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Design and Fabrication of Automatic Ground Clearance Adjustment System

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Abstract:-Vehicle ride comfort is one of the most important performances of vehicle; the research of automotive ride comfort is getting more and more important. In this paper is to design and develop a system that is "Automatic ground clearance adjustment system" to overcome this problem by adjusting the ground clearance over this particular time period. Automatic ground clearance adjustment system mainly consists of six major parts such as Chassis, D.C motor, Embedded Development board with Radio Frequency Modules (Encoder & Decoder) and micro controller, IR sensors, alarms, indicators and batteries. The average time required by the system to vary the ground clearance of the vehicle is two seconds. The cost of implementing this system is also low. By implementing "Automatic ground clearance adjustment system**"**, we can vary the ground clearance of the vehicle. So there is need of developing a system which can vary the ground clearance of the vehicle.

Keywords: *Ground Clearance, suspension system*

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I. INTRODUCTION

This paper presents a summary of research into the development and implementation of a Automatic Ground Clearance Adjustment System It is not possible for the vehicle to run at high speed on its standard ground clearance provided considering the city obstacles. To provide the ability to the vehicle to give 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 Suspension systems plays vital role while designing the car for good stability and road holding ability . It is very difficult to achieve this ability at all road condition with passive suspension system. This problem can solve by active suspension system but this is not widely used because it required more external energy and additional controlling system which affected on cost of the vehicle

G. N. Reizina[1] carried out experiments to Investigation of the Vibrations of an Automobile Suspension Using the Theory of Experiment Design Professor Jonathan S et al [2] carried out A form verification system for the conceptual design of complex mechanical systems Mehran Khalaj et al .[3] carried out A novel risk-based analysis for the production system under epistemic uncertainty Risk analysis of production system, while the actual and appropriate data is not available, will cause wrong system parameters prediction and wrong decision making. . The research has presented a hopeful concept for the calculation of production system's risk, and its results show that in uncertainty condition Sy-Wei Lo et al .[4] carried out Monitoring the Displacement of a Blank in a Deep Drawing Process by Using a New Embedded-Type Sensor Murray Mackay [5] carried out A Review of the Biomechanics of Impacts in Road Accidents The real world characteristics of road accidents relevant to biomechanical considerations will be outlined P. L. Ardoino and F. Ioppolo in.[6] carried out Kinematics and Dynamics of the Vehicle/Seat/Occupant System Regarding Whiplash Injuries Whiplash injuries continue to have significant societal cost; however, the mechanism and location of whiplash injury is still under investigation. Predicting neck response and injury resulting from motor vehicle. J Latchford et al .[7] carried out Development of a third generation mechanically inflated airbag head restraint system and its characterization under impact loading. The function of the head restraint system is to prevent injurious hyperextension of the neck following a vehicle rear end impact. The nature and severity of the head and neck injuries attributed to rear end

Eun-Mi Lee et al .[8] carried out Study on design of progressive dies for manufacture of automobile structural member using DP980 advanced high strength steel Advanced high-strength steel (AHSS) is widely used in automobile manufacturing to reduce the weight of vehicles, thereby improving fuel efficiency. PingJun Xia et al .[9] carried out A new type haptics-based virtual environment system for assembly training of complex products. Virtual reality (VR)-based assembly training has been an interesting topic for the last decades. Generally, there are two shortcomings for nowadays virtual assembly training systems

Hongshen Zhang and Ming Chen in[10] carried out Theoretical Analysis and Experimental Study on the Coating Removal from Passenger-Vehicle Plastics for Recycling by Using Water Jet Technology The recovery and utilization of automotive plastics are a global concern because of the increasing number of end-of-life vehicles. Kenneth A et al .[11]

carried out Improving Automotive Safety: The Role of Industry, the Government, and the Driver This paper identifies three groups that can improve automotive safety. The three groups are the automotive industry by designing into cars such safety devices as seat belts, roll bars, or air bags. Xiaoxuan Zhang et al .[12] carried out Application Research of Statistical Energy Analysis on Vehicle Sound Package A whole vehicle SEA model is established by hybrid method combining body structure and sound package. Modal density, damping loss factor and sound package material parameters are obtained by testing Lin Hu et al .[13] carried out Vehicle ride comfort is one of the most important performances of vehicle; the research of automotive ride comfort is getting more and more important. In this paper, the subsystems dynamics analysis models

