Design and Development of Pneumatic Bumper with Automatic Braking System

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ABSTRACT

Abstract:The aim is to design and develop a control system based an intelligent electronically controlled automotive bumper activation system is called "AUTOMATIC PNEUMATIC BUMPER". This system is consists of ultrasonic transmitter and Receiver ultrasonic circuit, Control Unit, Pneumatic bumper system. The ultrasonic sensor is used to detect the obstacle. There is any obstacle closer to the vehicle (with in 2 feet), the control signal is given to the bumper activation system.

Keywords: Automation, Sensor, Pneumatic Bumper, Automatic Brakesetc.

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1. INTRODUCTION

We have pleasure in introducing our new project "AUTOMATIC PNEUMATIC BUMPER", which is fully equipped by ultrasonic sensors Ultrasonic and Pneumatic bumper activation Ultrasonic circuit. It is a genuine project which is fully equipped and designed for Automobile vehicles. This forms an integral part of best quality. This product underwent strenuous test in our Automobile vehicles and it is good.

Automation can be achieved through computers, hydraulics, pneumatics, robotics, etc., of these sources, pneumatics form an attractive medium for low cost automation. The main advantages of all pneumatic systems are economy and simplicity. Automation plays an important role in mass production. For mass production of the product, the machining operations decide the sequence of machining. The machines designed for producing a particular product are called transfer machines. The components must be moved automatically from the bins to various machines sequentially and the final component can be placed separately for packaging. Materials can also be repeatedly transferred from the moving conveyors to the work place and vice versa. Now days almost all the manufacturing process is being atomized in order to deliver the products at a faster rate.

2. METHODOLOGY

Pneumatic braking system of an intelligent electronically controlled automotive braking system. Based on this model, control strategies such as an 'antilock braking system' (ABS) and improved maneuverability via individual wheel braking are to be developed and evaluated. There have been considerable advances in modern vehicle braking systems in recent years. For example, electronically controlled ABS for emergency braking, electronically controlled hydraulically actuated individual brake-by-ultrasonic (BBW) systems for saloon cars and electronically controlled pneumatically actuated systems for heavy goods vehicles. The work of recent years shall form the basis of a system design approach to be implemented. The novelty of the proposed research programmed shall lie in the design and evaluation of control systems for achieving individual wheel motion control facilitated by BBW. In the case of BBW the brake pedal is detached from the hydraulic system and replaced by a 'brake pedal simulator'. The simulator provides an electrical signal for the electronic control system.

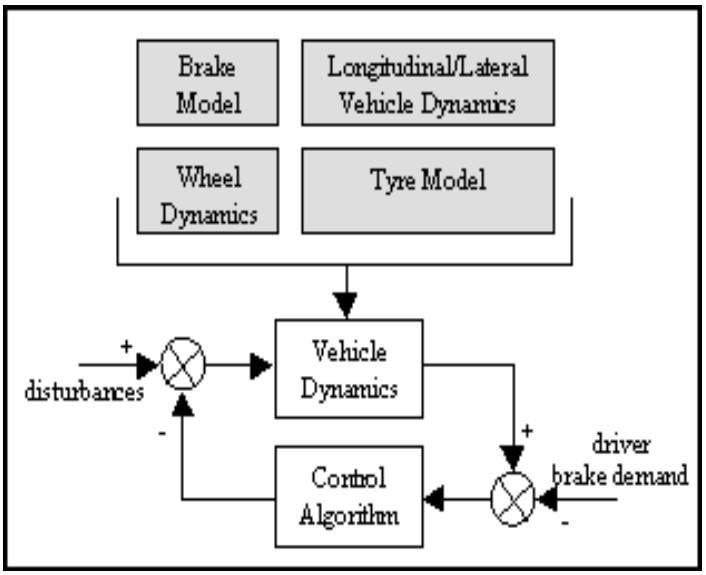

Fig-1: Constructional Block Diagram

There have been considerable advances in modern vehicle braking systems in recent years. For example, electronically controlled ABS for emergency braking, electronically controlled hydraulically actuated individual brake-by-ultrasonic (BBW) systems for saloon cars and electronically controlled pneumatically actuated systems for heavy goods vehicles. The work of recent years shall form the basis of a system design approach to be implemented. The novelty of the proposed research programmed shall lie in the design and evaluation of control systems for achieving individual wheel motion control facilitated by BBW. In the case of BBW the brake pedal is detached from the hydraulic system and replaced by a 'brake pedal simulator'. The simulator provides an electrical signal for the electronic control system.

