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DESIGN AND MANUFACTURING OF PNEUMATIC BUMPER FOR SUDDEN IMPACT REDUCTION IN FOUR-WHEELER

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***Abstract*— This project is related with the use of pneumatic system installed on the bumper of car to reduce the impact during the time of collision India has the large number of vehicles running on roads. Every day 405 deaths and 1290 injuries from 1274 accidents are reported in India. Though there are different causes for these accidents but proper technology to reduce the damage during accident are currently not in use. We are introducing our project "automatic Pneumatic bumper", which is fully equipped by IR sensors circuit and Pneumatic bumper activation circuit. With use of these components a bumper with ability to stand the impact up to a certain limit is developed and which results in increase of the safety of passengers seating inside the vehicle equipped with this technology. To achieve this system modification goal, design of "Automatic Pneumatic Bumper system" is a good solution to bridge the gates between institution and industries and able to understand the difficulties in maintaining the tolerances and also quality.**

***Keywords*— Automatic, Bumper system, Electro-pneumatic system, IR Sensors, Control Unit.**

I. INTRODUCTION

Vehicles are mankind's most revolutionary creation. They made an impact in every part of life with technological innovations. Vehicle demand has skyrocketed, resulting in a significant increase in the number of automobiles on the road. Even at the design stage of the car, vehicle safety is a crucial consideration. Several technologies, such as seat belts and air bags, have shown to be effective and valuable in the event of an accident. One such system to avoid the severity of accidents is an automated collision avoidance system. It's an electrically controlled pneumatic circuitry that seeks to keep the car from colliding with the road ahead of it and improve crashing safety. Automatic pneumatic circuits are used to accomplish this. We'd like to introduce our "automated Pneumatic bumper" project, which includes an IR sensors circuit as well as a pneumatic bumper activation circuit. It is a true project that is fully equipped and built to accommodate automobiles. This is an important aspect of high quality. This product has undergone extensive testing in our automotive vehicles and has passed with flying colors. Automation can be accomplished using computers, hydraulics, pneumatics, robots, and other methods. Of these, pneumatics is an appealing medium for low-cost automation. The fundamental advantages of all pneumatic systems are their cost-effectiveness and ease of use. The machining operations determine the sequence of machining, and automation plays a significant part in mass manufacturing of the product. Transfer machines are devices that are designed to produce a certain product rate.

II. OBJECTIVES

To overcome these unwanted accidental effects during automobile crash, we have to design the Automatic Pneumatic Bumpers system which have following objectives,

1) To improve the pre-crash safety.
2) To avoid the percentage of passenger injury by using external vehicle safety.
3) To reduce the requirement of internal safety devices like air bags.
4) To increase the sureness of impact absorption application while vehicle accident.

To reduce the response time of safety with bumper system.

III. PROBLEM STATEMENT

In currently used vehicles, bumpers used are of rigid types. These bumpers have specific capacity and when the range of the accidental force increases then these bumpers are of no help and so these forces are transferred towards the passengers causing them severe injuries. So, to reduce the damage to car and increase passenger safety design of Automatic Pneumatic Bumpers is necessary. The statement of project is "design and fabrication of automatic pneumatic bumper system for four-wheeler." for

the safety application in automobile as per requirements for vehicle performance.

IV. System Components

A. Frame

The frame is made of MS. Our machine's frame is primarily employed to sustain the pneumatic components that are mounted on it. On the frame are installed a piston cylinder, d.c.v., flow control valve, and switches.

