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“AUTOMATIC GROUND CLEARANCE SYSTEM SUSPENSION”

PROF.Vaibhav Edake¹, Mr.Pratik Patil², Ms. Trupti Jawale³, Mr. Abhishek Bhandari⁴, and Mr. Rahul Varpe⁵.

¹Professor, ^{2,3,4,5}students,

Department of mechanical Engineering,
ISB&M College of engineering, Pune, India.

ABSTRACT :

Suspension systems are now one of the inevitable sections in the automotive industry which are accountable for the ride safety and comfort and progressive research and development in this field seems unremitting. And the active suspension systems of an automobile, it addresses how active suspensions overthrow the conventional passive suspensions and its advancement for practical implementations. It focuses on the need, concept and current trends of the active suspension system. This is a study which encompasses the growth of active suspension, enunciating the best available choices of actuators and control methods in these suspensions and directing towards the possibilities of further improvements.

The handling of a vehicle depends upon the various parameters, centre of gravity of the vehicle is one of them. For better handling of the vehicle we need to keep the centre of gravity as low as possible. For sport cars it is always kept low but for the passenger cars it compromises with its ground clearance. The designers prefer to maintain fixed ground clearance and design the system to acquire requisite suspension parameters. For different types of tracks, the ground clearance of vehicles is designed accordingly and that is why this is a subtle reason which also differentiates the vehicles as on-road (Sedan/Hatchback cars) and off-road (Sports utility vehicles (SUV)). Off-road vehicles have to face the rough terrain, where we need the high ground clearance of the vehicle, on the other hand we run the same vehicle on road where high ground clearance is not necessary.

Where as a sedan car or hatchback has to run on smooth roads as well as on rough terrains sometimes with its fixed lower ground clearance which tends to create dents on the bottom portion of the car . In both cases we need the high ground clearance of the vehicle, on the other hand we run the same vehicle on road where high ground clearance is not necessary.

Keywords–SUV, off-road, Hatchback, Sport car utility, Active suspension system, passive suspension system, actuators, pneumatic piston cylinder, and control methods.

1. INTRODUCTION:-

Ground clearance is the position of the vehicle under body above the ground level. It's an important parameter in off-road vehicles. The grip of tires is constantly changing during running condition because there is certain amount of mechanical down force act on tires and The whole weight of vehicle is concentrated at a point known as a center of gravity point. The center of gravity of a vehicle is calculated by taking the sum of its moments divided by the overall weight of the vehicle. The moment is the product of the weight and its location as measured from a set point called the origin. At the lower ground clearance, we get the location of C.G point near to ground level. This reduces weight transfer during cornering, accelerating, and braking and increase the vehicle performance. Also, by lowering the front end and raising the rear end, we can improve high speed stability. Since the center of gravity has an influence on most parameters during running of the vehicle. We need a location of C.G point at a high level as well as at lower level according to road conditions. Designed a simple mechanical linkage mechanism for ground clearance adjustment. The adjustment is possible at droop conditions with the help of bell crank lever and pneumatic cylinder. With the help of this system we can vary ground clearance of the vehicle up to 60 mm. The system consist a new fabricated shock absorber mounting bracket. One end of suspension is connected to the wishbone and another end is connected to the bell crank lever. The pneumatic cylinder is actuated as per the readings given to the controller by ultrasonic sensor. We can adjust the ground clearance of our vehicle automatically whenever required.

In city at different sectors like school, hospital there are speed breakers of different dimensions. Most of the people buy only one four wheeler which they use that at all this condition. Hence it's necessary to give some standard ground clearance to the vehicle. But still there are some obstructions while driving the car on highway and in city. To obtain the good performance at high speed and low speed it is necessary to build one system which can vary the ground clearance. This can achieve by changing the suspension height so that the chassis height can be adjusted with respect to the speed and the quality of roads. We have designed a simple pneumatic linkage mechanism for ground clearance adjustment. The adjustment is possible with the help of an active and a passive suspension which are

linked together in series. Active suspension is placed below the passive suspension. With the help of this system we can vary ground clearance of the vehicle upto 50mm. We have designed a simple

pneumatic linkage mechanism for ground

Clearance adjustment. The adjustment is possible with the help of an active and a passive suspension which are linked together in series. Active suspension is placed below the passive suspension. With the help of this system we can vary ground clearance of the vehicle. Pneumatic cylinders are mechanical devices which use the power of compressed air to produce a force in a reciprocating linear motion.

