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Arduino Controlled Automatic Pneumatic Bumper System

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Abstract - *India is the largest country in the use of various types of vehicles. As the available resources to run these vehicles like quality of roads and unavailability of new technologies in vehicles are causes for accidents. Though there are different causes for these accidents but proper braking system and damage reducing technology during accident are mainly affects on the accident rates. So to avoid damage to vehicle and safety for pedestrian is must. To achieve this system modification goal, design this "Arduino Controlled Automatic Pneumatic Bumper system". The work 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.*

Key Words: Pneumatic Bumper, IR Sensor, Ultrasonic Sensor, Arduino, Solenoid Valve, Pneumatic Cylinder, etc.

1. INTRODUCTION

The number of peoples which are dead during the vehicle accidents is also very large as compared to the other causes of death. Though there are different causes for these accidents but proper technology of braking system and technology to reduce the damage during accident are mainly effects on the accident rates. So perfect breaking system to minimize impact of accident is necessary. To achieve this system modification goal, design this "Arduino Controlled Automatic Pneumatic Bumper system".

1.1 Objectives

1. To reduce injury to pedestrian.
2. To eliminate false triggering of sensors
3. To actuate the Bumper only above certain speed
4. To improve the pre-crash safety.
5. To minimize pedestrian injury due to collision.

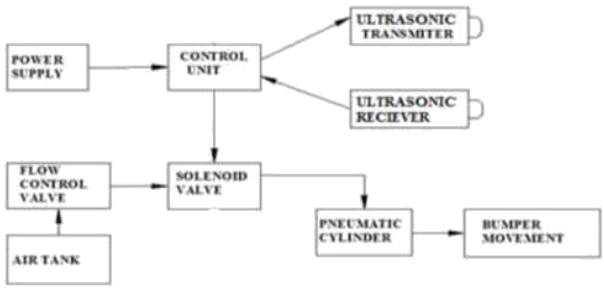
1.2 Current Trends

In conventional vehicles various braking mechanism are available but for low speed condition, particular mechanism should be present to avoid injury to pedestrian having collision with frontal part of the vehicle. Also it is necessary to minimize damage to the vehicle. During night the driver may not be able to pay full attention which may cause damage to the pedestrian coming in between the way of vehicle. Skidding may happen due to urgent breaking.

2. SYSTEM DESCRIPTION

Block Diagram

1) Frame
2) Control Unit
3) Solenoid Valve
4) Pneumatic Cylinder
5) Bumper



2.1 Working

The system of the pneumatic bumper works on the pneumatic system. Ultrasonic sensor is used to detect the obstacle. The signal send to the microcontroller which operate the solenoid valve. Compressed air supplied to the pneumatic actuator through compressor. For condition of the solenoid valve compressed air is passed through the solenoid valve which actuates the pneumatic actuator. It will absorb impact force to a certain limit hence it will retract due to that force. On removing the obstacle the actuator will set to its original position. In addition to this IR sensor will be placed along side edge of frame in order to identify overspeed and underspeed of our vehicle. When both the input from ultrasonic and IR sensor will be high then only bumper will actuate otherwise not.

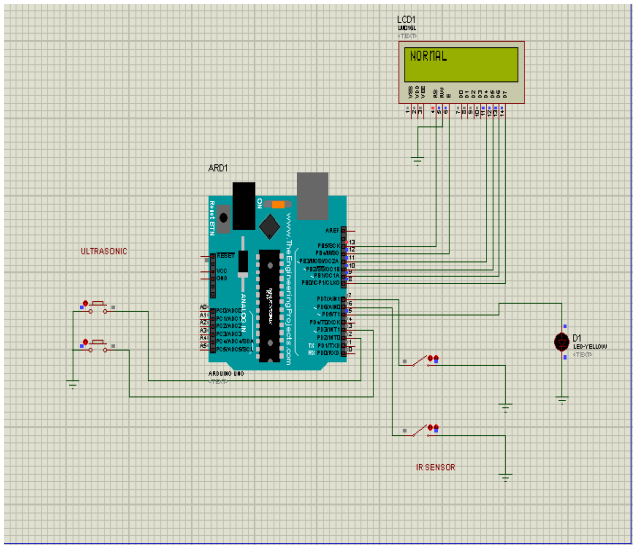


Fig. 1: Arduino Simulation (Normal Condition)