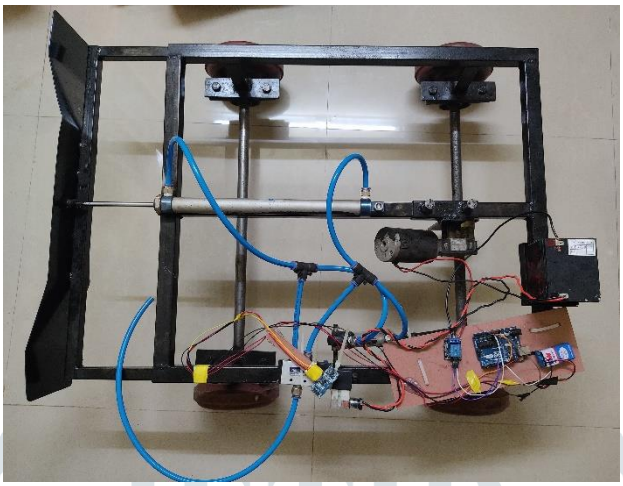

Fig.1 Frame

B. Pneumatic Cylinder

Pneumatic cylinders (sometimes called air cylinders) are mechanical devices that employ compressed gas to generate force in a reciprocating linear motion. Working with a pressure range of 3 to 6 bar.

Fig.2 Pneumatic Cylinder

C. Pneumatic Pipe Fittings

Pneumatic tubing is also available in a number of other materials both with and without reinforcement for use in standard applications. SMC fittings incorporate a positive tube seal while the fitting is under pressure which allows polyurethane tubing to be used. This can be used for connection of pneumatic system with total drill assemble.

Fig.3 Pneumatic Pipe Fittings

D. 3/2 Solenoid Valve

A valve is a device that opens and closes or partially obstructs passage ways to control the flow of fluids (gases, liquids, fluidized solids, or slurries). A 3/2-way directional valve has ports evenly spaced and 2 flow settings, as the name suggests. It can be used to isolate and bypass a passageway for fluid that needs to retract or extend a double acting cylinder, for example. This valve can be activated in a variety of ways.

Fig.4 3/2 Solenoid Valve

E. Ultrasonic Sensor

Ultrasonic ranging and detection devices detect the existence of an object and its range using high frequency sound waves termed ultrasonic waves.

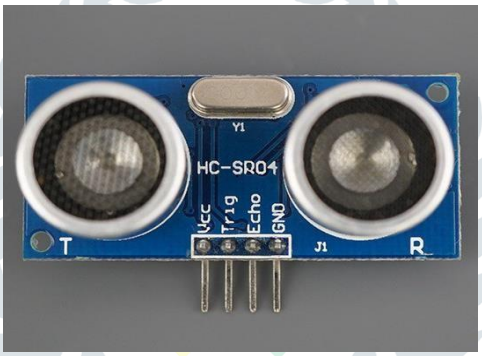

Fig.5 Ultrasonic Sensor

F. Control Unit

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

Fig.6 Control Unit

G. Compressed Air Tank

A compressor is a device that compresses air or another gas from a low inlet pressure (often atmospheric) to a higher target pressure. This is performed by lowering the gas's volume. Air compressors are positive displacement machines that use reciprocating pistons, rotary screws, or rotary vanes to compress air. The compressed air was stored in an air tank, from which pipes carried the air to the cylinder.

Fig.7 Compressed Air Tank

H. Wiper Motor

The wheel is rotated by a 12-watt DC motor, which is powered by a DC battery. Specification: DC supply: 12V RPM: 60 at 12V Shaft diameter: 6mm

Fig.8 Wiper Motor

V. METHODOLOGY

When a vehicle equipped with an Automatic Pneumatic Bumper with Breaking system encounters an obstruction in its path, the vehicle's Ultrasonic sensor identifies the obstacle and sends a signal to the control unit. As a result, the control unit measures the distance between the vehicle and the barrier. The control unit also runs the relay in response to the input signals it receives. During an emergency, the relay is utilized to turn off the electric power supply to the IC engine, resulting in the engine being switched off. The control unit notifies the solenoid valve when the obstacle is within the system's predefined range. The pneumatic cylinder is actuated by the solenoid valve, which opens the port. As a result, the bumper erected in front of the vehicle is extended.

