can also be installed in normal cars which is not having “Hill Hold Assist features” and to make is cost efficient.

- This system is designed according to the dimensions of Maruti Alto800 car so the design for different car will vary according to their disc rotor size. Our designed system is fully mechanical which does not require any electronic components.
- Thus this type of system design has not been made yet and initial cost for manufacturing can be costly so production of it in a large scale will makes its cost less and affordable. This system have many advantages compare to the available systems in car for rolling back problem, it will give freedom to the driver while driving in inclined road ,driver don’t have to activate the system again and again like in available cars. Once the system is activated driver can start the car in inclined road without any rolling back and no need of applying old techniques like controlling both brake and accelerator pedal with one foot which require proper skill and experience.

References

[1] Kuttolamadom, Mathew, Mostafa G. Mehrabi, and J. Weaver. 2010 "Design of a stable controller for accurate path tracking of automated guided vehicles systems." The International Journal of Advanced Manufacturing Technology 50.9, 1183-1188.
[2] Ban, Donghoon, Taeyoung Lee, and Sungho Jin. 2015 "Design and Implementation of an EPB Diagnostic." Journal of Automation and Control Engineering Vol 3.4.
[3] Ruikar, Manisha. 2013 "National statistics of road traffic accidents in India." Journal of Orthopedics, Traumatology and Rehabilitation 6.1.
[4] Reddy, Raj. 2011 "Automatic Collision Warning and Electro-Mechanical Braking System." International Journal on Emerging Technologies 6.1: 61.
[5] Wikipedia.org
[6] howstuffworks.com
[7] Balashanmugam, P., et al. 2013 "Fabrication of high speed indication and automatic pneumatic braking system." International Journal of Engineering Trends and Technology 5.1 40-45
[8] Muruganandham, Mukesh PR. 2010 "Real time web based vehicle tracking using GPS." World Academy of Science, Engineering and Technology 61.1: 91-9
[9] Wagner Electric and manufactured by Bendix Brake Company in South Bend, Indiana, Studebaker
[10] Cook George (May 31, 196) Anti-creep and hill holder brake system.