Design and Fabrication of Ground Clearance Adjustment System

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Abstract - **This Paper converse about the study of Electro pneumatic Ground Clearance Adjustment System. The handling of vehicle depends upon the various parameters, centre of gravity of the vehicle is one of them. It is the trickiest dimension because vehicle handling directly depends on it. The higher the clearance, the higher is the position of Centre of Gravity (CG) of the vehicle. And the higher position of CG means that the vehicle is prone to roll over. That means vehicles with higher clearance have more possibility of turning over than the vehicles with lower clearance. Thus it affects the handling. On the other hand, vehicles with lower ride height offer superb handling performance due to lower height of vehicle CG but due to lower ground clearance there are chances of damage on lower part of vehicle.**

keywords - **Ground Clearance, Lower ride height, Centre of Gravity, Higher ride height, Turning over.**

I. Introduction

Ride height or ground clearance is the amount of space between the base of an automobile tire and the lowest point. High ride height is useful particularly when you are driving on rough terrain. Sedan tend to sit low to the ground, providing great handling. SUVs have high ride heights, making them excellent option for adventures on and off the road. In technical terms, ground clearance is the minimum amount of distance between the bottom of the vehicle body and the ground. That is to say this dimension, also referred to as ride height, is how far the lowermost area of your vehicle is from the road. With lots of ground clearance, the underbelly of the vehicle is less likely to hit the ground. With little ground clearance, the underbelly may scrape against a bump in the road and potentially cause damage. Because you sit up taller in a vehicle with a higher ride height, you can also have more visibility. Off-road vehicles have to face the rough terrain, where we need high ground clearance, on the other hand we run same vehicle on a road where high ground clearance is not necessary. Whereas hatchback or sedan car has to run on smooth roads as well as rough terrains with its fixed lower ground clearance which tends to create dents on bottom portion of the car. In both cases we need an adjustable ground clearance system in the vehicle to have optimum performance. The whole weight of vehicle is concentrated at a point known as center of gravity. At the lower ground clearance, we get the location of center of gravity near the 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 of the parameters during running of the vehicle. We need a location of center of gravity at a high level as well as at lower level according to road conditions.

We live in India, with roads that have plenty of imperfections. Badly designed speed breakers, the ground clearance plays an Important part there are bad roads, unpaved roads and sometimes, no roads at all in rural India. Apart from speed breakers we often find a lot things like bricks, stones being lying on roads. Things mentioned above cause untold damage to vehicles. In case of higher ground clearance, the car's under body does not get hit by these hindrances thereby leads to lower maintenance. To obtain the good performance at high speed and low speed it is necessary to build one system which can vary the ground clearance.

II. Problem Statement

Higher ground clearance increases the center of gravity of vehicle. Which makes the handling of vehicle difficult. In this case there is chance of turning over. On the other hand with lower ground clearance center of gravity is low but due to lower ground clearance there is chance of untold damage on the lower portion of the vehicle. So there is need to make one system which can adjust the ground clearance.

III. Working

We have designed a simple pneumatic linkage mechanism for ground clearance adjustment. The adjustment is possible with the help of an Ultrasonic Sensor and pneumatic system. Pneumatic cylinders are mechanical devices which use the power of compressed gas to produce a force in a reciprocating linear motion. Like in hydraulic cylinders, something forces a piston to move in the desired direction. Thus it produces a lift in desired direction. Air compressor is utilized to produce a pneumatic lift to increase the ground clearance whenever required otherwise it brings the chassis down to its position to have standard ground clearance by acting as an active suspension system. Ultrasonic sensor is an electronic device which senses distance of an obstacle by emitting Ultrasonic sound waves and it converts this sound waves into electrical signal. Pneumatic system can be

installed below the chassis of vehicle. Pneumatic system is consist of four double acting cylinders. An Ultrasonic sensor is mounted on lower side of vehicle at front end. When there will be any obstacle Ultrasonic sensor will send signal to Arduino board, then Arduino board will send signal to battery which will send signal to solenoid valve. Compressed air from compressor will pass through solenoid valve to four cylinders which are mounted below the chassis. So four cylinder will get extended which will in turn lift the chassis. When obstacle will be passed again Ultrasonic sensor will send signal to Arduino board and it will bring back the system to its original height. With the help of this system we can vary ground clearance of the vehicle up to 200mm.