2.1 Flow control valve

Features:

- Maintains constant flow with changing inlet and outlet pressures. The minimum pressure differential between inlet and outlet ports must be 100 PSI (7 Bar) to function properly.
- Maintains flow setting within approximately ±5% variation over pressure drop range 100 to 3000 PSI (7 to 205 Bar).
- Has an adjustable flow setting. See needle chart for controlled flow range.
- Trim adjustment option allows valve to be adjusted ±5% when valve is locked in a flow setting.
- Sub plate mounted valve is standard with reverse flow check valve. (See Reverse Flow Chart.) Check valve cracking pressure is 5 PSI (0.3 Bar).
- Designed to give a constant flow rate over a wide change of fluid temperature. Refer to needle chart for percentage change in flow.
- Available with optional lunge control for limiting compensator piston travel. This control prepositions the compensator piston to reduce actuator lunge or jump.

2.2 Solenoid valve

- Valve Model: 2P025
- Valve Type: 2 Way, Normally Closed (NC)
- Action: Direct Acting (Poppet)Fast Response Time: <20msec
- Orifice (Cv): 2.5mm (0.23); 22SCFM @ 100psi
- Operating Pressure: Vacuum to 115psi
- Operating Temperature: 14 to 122°F (-10 to 50°C)
- Port Size (Tube OD): 1/8” or 1/4” NPT
- Wetted Surfaces: Valve Body: Engineered Nylon Seals: NBR (Buna); Option: Viton (FKM), EPDM Armature Assembly: Brass; Option:Stainless Steel
- Coil Duty: H Class, IP65, 100% ED
- Voltag: Options: 12, 24 VDC; 24,110/120 (50/60Hz), 220/240 VAC (50/60Hz)
- Voltage Tolerance: ±10% of Specified voltage
- Coil Power: 3 to 8W (pressure dependent)

- Electrical Connections: DIN or Grommet
- Installation: Orientation Requirement (Optimum Position: Flow Horizontal & Solenoid Vertical)
- Service: Air, Liquid, Water

2.3 Pneumatic cylinder

Construction:

- Cylinder Tube: For bore of 19, 25, 40, and 50 mm hard drawn, polished brass/ aluminum tube
- Piston Rod: High tensile steel, Ground & hard chrome plated.
- Seals: Buna "N" (Nitrile elastomer)
- End cover & piston: Close grained cast iron.
- Operating Condition
- Media: Air,Oil and inert-gases.
- Temp. Range: 0° C to +85° C
- Pressure Range: 10 Kg/cm2 (150 PSIG) for compressed air. 25 Kg/cm2 (350 PSIG) for oil.
- Cushions: For 19 and 25 mm bore rubber shock absorbers as optional. Above 25 mm bore adjustable cushions as standard.
- Consumption: Liters of free air per 100 mm single stroke at 5 Kgf/cm2

2.4 Frame material

AISI 1018 mild/low carbon steel has excellent weld ability and produces a uniform and harder case and it is considered as the best steel for carburized parts. AISI 1018 mild/low carbon steel offers a good balance of toughness, strength and ductility. Provided with higher mechanical properties, AISI 1018 hot rolled steel also includes improved machining characteristics and Brinell hardness.

