

Development of Advanced Pneumatic Lifting and Ground Clearance Technique in Car

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ABSTRACT: The handling of 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 centre of gravity as low as possible. Whereas a sedan car or hatchback has to run on smooth roads as well as on rough terrains sometime with its fixed lower ground clearance which tends to create dents on the bottom portion the car. In both cases we need an adjustable ground clearance system in the vehicle to have optimum performance.

Most commercial vehicles currently on the market are still equipped with a passive suspension system, while some luxury brands may already use an adaptive suspension. Active suspension systems on the other hand are rarely found, however, they offer great opportunities to close the gap of the well-known trade-off between ride comfort and handling. Besides that, they can also be used to mitigate single event disturbances, an objective of the USA army as announced in a solicitation which initiated and motivated this research. In addition to that, several studies were found stating the impact and danger of potholes and their impact on the vehicle and passenger.

"Pneumatic jack" fabricated model consists of a pneumatic control valve which regulates the air flow and double acting cylinder used as a jack which performs lifting. Thus the car is lifted using jack and the problem related to tyres such as puncture types, tyre replacement and wheel balancing can be resolved with less effort and time.

KEYWORDS: Pneumatic jack, Pneumatic lifting, DC Motor, Wheels, Pneumatic cylinders, solenoid valve

I. INTRODUCTION

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 up to 200mm.

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 gas to produce a force in a reciprocating linear motion.

Due to the difficulty of operating automobile jacks, various forms of electric jacks have been proffered. With the development of such electric jacks has gradually come an understanding of some of the problems associated therewith. Due to the torque needed to lift something as heavy as most automobiles, as a severe mechanical advantage must be utilized. Jacks that are built into an automobile have not been accepted due to expense and the need to at least lift each side of an auto, if not all corners individually. To reduce the human effort for operating any kind of jack separately. This will most appropriately benefit senior citizens to provide a safe and simple automatic pneumatic jacking system without manual effort. To provide a novel jacking system that can be operated from within the vehicle by means

of a valve control. There are certain mechanisms already available for the same purpose which has a definite capacity to lift the car wheels viz.

OBJECTIVE OF THE WORK

- 1) The automatic in built pneumatic system is used to lift the chassis from the ground without human efforts and time.
- 2) Pneumatic lifting technique system is used to provide higher ground clearance at the time of rough roads and speed bumps.
- 3) To cope up the shortage of most commonly used fuel and go for compressed air or liquid fuel as a working medium.
- 4) While driving four wheelers, we faced a problem related to tyres. A hydraulic operated jack is placed in a supportable position where transitional motion to lift vehicle.
- 5) In several automobile garages, revealed the facts that mostly some difficult methods were adopted in lifting the vehicles for reconditioning.
- 6) Hence a suitable Design has been designed such that the vehicle can be lifted from the floor land without application of any impact force.
- 7) 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.
- 8) In order to fulfil the needs of present car jack, some improvement must be made base on the problems statement:
 - To design and develop efficient jack system.
 - To minimize human effort.

II. RELATED WORK

Hrshikesh V Deo& Nam P Suh Et.al [1] introduced that how the comfort and handling are interrelated with centre of gravity of the vehicle. They designed the suspension system which varies its height and stiffness according to speed. The researchers used short long arm suspension system which is widely used in front wheel suspension. For controlling the height and stiffness, it can be achieved by making the lower spring pivot movable along the lower control arm. For moving the pivoted point and achieve desired position electric motor is used to actuate the actuator. But there are some limitation which we come across, that is about less quick response. In this paper they also described about active and semi-active suspensions limitations and how it can be overcome with adaptive control with variable height.

P.E. Uys, P.S. Els, M. ThoressonEt.al [2] presented the suspension settings for optimal ride comfort of off-road vehicles travelling on roads with different roughness and speeds. In this they vary the suspension settings for different roads roughness and vehicle speeds and results achieved for comfort level. Simulation is performed on a Land Rover Defender 110 model in MSC.ADAMS software for speeds ranging from 10 to 50 km/hr. Tests were performed on 100m Belgian paving and also ISO 2631-1, BS 6841 and VDI 2057 at different speeds. Correlation between measured and simulated results is very good, especially with respect to vertical acceleration. There are number of applications related to ground clearance and their consideration is designer need. To give the information about vital role of ground clearance.

DebojyotiMitra Et.al [3] presented design optimization of ground clearance of domestic cars. Stability and performance is also parameter of ground clearance. If we allow the vehicle for the low ground clearance then it helps to give less drag force simultaneously it consumes less fuel resulting less pollution. The experiment is carried out in wind tunnel with the help of notch back car model. The result shows that the positive lift force reduces with increasing height of ground clearance. Hence the optimized value of h/b ratio has to be taken in to consideration of clearance design. With the help of spoiler the lift force problem can be solve. The active suspension system is very essential for handling and giving comfort. These days this system is used in different type of vehicles like hybrid vehicles.