IV. Design Calculations

W=10 kg
F=100 N
Divided in Four (4) wheel so, 100/4= 25N
F= 25N
F= A *P
24.5 = A * 0.4
Basic Calculations for Frame Design- we have considered frame size as, Length of frame= 762mm
Breadth of frame=610 mm

Now in our design as on the length part of frame overall weight of the system is placed so the length part is considered as beam, and design is done accordingly.

While designing the beam is considered as overhang beam as two motors are placed between the ends of beam, with uniformly distributed loading,

Hence UDL=100N/m considering total mass of the prototype as 10kg.

V. COMPONENTS OF SYSTEM

ULTRASONIC SENSOR

Ultrasonic sensor is an electronic device that measures the distance of target object by emitting ultrasonic sound wave and covert reflected sound into electrical signal. There are three types of Ultrasonic sensor, 1) Proximity sensor 2) Retro-reflective sensor 3) through-beam sensor. In these types ultrasonic sensing with proximity is one of the best way to sense presence of nearby object and detect levels with high reliability. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. Transducers are the microphones used to receive and send the ultrasonic sound. The sensor determines the distance to a target by measuring time lapses between the sending and receiving of the ultrasonic pulse. The working of Ultrasonic sensor in this project having simple principle. Ultrasonic sensor sends pulse at 40 KHz which travel through air and if there is an obstacle or object, it will bounce back to sensor and receiver collect the pulses. By calculating the travel time and speed of sound, the distance can be calculated.

PNEUMATIC CYLINDER

An actuator is a device that translates a source of static power into useful output motion. It can also be used to apply a force. Pneumatic actuators are mechanical devices that use compressed air acting on a piston inside a cylinder to move a load along a linear path .Engineers sometimes prefer to use pneumatics over hydraulic cylinder because they are quieter, cleaner, and do not require large amounts of space for fluid storage. Because the operating fluid is a gas, leakage from a pneumatic cylinder will not drip out and contaminate the surroundings, making pneumatics more desirable where cleanliness is a requirement. Piston is of disc or cylinder type and double acting cylinder with an air ports at each end. When selecting any air cylinder, it's important to properly match the cylinder to the application, particularly in terms of required force. The actual force applied to the load will be 3% to 20% less due to pressure losses in the system. When the required piston surface area (A) is known, the bore diameter (d) can be found by the formula.

MOTOR

An electric motor is a device which converts the electrical energy into the mechanical energy. Principle: An electric motor (dc motor) works on the principle that when an electric current is passed through a conductor placed normally in a magnetic field. A force acts on the conductor as a result of which the conductor begins to move and mechanical energy is obtained. Electric motors can be powered by direct current (DC) sources, such as from batteries, motor vehicles or rectifiers, or by alternating current (AC) sources, such as a power grid, inverters or electrical generators. Electric motors may be classified by considerations such as power source type, internal construction, application and type of motion output. In addition to AC versus DC types, motors may be brushed or brushless, may be of various phase (see single-phase, two-phase, or three-phase), and may be either air-cooled or liquid-cooled. General-purpose motors with standard dimensions and characteristics provide convenient mechanical power for industrial use. We used DC motor which is center shaft motor specially designed for robotics application and open a wide choice for you in terms of wheel and chassis. Due to particular characteristic such as speed control, speed torque performance, high torque over wide range DC motor is to be chosen. There are a variety of types of electric motors are available in the market. The selection of these motors can be done based on the operation and voltage and applications. Electric motors are found in industrial fans, blowers and pumps, machine tools, household appliances, power tools and disk drives. Small motors may be found in electric watches.

ARDUINO BOARD

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

VI. PROCESS SHEET

1. CUTTING

Cutting is the process is separating a material into two or three pieces by the application of force. It is process of producing the work piece by removing unwanted material from material. Turning, threading, and shaping, boring, chamfering, and facing are some cutting operations done by single point cutting tool. . The power chop saw is used for this operation. Chop saw, is a circular saw (a kind of power tool) which is typically used to cut hard materials, such as metals, tile, and concrete. The cutting action is performed by an abrasive disc, similar to a thin grinding wheel. The chop saw is a motorized working power tool designed to accurately and precisely complete square and angled cuts in metal. It works by spinning a circular steel saw blade at high speed. The work piece is placed against the fence, in standard position angle is 90 degree. A miter saw is a specialized tool that lets you make cuts at a variety of angles. The saw has a blade mounted on a swing arm that pivots left or right to produce angled cuts. You can use a miter saw to quickly make cuts for crown molding, picture frames, door frames, window casings etc. Approximately 50 to 60 minutes are required for this operation.