Chemical Composition:

- Element Content:
- Carbon, C 0.14 - 0.20 %
- Iron, Fe 98.81 - 99.26 % (as remainder)
- Manganese, Mn 0.60 - 0.90 %
- Phosphorous, P ≤ 0.040 %
- Sulfur, S ≤ 0.050

2.5 Brake: - drum brake

2.6 Controller: - Adriano atmega328

2.7 Sensor: - IR sensor

3. PHASES OF NEW MODERN VEHICLE

The aim is to design and develop a control system based on pneumatic brakeing system of an intelligent electronically controlled automotive braking system. for comparison of iterative technologies / techniques. The final phase of the new modern vehicle shall include:

- Development of improved ABS control systems
- Development and assessment of an electro-hydraulic-BBW (EH-BBW) system
- Individual wheel braking combined with traction control
- Assessing sensor failure and fault tolerant control system design
- Preliminary studies into an electrically actuated system
- Re-engineering using simplified models.

4. PNEUMATIC SYSTEM

Pneumatic systems operate on a supply of compressed ultrasonic which must be made available in sufficient quantity and at a pressure to suit the capacity of the system. When the pneumatic system is being adopted for the ultrasonic time, however it wills indeed the necessary to deal with the question of compressed ultrasonic supply. The key part of any facility for supply of compressed ultrasonic is by means using reciprocating compressor. A compressor is a machine that takes in a ultrasonic, gas at a certain pressure and delivered the ultrasonic at a high pressure.

Compressor capacity is the actual quantity of ultrasonic compressed and delivered and the volume expressed is that of the ultrasonic at intake conditions namely at atmosphere pressure and normal ambient temperature. The compressibility of the Ultrasonic was Ultrasonic investigated by Robert Boyle in 1962 and that found that the product of pressure and volume of a particular quantity of gas.

The usual written as

$PV = C$ (or) $P_1V_1 = P2V2$

In this equation the pressure is the absolute pressured which for free is about 14.7 Psi and is of courage capable of maintaining a column of mercury, nearly 30 inches high in an ordinary barometer. Any gas can be used in pneumatic system but ultrasonic is the mostly used system now days.

5. PNEUMATIC SINGLE ACTING CYLINDER

The cylinder is a Single acting cylinder one, which means that the air pressure operates forward and spring returns backward. The air from the compressor is passed through the regulator which controls the pressure to required amount by adjusting its knob. A pressure gauge is attached to the regulator for showing the line pressure. Then the compressed air is passed through the single acting 3/2 solenoid valve for supplying the air to one side of the cylinder.

Fig: - 2: Single Acting Cylinder

6. ULTRASONIC SENSOR

A sensor is a transducer used to make a measurement of a physical variable. Any sensor required ultrasonic calibration in order to be useful as a measuring device. Calibration is the procedure by which the relationship between the measured variable and the converted output signal is established. Care should be taken in the choice of sensory devices for particular tasks. The operating characteristics of each device should be closely matched to the task for which it is being utilized. Different sensors can be used in different ways to sense same conditions and the same sensors can be used in different ways to sense different conditions.

Fig: - 3: Ultrasonic sensor

6.1 Ultrasonic transmitter

The ultrasonic transmitting ultrasonic circuits used in many projects. The ultrasonic transmitter sends 40 kHz (frequency can be adjusted) carrier under 555 timer control. Ultrasonic carriers at around 40 kHz carrier frequencies are widely used in TV remote controlling and ICs for receiving these signals are quite easily available.

6.2 Ultrasonic receiver

The transmitted signal reflected by the obstacle and the ultrasonic receiver ultrasonic circuit receives the signal and giving control signal to the control unit. The control unit activates the pneumatic brakeing system, so that brake was applied.