Arguably, the first attempt to develop such a design technique was on the 1922 Lancia Lambda to provide structural stiffness and a lower body height for its car body. The next application of an effective structural integration of body and chassis using spot welded deep stamped steel sheets into a structural cage, including sills, pillars and roof beams was on the 1934 Citroën Traction Avant. The streamlined 1936 Lincoln-Zephyr with conventional front-engine, rear-wheel-drive layout utilized a unibody structure. By 1941, unit construction was no longer a new idea for cars, "but it was unheard of in the low-price field [and] Nash wanted a bigger share of that market." The single unit body construction of the Nash 600 provided weight savings and Nash's Chairman and CEO, George W. Mason was convinced "that unibody was the wave of the future." Nash became the first automaker to develop this type of construction for a mass-produced, low-priced car.

Suspension is the system of tires, tire air, springs, shock absorbers and linkages that connects a vehicle to its wheels and allows relative motion between the two. Suspension systems serve a dual purpose — contributing to the vehicle's road holding/handling and braking for good active safety and driving pleasure and keeping vehicle occupants comfortable and a ride quality reasonably well isolated from road noise, bumps, vibrations etc. These goals are generally at odds, so the tuning of suspensions involves finding the right compromise. It is important for the suspension to keep the road wheel in contact with the road surface as much as possible, because all the road or ground forces acting on the vehicle do so through the contact patches of the tires. The suspension also protects the vehicle itself and any cargo or luggage from damage and wear. The design of front and rear suspension of a car may be different.

Ride height (also called ground clearance or simply clearance) is the amount of space between the base of an automobile tire and the underside of the chassis; or, more properly, to the shortest distance between a flat, level surface, and any part of a vehicle other than those parts designed to contact the ground (such as tires, tracks, skis, etc.). Ground clearance is measured with standard vehicle equipment, and for cars, is usually given with no cargo or passengers.Ground clearance is a critical factor in several important characteristics of a vehicle. For all vehicles, especially cars, variations in clearance represent a trade-off between handling and practicality. A higher ground clearance means that the center of mass of the car is higher, which makes for less precise and more dangerous handling characteristics (most notably, the chance of rollover is higher).

The wheelbase of a vehicle equals the distance between its front and rear wheels. At equilibrium, the total torque of the forces acting on a vehicle is zero. Therefore, the wheelbase is related to the force on each pair of tires by the following formula:

$$F_f = \frac{d_r}{L} mg$$

$$F_r = \frac{d_f}{L} mg$$

Where F_f is the force on the front tires, F_r is the force on the rear tires, L is the wheelbase, d_r is the distance from the centre of mass (CM) to the rear wheels, d_f is the distance from the centre of gravity to the front wheels ($d_f + d_r = L$), m is the mass of the vehicle, and g is the gravity constant. So, for example, when a truck is loaded, its centre of gravity shifts rearward and the force on the rear tire increases. The vehicle will ride lower. The amount the vehicle sinks will depend on counter acting forces like the size of the tires, tire pressure, and the stiffness of the suspension. If the vehicle is accelerating or decelerating, extra torque is placed on the rear or front tire respectively. The equation relating the wheelbase, height above the ground of the CM, and the force on each pair of tires becomes:

$$F_r = \frac{d_f}{L} mg + \frac{h_{cm}}{L} ma$$

$$F_f = \frac{d_r}{L} mg - \frac{h_{cm}}{L} ma$$

Where m is the mass of the vehicle, g is the acceleration of gravity (approx. 9.8 m/s^2), h cm is the height of the CM above the ground, a is the acceleration (or deceleration if the value is negative). So, as is common experience, when the vehicle accelerates, the rear usually sinks and the front rises depending on the suspension. Likewise, when braking the front noses down and the rear rises.