1.2 Problem Statement :-

As we can observe on daily basis most of the sedan cars are in trend for its look. Also the space is more as compared to other cars so most of the crowd is going for a sedan cars. But the companies are trying to reduce the ground clearance to make it better in look which leads to dashes under the body on off roads and specially on speed breakers. So we made an arrangement in such a way that, it will not change in look but the user can adjust the height of the vehicle.

1.3 OBJECTIVES OF THE PROJECT :

The main objective of the project to increase the height of the vehicle by sensing the ground clearance and increase by at least 40mm.

1. To design and fabricate automatic ground clearance adjustment.
2. To make system very user friendly.
3. The automatic inbuilt pneumatic system is used to lift the chassis from the ground without human efforts and time.
4. Pneumatic lifting technique system is used to provide higher ground clearance at the time of rough roads and speed bumps.
5. To cope up the shortage of most commonly used fuel and go for compressed air as a working medium.
6. To lift the vehicle very smoothly without any impact force. The automatic inbuilt pneumatic system is used to lift the chassis from the ground without human efforts and time.
7. Pneumatic lifting technique system is used to provide higher ground clearance at the time of rough roads and speed breaker bumps.
8. To cope up the shortage of most commonly used fuel and go for compressed air or liquid fuel as a working medium.
9. While driving four wheelers, we faced a problem related to tires. A hydraulic operated jack is placed in a supportable position where transitional motion to lift vehicle.

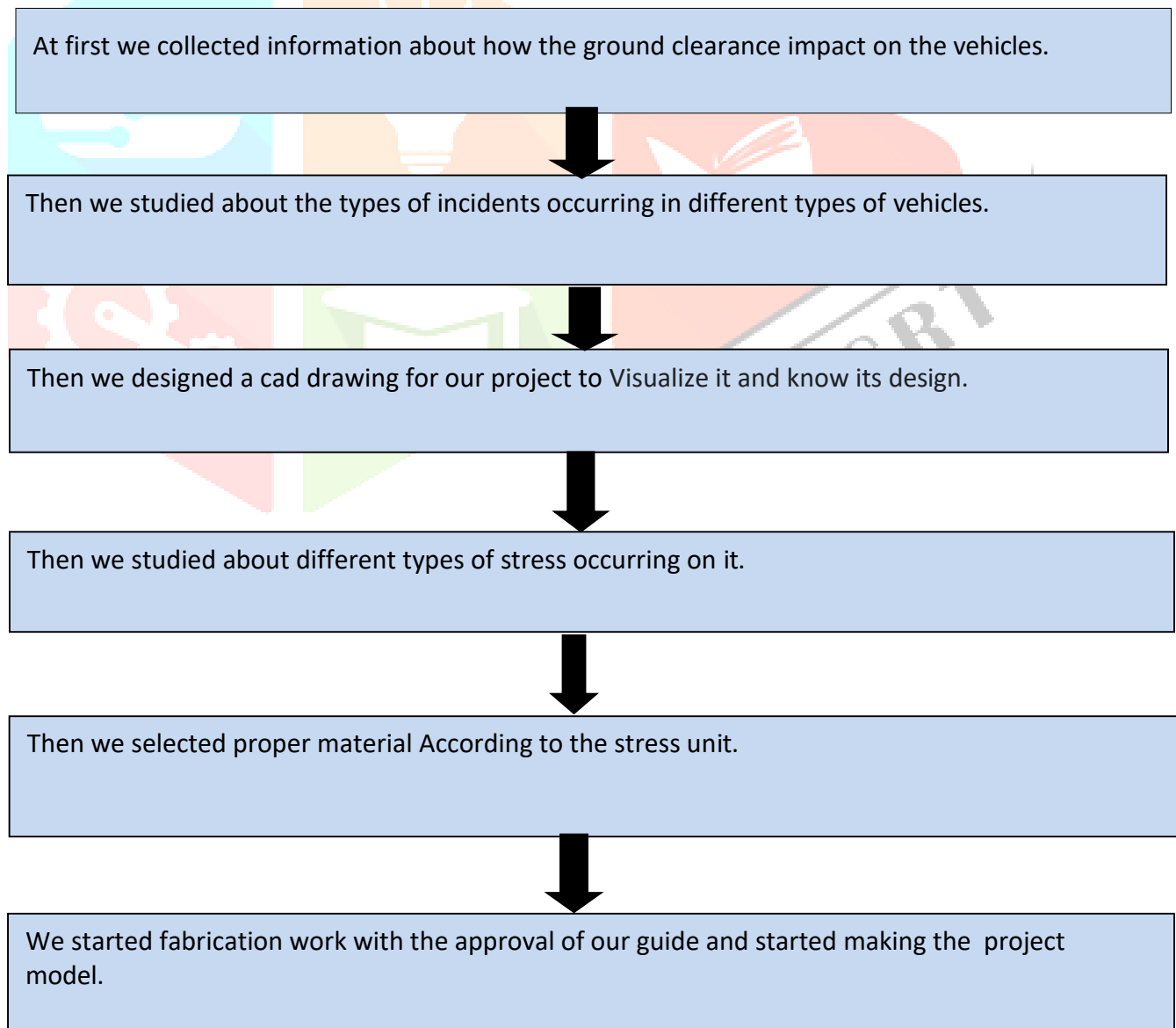
10. In several automobile garages, revealed the facts that mostly some difficult methods were adopted in lifting the vehicles for reconditioning.
11. Hence a suitable Design has been designed such that the vehicle can be lifted from the floor land without application of any impact force.
12. In order to avoid all such disadvantages, the automatic jack has been designed in such a way that it can be used to lift the vehicle very smoothly without any impact force.