7. BRAKING SYSTEM

The foot brake or service brake is always applied by a pedal, while the parking brake is applied by a hand lever. The parking brake is intended chiefly to hold the car in position. The parking brake can be set in the "ON" position by means of a latch while the service brake remains on only as long as the driver presses down on the pedal. The hand brake is normally used only after the driver has stopped the car by using the foot brake. Its other use is as an emergency brake to stop the car if the foot broken system should fail. The hand or parking brakes operates on a PA Ultrasonic of wheels, frequently the rear wheels. When drum type rear brakes are used, the same shoes can be used for both hand and foot control. The drum type of brake may either be a band brake or a shoe brake. Both band brakes and shoe brakes may be either external or internal. The band brakes generally are external and shoe brakes internal. In drum brakes the drum is attached to the wheel and revolves with it. Friction to slow the drum is applied from inside by the shoes which do not rotate but are mounted on a stationary metal back plate. There are different types of drum brakes such as a two leading shoe arrangement – which gives an augmented response to pedal effort because of its self-applying arrangement. A leading-trailing shoe is a cheaper and better alternative as it is equally effective whether the car is going forward or backwards.

Manufacturers design drum brakes so that rain, show or ice or grit cannot get inside and decrease braking efficiency for moisture greatly reduces the friction between the linings and the drum. The dissipate quickly the considerable amount of heat generated when braking a fast moving heavy car large brake drums would be required ultrasonic. Disc brakes do the job more efficiently, for the cooling a ultrasonic can get to the rubbing between each piston and the disc, there is a friction pad held in position by retaining pins, spring plates etc. Passages are drilled in the calliper for the fluid to enter or leave the each housing. These passages are also connected to another one for bleeding. Each cylinder contains a rubber selling ring between the cylinder and the piston. The brakes are applied, hydraulically actuated piston move the friction pads into contact with the disc, applying equal and opposite forces on the later. On releasing the brakes, the rubber sealing rings act as return springs and retract the pistons and the friction pads away from the disc.

8. WORKING PRINCIPLE

The ultrasonic circuit is to transmit the ultrasonic rays. If any obstacle is there in a path, the ultra-sonic rays are reflected. These reflected ultrasonic rays are received by the receiver. The receiver circuit receives the reflected rays and giving the control signal to the control circuit. The control circuit is used to activate the solenoid valve. If the solenoid valve is activated, the compressed air passes to the Single Acting Pneumatic Cylinder. The compressed air activates the pneumatic cylinder and moves the piston rod forward. Thus the bumper is actuated. When the solenoid valve gets actuated the compressed air also goes to the small single acting pneumatic cylinder and actuates it. If the piston moves forward, then piston rod which is connected to the lever

of the hydraulic disc brake pushes and hence the brake is applied. The braking arrangement is used to brake the wheel gradually or suddenly due to the piston movement. The braking speed is varied by adjusting the valve is called flow control valve. The compressed air flow through the polyurethane tube to the flow control valve. The flow control valve is connected to the solenoid valve.