II. BLOCK DIAGRAM OF THE AUTOMATIC GROUND CLEARANCE ADJUSTMENT SYSTEM

This paper presents a summary of research began with the collection of information and data on ground clearances and suspensions of various cars. The current difficulties are being analyzed. The main problem of low ground clearance vehicles is that the chassis hits the ground when they cross speed breakers and slopes.

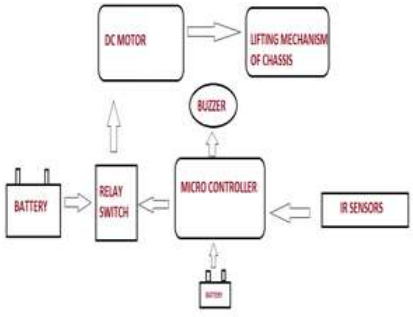

Fig 1. Block diagram of the automatic ground clearance adjustment system for cars

III. WORKING MECHANISM

The components consist of essential of Chassis, D.C Motors , IR 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

- IR Sensors are placed under the bumper and at middle and rare parts of the chassis. IR Sensors detects the clearance height of the vehicle continuously.
- The IR sensors detect the obstacles (speed breakers, slopes etc.) and sends signals to the ECU circuit.
- The system alerts the driver by an alarm.
- By using relay switch, the ECU circuit sends power supply to the wiper motor.
- The wiper motor lifts the chassis there by increasing the ground clearance.
- When the IR sensors detect no obstacles, they send signals to the ECU circuit, and then the wiper motor lowers the chassis thus by maintaining the normal ground clearance.

Fig 2. 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. In symbols:

$$T = F * R$$
$$T = \|R\| \, \|F\| \, \sin\theta$$

Where

T is the torque vector and T is the magnitude of the torque,

R is the position vector (a vector from the origin of the coordinate system defined to the point where the force is applied), F is the force vector,

θ is the angle between the force vector and the lever arm vector.

IV. SAFE AMOUNT OF WEIGHT THAT THE MECHANISM CAN WITHSTAND

T=F*R

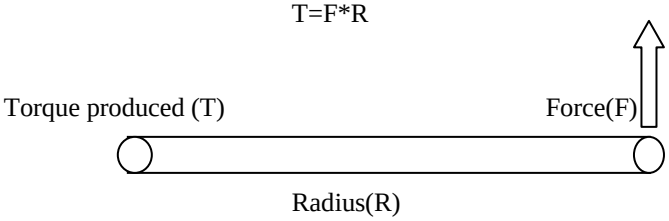

Fig 3.torque produced diagram

Here, Magnitude of torque = 10N-m
Radius of curvature of the circular frame = 10cm or 0.1m
Torque = force * radius of curvature
Force = torque / radius of curvature
Force = 10N-m/0.1m
Force = 100N
It is the force that the system can withstand.
The amount of weight that the system can withstand is 100N
The weight of an object is usually taken to be the force on the object due to gravity. Weight is a vector whose magnitude, often denoted by an italic letter W, is the product of the mass m of the object and the magnitude of the local gravitational acceleration g.

W = mg.

Consider force as weight
Force = mass* acceleration due to gravity
Mass = force / acceleration due to gravity
Mass = 100N / 9.81m/s2
Mass = 10.193 Kg
The mass that the system can withstand is 10.193Kg

Fig 4. Design of photo type automobile

V. RESULTS AND DISCUSSIONS

•The average time required by the system to vary the ground clearance of the vehicle is two seconds.
•The ground clearance of the vehicle is increased by 5cm along the obstacles. Car chassis is prevented from being damaged
•The system can withstand a weight of 100N with the wiper motor of 70watts capacity.

VI. CONCLUSIONS

By implementing the Automatic ground clearance adjustment system , number of damages to the car chassis are greatly reduced.
Below are some of the conclusions based on new derived process and new design

- Smooth drive.
- The system comes into work within time indicating us with the buzzer.
- The model is compact with low cost and safety.