Morteza and Mahdi Et.al [4] presented active suspension system in parallel hybrid electric vehicles. In this they compare the conventional and hybrid vehicle with active suspension. For conventional the power is taken from the IC engine hence gives little lag in actuation while in hybrid electric vehicle it is direct, resulting less fuel consumption and less emission.

Guangqiang Wu, Guodong Fan, and JianboGuo Et.al [5] presented ride comfort evaluation for road vehicle based on rigid-flexible coupling multibody dynamics. Spectrum of vibrations occurs in the vehicle due to various speeds. There are different road profiles and roughness therefore occupants are subjected to accelerations in different directions, which caused discomfort. With the help of ADAMS-CAR they built rigid and rigid flexible coupling multi-body vehicle models. As speed increases the relative difference goes increases, at 80 km/hr it becomes 8%. It is better to build the variable suspension with rigid flexible coupling.

Mohammad, Mahir and IyadEt.al [6] gives new control strategy for active suspension using modified fuzzy and PID controllers. In this they proposed controlled strategy to control the suspension system by means of electro-hydraulic actuator. The passive suspension is replaced by low frequency active suspension. The quarter car model tested under rolling effect, cornering and pitching effect at different speeds and road profiles. The reduction in body acceleration by 60% gives better road holding and car stability. There are two types of active suspensions which are commonly recognized that are low bandwidth and high bandwidth. Non-linear controllers are more capable to handle high bandwidth active suspension because they show good capability at worst road condition. Researchers give the linear controller over active suspension of low bandwidth new PID with fuzzy switch which improve the performance of suspension. The design of suspension is concern with three main parameter; car body acceleration for ride comfort, the tire deflection for road holding and the suspension travel. The ideal suspension system would minimize these three quantities for any road and operating condition, which is not achievable for suspension having constant spring stiffness and damping. This can be achieved by active suspension system. But this needed high external energy. Hence it is not widely used. The alternative solution is to use of semi-active suspension. It reduces car body resonance without compromising road holding. But this solution gives disturbance like jerk, rattling noise etc.

III. TEXT INPAINTING

PNUMATIC JACK

The working medium adopted is compressed air. The compressed air is transmitted through tubes to pneumatic cylinder where power is converted into reciprocating motion. The reciprocating motion is obtained by using an electrically controlled solenoid valve. The input to the solenoid valve is given through the control unit. The reciprocating motion transmitted to the jack through the piston which moves on the cylinder. The jack is placed under the vehicle chassis, where the vehicle to be lifted. The vehicle can be lifted when the solenoid valve is switched. The vehicle over the jack gets the reciprocating motion through the piston which is connected to the jack. Thus using a pneumatic jack the vehicle can be lifted with ease in operation.

- Power can be easily transmission.
- Less loss in transmission
- A single compressor can supply power to many pneumatic Jacky.
- Low cost.
- Easy to work and reduces the manual stress.

AUTOMATIC GROUND CLEARANCE

The components consist of essential of Chassis, D.C Motors, Ultrasonic Sensors, alarms, indicators, and Batteries .These components are used to Design and Fabrication of Automatic Ground Clearance Adjustment System. The working mechanism of in this system is

- ✓ Ultra Sonic Sensors are placed under the bumper and at middle and rare parts of the chassis. Ultrasonic Sensors detects the clearance height of the vehicle continuously.
- ✓ The Ultrasonic sensors detect the obstacles (speed breakers, slopes etc.) and sends signals to the arduino board circuit.
- ✓ By using relay switch, the arduino board sends power supply to the solenoid valve.
- ✓ The pneumatic cylinder lifts the chassis there by increasing the ground clearance.
- ✓ When the ultrasonic sensors detect no obstacles, they send signals to the arduino board, and then the solenoid valve acts and it to the pneumatic cylinder lowers the chassis thus by maintaining the normal ground clearance.

Working mechanism Torque, moment, or moment of force is the tendency of a force to rotate an object about an axis, fulcrum, or pivot. Just as a force is a push or a pull, a torque can be thought of as a twist to an object.

Mathematically, torque is defined as the cross product of the position vector of the point where the force is applied (distance vector) and the force vector, which tends to produce rotation. The magnitude of torque depends on three quantities: the force applied, the length of the lever arm connecting the axis to the point of force application, and the angle between the force vector and the lever arm.

WORKING OF ARDUINO BOARD

We used an Arduino Uno V2, but there are many different types available. Breadboards are named after cutting boards that early circuit enthusiasts used to hold their sensors. A breadboard is used as a place to hold your sensors, resistors and wires, and also serves as an easy way to connect things together. Breadboards come in all shapes and sizes.