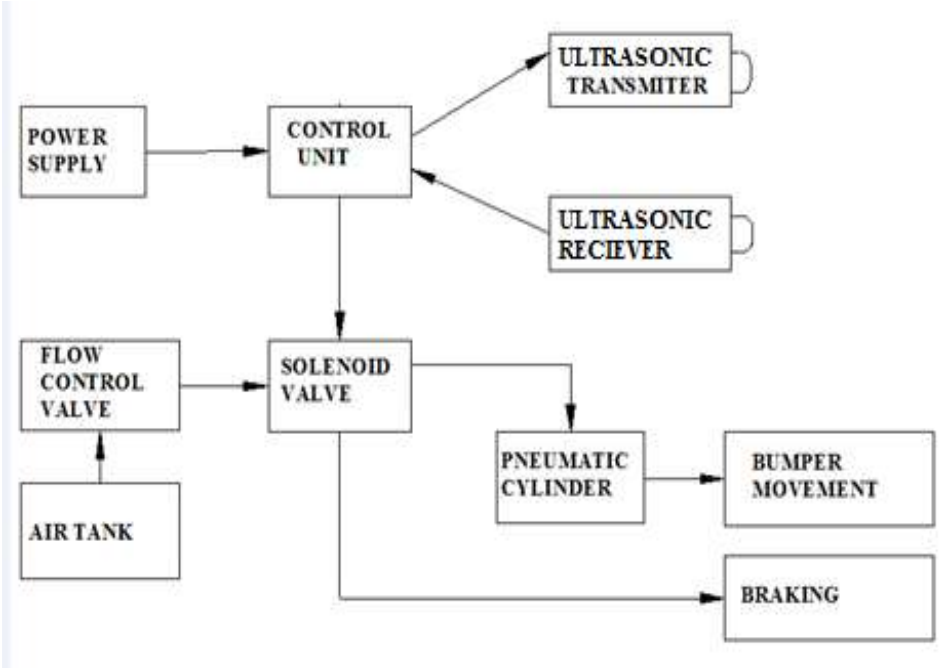

Fig:-4 Block diagram of our project

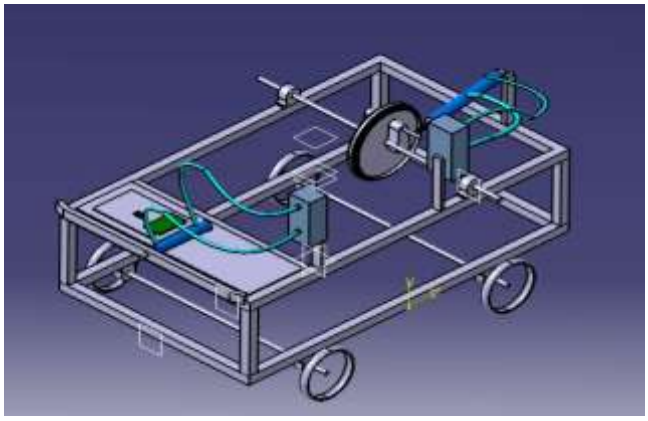

Fig:-5 3D model of automatic pneumatic bumper and braking system

9. ADVANTAGES

1) It able to Increase the sureness in braking system.
2) Braking system able to give fast response.
3) System able to increase the pre-crash safety.
4) System able to provide more safety to the passengers.
5) System plays an important role to save human Life in road accidents

10. LIMITATIONS

1) System has few limitations in densely traffic road.
2) System has no provision to prevent and cure the accidents from rear side of vehicle.
3) Hard and thick materials cannot be riveted.

4) Due to the linkages there will be frictional losses.
5) Maintenance will be more due to the number of moving parts.
6) Stroke length is fixed.

11. APPLICATIONS

1) This system may be applicable in all types of light vehicles like cars, Rickshaws, Tempos.
2) This system also successfully installed in the heavy vehicles like buses, trucks, trailers, etc.

12. CONCLUSION

Behind the designing of this system, our main aim is to improve the technique of prevention of accidents and also reducing the hazard from accidents like damage of vehicle, injury of humans, etc. The application of pneumatics produces smooth operation. By using more techniques, they can be modified and developed according to the applications. By implementing this project we can reduce cost of high end cars by giving similar kind of safety. This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We have gained practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. Towards the end of completion of the project, we felt that the project has helped us to bridge the gates between institution and industries.

In conclusion remarks of our project work, we have developed an "DESIGN AND DEVELOPMENT OF PNEUMATIC BUMPER WITHAUTOMATIC BRAKING SYSTEM**"** which helps to achieve low cost automation. We are proud that we have completed the work with the limited time successfully. We have done the project to our ability and skill making maximum use of available facilities and we are able to understand the difficulties in maintaining the tolerances and also quality. We also observed that the prototype manufactured is working with satisfactory conditions and our work is able to achieve all the objectives which are necessary

13. FUTURE SCOPE

Our future work deals with incorporating this system with various different features to provide enhanced protection by the intelligent braking system in real time application. For that, some of the possible changes are:
1) Regular bumpers can be replaced by hydraulic bumpers.
2) Infrared sensors can sense eye blinking and give signal to solenoid valve when driver sleeps.
3) Limit switch can be used to limit the minimum speed above which the system gets triggered.
4) PIC can be implemented in system for further modifications like gradual slowdown of vehicle.
5) Bumper design can further be enhanced to act as external air bags.
6) With some modifications, the project can be used with timer circuits so as to apply brakes and extend the bumper after a delay of few milliseconds so that the bumper does not extend unless the vehicle just reaches the crashing distance.