1.4 SCOPE OF WORK

The scopes of work for this study are as follows:

- a) Study on semi-active suspension system for a quarter car model and the Fuzzy Logic controller used in the system
- b) Design the system by using MATLAB/SIMULINK
- c) Simulate the system using MATLAB/SIMULINK

1.5 ACTUAL METHODOLOGY FOLLOWED





After Finishing the Project we tested it for various considerations.

2. DESIGNING OF THE PROJECT

BRAKING FORCE REQUIRED CALCULATION

To find force applied by pneumatic cylinder on Suspension

Piston Diameter : 25mm = 0.025m

$$\begin{aligned} \text{Area} &= \frac{\pi}{4} \times D^2 \\ &= \frac{\pi}{4} \times 0.025^2 \\ &= 0.000498\text{m}^2 \end{aligned}$$

Stroke = 50mm = 0.05m

Assume pressure = 8bar = $8 \times 10^5 \text{ n/m}^2$

Force = Pressure X Area

$$\begin{aligned} F &= P \times A \\ &= 8 \times 10^5 \times 0.0000498 \\ &= 392.69 \text{ Newton} \end{aligned}$$

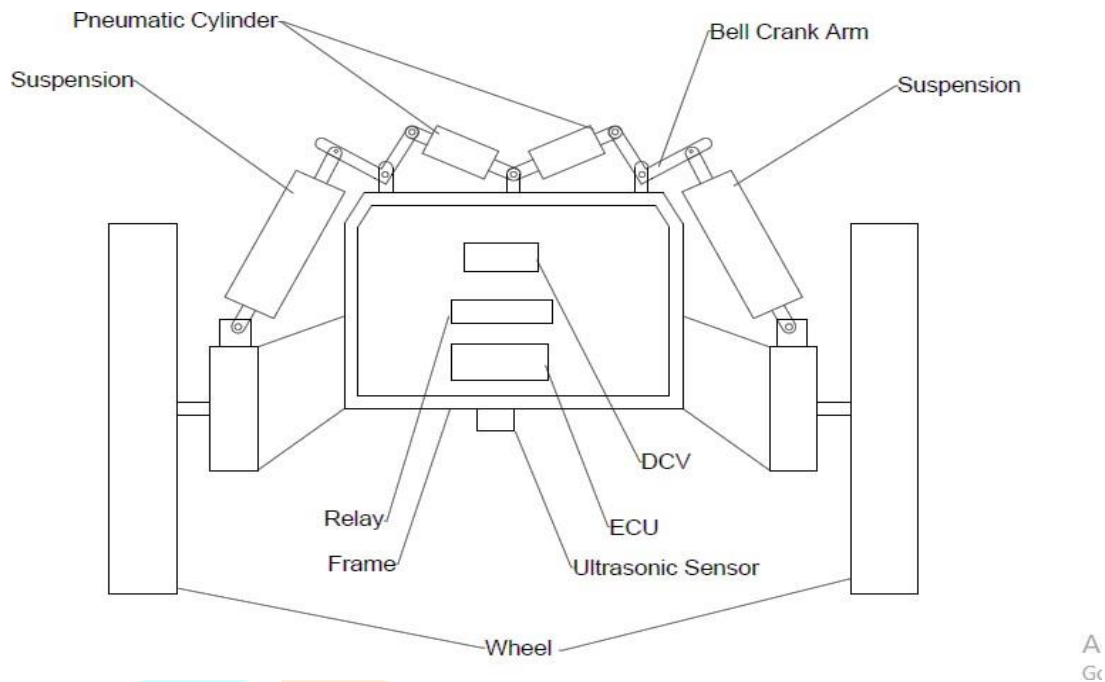
Rise in the height of the frame = stroke of cylinder = 50mm