Wires are essential to Arduino. They are what allow you to actually connect your Arduino to stuff. Most small, hobby wire will work. All you need to make sure is that it is small enough to easily fit into the pins on your Arduino and breadboard.

Different breadboards are set up in different ways. All you need to worry about with this one are the middle two big pin columns and column each big column has a bunch of rows. All of the pins within the same big column and row are connected together. This means that if we were to plug a 5v power source into pin a1, pins b1, c1, d1 and e1 will also receive power. No other pins on the board will be powered though. If we wanted to make a basic circuit to say, power an LED we first will plug our power source (in this case the Arduino 5v port) into one of the rows.

Coding can be a bit overwhelming at first. You are essentially trying to learn a new language, and may be frustrated that you can't get your code to work properly or do what you want. If you are just learning Arduino, I would recommend looking for code online instead of trying to teach it all to yourself. There is no shortage of helpful people online who post guides and code to projects they've done. As you gain experience you will become more familiar with the language and what the codes are actually doing. Until that point though, don't discourage yourself by trying to write something. The following code is a very basic code that will work for most digital sensors. It's highly commented as well so it should be able to explain what it is doing pretty well.

IV. EXPERIMENTAL RESULTS

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 30-40kg with a compressor of capacity 5bar, which is good enough for a lower scale work. The mechanisms 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 3cm along the obstacles. Car chassis is prevented from being damaged
- ✓ The system can withstand a weight of 3 to 4 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.

As a result of this automatic braking system, the function of each part is working well and the whole system is successfully accomplished. The safety distance is determined then the vehicle system is broken when the obstacle is detected. The ranging accuracy of ultrasonic sensor in this prototype is about 2cm to 1m and works effectively within the prescribed limit. Final Overview of Project In this project, we have checked the working of our project, we connected it with a batteries and whose braking system is controlled by a DC gear motor and servomotor. This technique is eco-friendly and this work is an attempt to reduce accidents while in critical driving conditions. We have tested the working of the system by placing various objects ahead as obstacles. The system responded by reducing the speed of the vehicle when the obstacle is placed at various distances from it. Also the system stopped automatically in restricted areas. It gave very accurate measurement according to limit of values interpreted .

Pneumatics working fluid is also widely available and most factories are pre-plumbed for compressed air distribution, hence pneumatic equipment is easier to set-up than hydraulics. To control the system, only ON and OFF are used and the system consists only of standard cylinders and other components, making it simpler than hydraulics. The working fluid of the pneumatic system absorbs excessive force, leading to less frequent damage to equipment. We can lift the weight of 40 kg at pressure of 4-5bar.

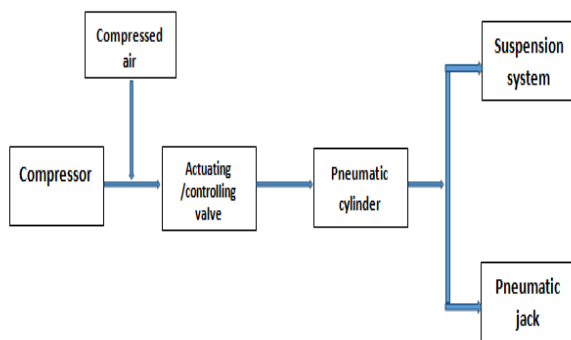


Fig.4.1 working operation of pneumatic cylinder

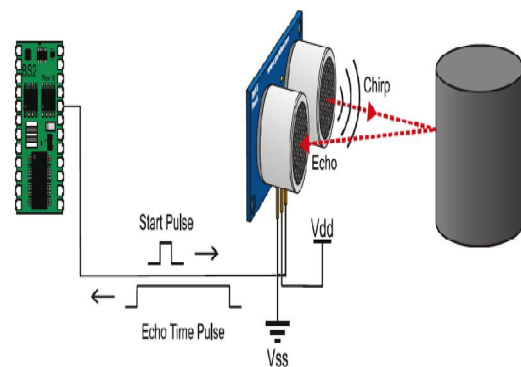


Fig.4.2 Working of Arduino Board



Fig.4.3 Arduino Board



Fig.4.4 Chassis setup



Fig.4.5 Model

V. CONCLUSION

The pneumatics jacks can act in the place of hydraulic jacks efficiently. The air required for the operating of the jack is easily available in the nature. Cost of the project is not high compared with other jacks. As our jack is in built the fatigue is less. If made in the lot the cost could be less.

1. It serves better than hydraulic jacks which is used for lifting.
2. Such that distraction driving is a major contributor to accident death, thus by implementing this System we can reduced the close impact potential accident.
3. This innovation would help the women elders and other fellow folks to easily change the tires.
4. It would save time of installing a manual jack and washing of the lower body of the car as it would raise the car by about 2 feet.
5. To minimize human effort.

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