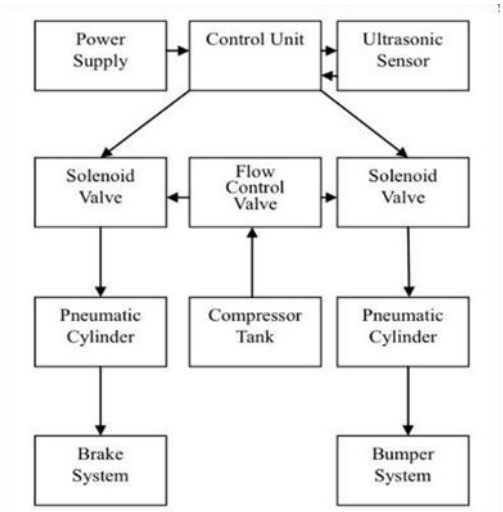

Fig.9 Block Diagram of System

VI. Design Model

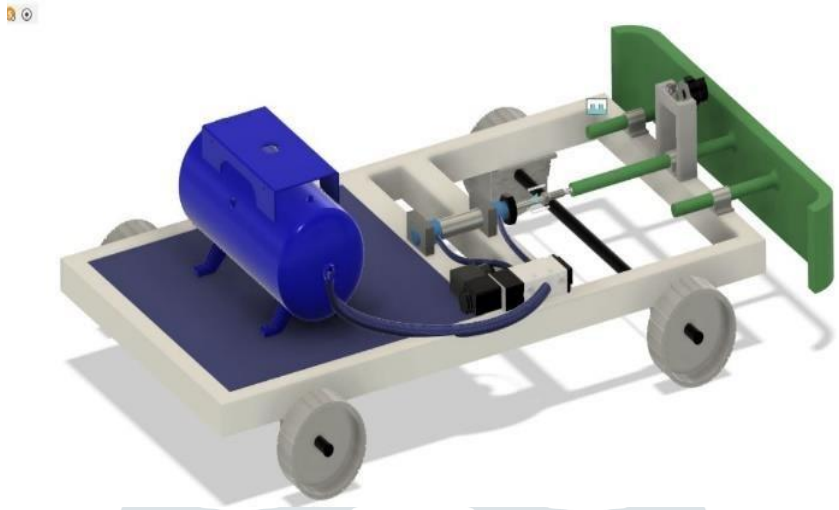

Fig.9 3D Model of Pneumatic Bumper System

VII. Result

1) SHAFT
The shaft is supported on bearings and it rotates on a set of gears or pulleys for the purpose of power transmission. As we know that shaft diameter is given as:

$d= [(mr*16/\pi* \tau)$

By calculating we get the diameter as 20mm.

We chose a safe diameter from DDHB (Table 3.5a) of standard shafts. Thus, the diameter of the shaft is selected as 20mm**.**

2) BEARING
As shaft dia. is 20mm so we have selection a pedestal bearing having shaft outer dia. – 20mm.

4) MOTOR
For determining the motor of required speed, the following equation is considered.

$P=2\Pi nt/16$

Taking a 50Watt power motor we have selected the speed of motor as 60rpm

VIII. Advantages

1) This system increases the response time of vehicle by keeping safe distance between two vehicles.

2)The design also increases the crashing distance by providing extra space due to extension of the bumper, decreasing the chances of injuries to commuters.

IX. Disadvantages

1) Modifications will incur an additional fee.

2)In heavily travelled road, the system has minimal limitations.

X. COST ESTIMATION

Part Name	Quantity	Total Cost (Rs)
Wheel	4	1300
Solenoid Cylinder	2	1500
Solenoid Valve	1	1300
Small Wheel	4	800
Bearing	4	600
Shaft(m)	3	285
Clamp	6	360
Battery(12V)	1	850
Electronic Circuit	1	1200
Pneumatic Pipe(m)	2.5	300
Square Pipe(ft)	2	1100
Total		9595

Table No. 1 Cost Estimation

XI. CONCLUSION

The main goal of this project's design and production was to limit the number of road accidents, therefore ensuring the safety of the passengers. With the help of the pneumatic bumper, our concept also decreases the damage caused to the car after a collision. Our work not only has strong feasibility and great reliability, but it is also cost effective, compensating for the drawbacks of other presently available systems.

Our work on this project has given us a lot of experience in terms of planning and applying our practical and theoretical skills. We are pleased that we were able to complete the work in the allotted period.

The prototype we developed and built is operating in good conditions and achieving all of the goals we set out to accomplish.

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