14. REFERNCES

[1] SrinivasaChari.V, Dr.Venkatesh P.R, Dr.PrasannaRao N.S, Adil Ahmed S "Automatic Pneumatic Bumper And brake Actuation Before Collision", 2015, International Research Journal Of Engineering And Technology (Irjet) Volume: 02 Issue: 04, Pp1015-1023
[2] Dr. P. Poongodi. Mr. P. Dineshkumar, "Automatic Safety System For Automobiles"
[3] Jadhav N. D., Gulmire S.M., Ghutukade R.S., Gaikwad A.S., Prof.Fegade S.G. "Automatic Braking With Pneumatic Bumper System" 2015,Ijsart Volume 1 Issue 5, Pp
[4] Jadhav N. D., Gulmire S.M., Ghutukade R.S., Gaikwad A.S., Prof.Fegade S.G. "Automatic Braking With Pneumatic Bumper System" 2015,Ijsart Volume 1 Issue 5, Pp
[5] Dr.EungSooKim,"Fabrication Of Auto Braking System Using Sensor", International Journal Of Control And Automation, Vol-2, And No1.
[6] Takahiro Wada, "A Deceleration Control Method Of Automobile For Collision Avoidance Based On Driver Perceptual Risk" IEEE International Conference On Intelligent Robots And Systems, Oct 4881-4886.
[7] Lee, "A Theory Of Visual Control Of Braking Based On Information About Time To Collision", Perception, Vol 5, Pp 437-459
[8] J. T. Wang, "An Extendable And Retractable Bumper
[9] S. P. Patil, "Mechanical System Design", Second Edition, JAICO Publishing House, Mumbai 400001
[10] Intelligent Mechatronic Braking System",G.V. Sairam, B. Suresh, CH. SaiHemanth, K. Krishna sai,International Journal of Emerging Technology and Advanced Engineering , Volume 3, Issue 4, April 2013 pp.100-105
[11] Collision Control and Collision Avoidance Using Ultrasonic Sensor", Anusha c, Dr. P. Venkataratnam, International Journal of Current Engineering and Scientific Research (IJCESR), Volume-2, Issue-7, 2015 pp.218-223

[12].Katore S.R., Kadlag S.C., Mane P.V., Pawar G.V., Prof.Londhe B.C., "Automatic Braking With Pneumatic Bumper System", 2015, International Journal Of Engineering, Education And Technology (Ijeet), Volume 3, Issue 2
[13] J.B.K.Das, P.L.Srinivasa Murthy (2011) "Design of Machine Elements-2", Sixth Edition, pg.no 66-70 & 570-584
[14] S. Ramamrutham& R. Narayan, (1998) "Strength of Material", 12th Edition, pg.no 503-523
[15] Erik Coelingh, Lottajakobsson, Henrik Lind, Magdalena Lindman, "Collision Warning With Auto Brake - A Real-Life Safety Perspective", Volvo Car Corporation Sweden Paper Number 07-0450
[16] Erik Coelingh, etal, "Collision Warning with Auto Brake", Sweden, ppn: 07-0450.
[17] Dr. K. Lingaiah. (2006), "Machine Design Data Handbook Volume-1", Fourth Edition.
[18] Dr.Kripal Singh, "Automobile Engineering – Vol.1", Standard Publishers Distributors New Delhi-110 006
[19] "Automatic Hydraulic Bumper and Speed Limiting System",Rohit P. Jain, Dr.V.Singh,IJSRD -International Journal for Scientific Research & Development Vol. 3, Issue 06, 2015 pp.357-361.
[20] "Automatic Braking With Pneumatic Bumper System",Jadhav N. D, Gulmire S.M, Ghutukade R.S, Gaikwad A.S, Prof.Fegade S.G,IJSART, volume-1 Issue-5, MAY 2015 pp.258-260.