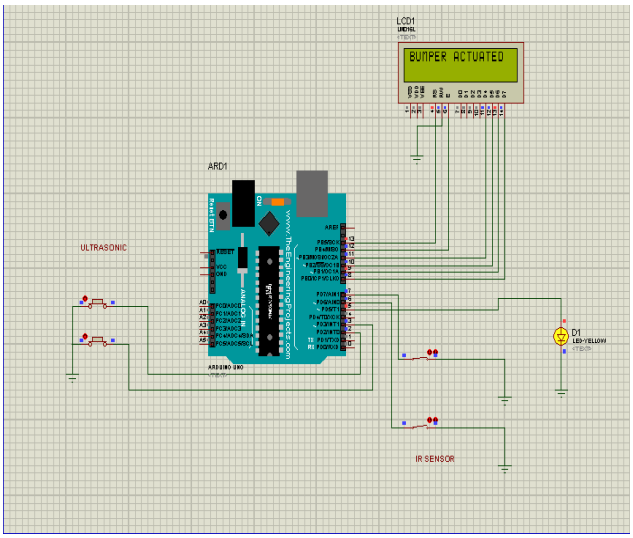


Fig. 2: Arduino Simulation (Bumper Actuated condition)

As shown in above diag. When all ports are open it will show "Normal" condition and when all ports are closed it will show "Bumper Actuated". If any one of the ports is open we will never get "Bumper Actuated" condition, it means when both input from ultrasonic and IR sensor should be high to actuate bumper. The simulation shown above has been carried out in Proteus software and programme required for simulation has been written in the Arduino software.

3. COMPONENT DESCRIPTION

3.1 Frame

We design a basic frame for a prototype by mild steel channel (L beam), L Channel- MS Angles are L-shaped structural steel represented by dimension of sides & thickness. For e.g. 25*25*3 means, both the sides of angles are 25mm & thickness is of 3mm.

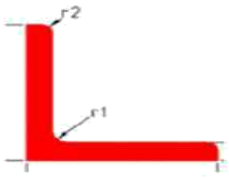


Fig. 3: Frame

3.2 Pneumatic cylinder

Based on the required force we will consider cylinder diameter by using below formula

$$d = \sqrt{\frac{4A}{\pi}}$$

Fig. 4: Pneumatic Cylinder

3.3 Ultrasonic Sensor

Fig. 5: Ultrasonic sensor

Ultrasonic waves travel as a sequence of compression and rarefactions and measures the distance of obstacle present in front of the vehicle.

3.4 IR Sensor

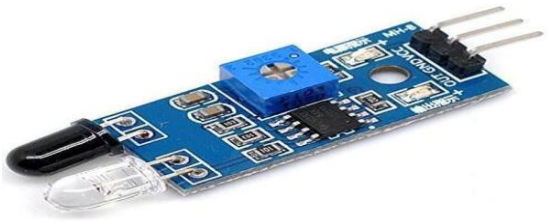


Fig. 6: IR sensor

IR sensor emits infrared rays to understand the speed of our moving vehicle and actuate bumper in case speed exceeds set value.

3.5 Arduino UNO

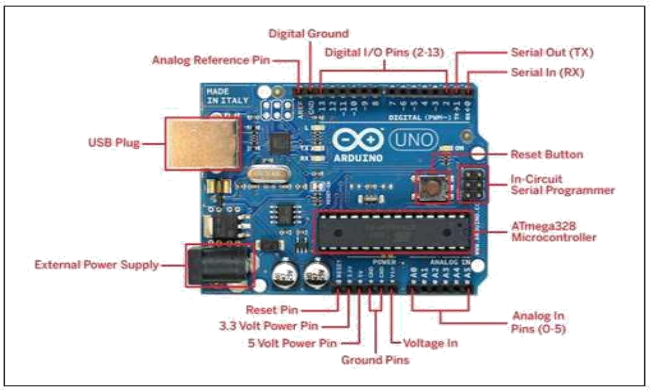


Fig. 7: Arduino UNO

It is a microcontroller board on the basis of ATmega328. It has 14 input/output digital pins, a 16 MHz crystal oscillator, a power jack, 6 analog inputs and a reset button. The programme made is dumped into this Arduino and then it will give signal according to it.