REFERENCES

[1] G. N. Reizina, Investigation of the Vibrations of an Automobile Suspension Using the Theory of Experiment Design, Journal of Engineering Physics and Thermophysics ,2001
[2] Professor Jonathan S. Colton, Mark P. Ouellette A form verification system for the conceptual design of complex mechanical systems, Engineering with Computers ,1994
[3] Mehran Khalaj,Fereshteh Khalaj, Amineh Khalaj A novel risk-based analysis for the production system under epistemic uncertainty, 26 November 2013
[4] Sy-WeiLo, Guo-MingJeng, Monitoring the Displacement of a Blank in a Deep Drawing Process by Using a New Embedded-Type Sensor, The International Journal of Advanced Manufacturing Technology ,1999
[5] Murray Mackay, A Review of the Biomechanics of Impacts, Road Accidents in Crashworthiness of Transportation Systems, 1997
[6] P. L. Ardoino, F. IoppoloMurray Mackay, Kinematics and Dynamics of the Vehicle/Seat/Occupant System Regarding Whiplash Injuries, 2014
[7] J Latchford, E C Chirwa , Development of a third generation mechanically inflated airbag head restraint system and its characterization under impact loading, 2003
[8] Eun-Mi Lee, Do-Sik Shim, Jong-Youn Son, Study on design of progressive dies for manufacture of automobile structural member using DP980 advanced high strength steel, Journal of Mechanical Science and Technology , 2016
[9] PingJun Xia, António M. Lopes, A new type haptics-based virtual environment system for assembly training of complex products, The International Journal of Advanced Manufacturing, 2012
[10] Hongshen Zhang, Ming Chen , Theoretical Analysis and Experimental Study on the Coating Removal from Passenger-Vehicle Plastics for Recycling by Using Water Jet Technology, JOM , 2015
[11] Kenneth A. Solomon, Susan Resetar, Improving Automotive Safety: The Role of Industry, the Government, and the Driver, Risk Assessment and Management, 1987
[12] XiaoxuanZhang, XingrangWu, YuhuCheng, Application Research of Statistical Energy Analysis on Vehicle Sound Package, Proceedings of the FISITA 2012 World Automobile, 2013
[13] Lin Hu, Jing Huang, Fangyi Li , Simulation and Optimization of Vehicle Ride Comfort on Random Road, Advances in Mechanical and Electronic Engineering , 2012
[14] Toshiyuki InagakiTowards Monitoring and Modelling for Situation-Adaptive Driver Assist Systems, Modelling Driver Behaviour in Automotive Environments, 2007
[15] Jae-DuNam, Seung-HoonCha, Min-SuAhn, Development of non-lubricated die for magnesium sheet forming of car body part**,** International Journal of Precision Engineering, 2014
[16] Makoto Itoh, Toward Preventive ACC Systems against Crashes Due to Another Vehicle's Cut-in, Intelligent Robotics and Applications, 2009
[17] Clifford Winston, Vikram Maheshri, Fred Mannering, An exploration of the offset hypothesis using disaggregate data: The case of airbags and antilock brakes, Journal of Risk and Uncertainty, 2006
[18] Hyun-sik Kim, Yoon-sun Lee, Sung-mo Yang, Structural analysis on variable characteristics of automotive seat frame by FEA, International Journal of Precision Engineering, 2016
[19] Gail M. Heffernan Path Dependence, Behavioral Rules, and the Role of Entrepreneurship in Economic Change: The Case of the Automobile Industry, The Review of Austrian Economics, 2003
[20] D.L.Smith, Y.Wu, D.Matthew, Application of Nonstationary Markovian Models to Risk Management in Automobile Leasingin, Decision Making: Recent Developments and World, 2000
[21] T. -W. Kim, H. -Y. Jeong, Stochastic analysis of the variation in injury numbers of automobile frontal crash tests, International Journal of Automotive Technology, 2010