2. FINISHING

The main aim of finishing processes to alter the properties of surface. Commonly desired characteristics include improved aesthetics, adhesion, solder ability, chemical-, corrosion-, tarnish- or wear-resistance, hardness, electrical conductivity, flaw removal, and surface friction control. The machine used for this operation is hand grinder. The hand grinder also called as angle grinder is power tool used for finishing the surface. Angle grinders are typically used for both cutting, sharpening, and shining metal so it provides more of a versatile use for the user as opposed to cut off tools. Angle grinders are standard equipment in metal fabrication shops and on construction sites. They are also common in machine shops, along with die grinders and bench grinders. The angle grinder has large bearings to counter side forces generated during cutting, unlike a power drill, where the force is axial. The 20 minutes is sufficient for this operation

3. WELDING

Welding is a fabrication process whereby two or more parts are fused together by means of heat, pressure or both forming a join as the parts cool. This method is used to weld the square section pipe to form one object. Here we used arc welding method. In arc welding process electric arc is used to create heat to melt and join the material. By using power supply arc is created between the electrode and base metal either by AC or Dc current. The direction of current used in arc welding also plays an important role in welding. The welding arc powered by machine called welder. It is single phase static transformer .Current is continuously regulated by hand wheel. Read the entire contents of this manual before installing, using or servicing the equipment, paying special attention to the chapter on safety precautions. Contact your distributor if you do not fully understand these instructions. The time required for this operation is 2 hours.

4. POLISHING

Polishing is the process of enhancing the appearance of surface by making is smooth and shiny. This operation is performed to polish the welded joints with hand grinder using grinding wheel. The machine used for this operation is hand grinder With refinement, grinding becomes polishing, either in preparing metal surfaces polishing, either in preparing metal surfaces for subsequent buffing or in the actual preparation of a surface finish such as a No. 4 polish in which the grit lines are clearly visible. The strength of polished products can be higher than their rougher counterparts owing to the removal of stress concentrations present in the rough surface. They take the form of corners and other defects which magnify the local stress beyond the inherent strength of the material. Grinding removes saw marks and levels and cleans the specimen surface. Polishing removes the artifacts of grinding but very little stock. A typical speed for wheel operation is 2500 meter per minute. The time required for this operation is 20 minutes. There are wide number of grinding and polishing tools are available in market.

VII. BLOCK DIAGRAM

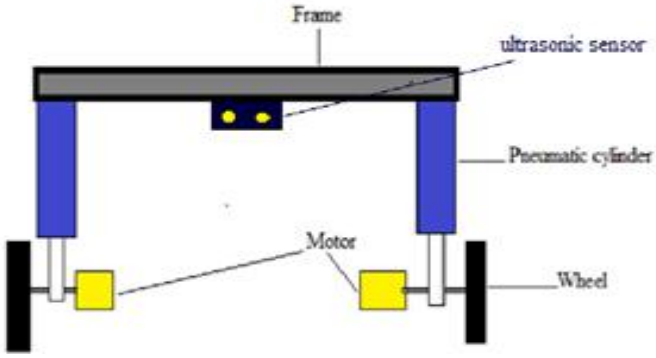

Fig. Block Diagram

VIII. CONCLUSION

This pneumatic lifting technique is used to provide high ground clearance at the time of rough road/breakers and lower the same to get proper ground clearance to maintain the stability at high speed on smooth roads. With the help of this system we can vary ground clearance of the vehicle up to 200mm. This system helps in under steering of vehicles. With this system we can adjust the ground clearance of vehicles according to comfort. This type of mechanism is very useful in today's world where the roads are heavily flooded with traffic for keeping safe distance between the vehicles. This mechanism is useful for on roads as well as off roads vehicles. I.e. for off roads one can have high ground clearance and in case of on roads by lowering the ground clearance for better journey. This system is more user friendly and at the same time it will give better performance. The cost for that system is also less. And also this mechanism have good market potential.

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