3.6 Solenoid Valve

Fig. 8: Solenoid Valve

Solenoid Valve; Model: 4V210-08
Working Pressure: 0.15~0.8Mpa
Operating Temperature: 35Celsius
Power Consumption: DC 12V, 3W
Current: 120mA
Position & Way Number: Two-position, Five-way
Total Size: 11.8 x 6.6 x 2.2cm/4.6'' x 2.6'' x 0.7'(L*W*H)

In solenoid valve, solenoid uses electric current and produces magnetic field thereby operating a mechanism which regulates opening of fluid flow in valve.

4. DESIGN

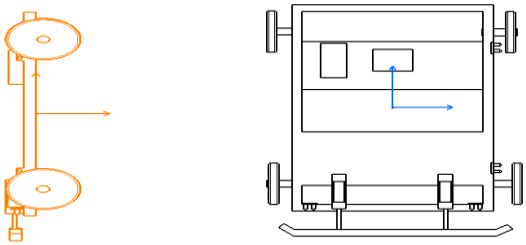


Fig. 9: Top View and Side View of Assembly

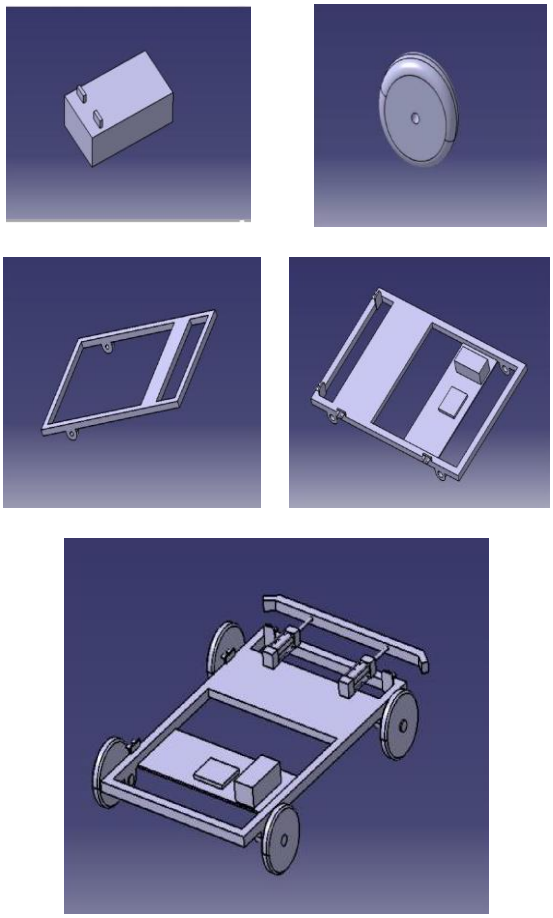


Fig. 10: Catia V5 parts and Assembly

Each part and assembly is made in Catia V5 software. Above fig. shows all parts like battery, wheel, frame and final assembly of our prototype. All constraints are taken into consideration while creating all catia parts and final assembly of our prototype.

5. ADVANTAGES

1. Power consumption is less
2. Wear adjustment is not required.
3. It is simple in operation.
4. Installing the system is simplified.

6. CONCLUSION

Behind the designing of this system, our main aim is to improve the prevention technique of accidents and also reducing the hazard from accidents like damage of vehicle, injury to pedestrians, etc. We observed that our work is able to achieve all the objectives which are necessary.

By implementing this project we can minimize bumper beam deflection so as to protect assembly of the vehicle such as engine, fuel unit, cooling unit, etc. The maximum stress acting on bumper beam should be below its yield stress value to avoid plastic deformation. The optimal design

satisfying all above conditions should posses minimum total mass of bumper.

ACKNOWLEDGEMENT

It indeed is a great pleasure and moment of immense satisfaction for us to have successfully completed the project of "Arduino Controlled Automatic Pneumatic Bumper System" and we take the opportunity to thank all those who provided us inspiring guidance and encouragement, we take the opportunity to thanks those who gave us their indebted assistance. We wish to extend our cordial gratitude with profound thanks to our internal guide Prof. S. B. Jadhav for her precise guidance.

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