3. WORKING:

The ground clearance adjustment system is designed in such a way that it can increase the distance between ground and frame of vehicle. We are using 4 pneumatic cylinders each for every wheel.

Our entire framework is mounted on outline which is move with the assistance of wheels. Toward the front of the framework there is sensor. We take ultrasonic sensor here. These sensors sense the article before outline. Ultrasonic sensor utilizes transducer and beneficiary to send and get single. When there is an item before the framework, our framework is lift. This lift happens with the assistance of pneumatic chamber. Ultrasonic sensor offers single to pneumatic chamber and casing lift upward way. As the article die pneumatic chamber goes down.

Fig no:3.1.a (Circuit diagram for Brake failure detection system)



4. RESULT AND DISCUSSION:-

The pneumatic lift mechanism applied in prototype to increase the ground clearance works successfully. It is able to lift the weight of chassis up to 8-10 kg with a compressor of capacity 350psi, which is good enough for a lower scale work. The mechanism takes maximum 5 seconds to lift the chassis after providing input to the controller and then can have a fixed higher ground clearance up to required period of time to protect the chassis of prototype. And later can lower the chassis using controller to have fixed lower ground clearance within 5 second. And the performance can be optimized. The results can be arranged as:

- The average time required by the system to vary the ground clearance of the vehicle is 5 seconds.
- The ground clearance of the vehicle is increased by 4cm along the obstacles. Car chassis is prevented from being damaged
- The system can withstand a weight of 8 to 10 kg with the compressor of 350psi capacity.

The project works well in case of prototype but there might be a chance that the result can vary with the real time application of the pneumatic system. But with proper design and mechanism with having accurate measurement in real time application the performance can be optimized.

5. CONCLUSION :-

This paper has rendered a broader understanding into advancements and current trends in the research and development of the active suspensions. Active suspension systems furnish much flexibility in enhancing ride and handling, but higher power requirements have limited its practical implementation. However, if its power requirements can be evidently decreased, large scale implementation can be expected.

Hydraulic actuators have thus far been chosen to in active

Suspensions due to easy availability of various parts and simple structure. However, more recently, electromagnetic actuators have emerged as a potentially superior alternative, showing lower power consumption and higher bandwidth abilities. Active suspension systems that adapt to the road profile have been considered as capable of reckoning larger improvements in ride and handling performance, in distinction to devising the system robust to vehicle parameter fluctuations. For this, look-ahead preview

control is being actively developed by motorcar manufacturers. The multiple model adaptive control approach is a control method that is potentially appropriate to this type of suspension adaptation.

- 1) We have concluded that this project model can be heavily commercialized in various industries.
- 2) We can use this model in accident prevention of private and commercial vehicles basically the four wheelers .
- 3) We can conclude that this type of mechanism is very essential in current scenarios where the roads are heavily flowing with mixed traffic keeping safe distance between two vehicles.
- 4) We can conclude that this mechanism can be useful for off-road vehicles for better obstacle prevention.

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