ANTI-COLLISION SYSTEM FOR FOUR WHEELERS

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Abstract
According to the Indian Road, Transport Authority accidents are a major cause for loss of human life and vehicle. The focus of the work, Anti-collision System for Four Wheelers, is to minimize the extent of damage to both the human passengers and the vehicle. The integration of mechatronics with the automobiles field is the key to a safer and greener future. The intelligence of an electronically controlled system controls the pneumatic system, which applies the break of the vehicle and extends the bumper, and switches off the power supply to the prime mover. The structure contains a pneumatic bumper system, pneumatic braking system, an infrared transmitter and receiver circuit, control Unit. The sensor then sends a feedback signal to the control unit, thereby activating the solenoid valve. Pressurized air streams to the bumper and breaks initiation systems. The driver can also try to stop the vehicle by pressing the brake pedal. The entire system is activated only when the speed of the vehicle is above 40-50 Km/hr. The speed is sensed by the system by a simple connection to the speedometer. This system provides pre-crash safety to the vehicle. It progresses the response time of vehicle decelerating to keep a safe distance between the vehicles. By using this system we can obtain control over the speed of the vehicle in short distance.

Keywords: pneumatic bumper, obstacles, sensor, feedback, Break activation system, solenoid value, pressurized air flow

Introduction

Safety is a necessary part of man's life. Due to the accident cases reported daily on the major roads in all parts of the developed and developing countries, more attention is needed for research in designing an efficient car driving aiding system. It is expected that if such a device is designed and incorporated into our cars as a road safety device, it will reduce the incidence of accidents on our roads and various premises, with subsequent reduction in loss of life and property. Rear-end collisions are common accident scenarios and a common cause of these accidents is driver distraction and thus not reacting in time [1]. "Anti Collision System for four-wheelers" prevents a collision by using sensors to detect obstacles. The "Anti Collision System for four-wheelers" will process the sensor data and control the vehicle to prevent accidents caused by careless driving or difficulty in detecting objects in the reverse path [2]. The "Anti Collision System for four-wheelers" will process the sensor data and control the vehicle to prevent accidents caused by careless driving or difficulty in detecting objects in the reverse path [3]. Most of the accidents in four-wheeled vehicles occur because of failure of braking systems. The manual method of applying brakes is always dangerous as it leads to accidents. Unconsciousness of the driver, failure in the linkages of braking systems, road conditions, and the uncontrollable speed of the vehicle and manual operation of braking systems are the reasons for accidents. It is necessary to control brakes automatically through electronics devices to minimize accidents [4].

This work consists of an Infrared Transmitter and Receiver circuit, Control Unit, Pneumatic bumper, and brake system. The infrared sensor senses the obstacle. If there is an obstacle close to the vehicle the control signal is given to the bumper and brake activation system. This bumper activation system is activated when the vehicle speed above 80-100 Km/hr. The brake activation happens anywhere above 40 Km/hr. The speed is sensed by a speed sensor and this signal is transferred to the control unit and pneumatic bumper activation system.

Basic Components

Solenoid Valve

A solenoid valve is an electromechanical device used for controlling liquid or gas flow. The solenoid valve is controlled by electrical current, which is run through a coil. When the coil is energized, a magnetic field is created, causing a plunger inside the coil to move. Depending on the design of the valve, the plunger will either open or close the valve. When electrical current is removed from the coil, the valve will return to its de-energized state.

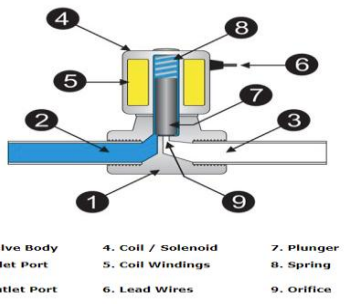

Figure 1: :Solenoid Valve

Chassis or Frame

A truss or frame may be defined as a structure, made up of several bars, riveted or welded together. These are made up of angle irons or channel sections and are called members of the frame or framed structure. A perfect frame is that which is composed of members just sufficient to keep it in equilibrium, when loaded, without any change in its shape.

Infrared Sensor

Sensors measure only infrared radiation, rather than emitting it. This is called Passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiation detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and these output voltages, change in proportion to the magnitude of the IR light received. An infrared sensor circuit is one of the basic and popular sensor modules in an electronic device. This sensor is analogous to human's visionary senses, which can be used to detect obstacles and it is one of the common applications in real time. This circuit comprises of the following components.

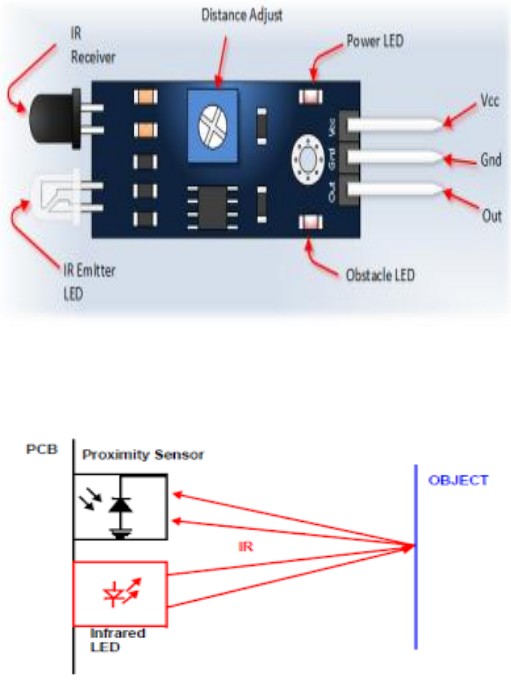

Figure 2: Infrared Sensor

Specification of IR Sensor

- Type: Optical Sensor
- Power Source: DC Power
- Operating Voltage: 3.0V – 5.0V
- Detection range: 2cm – 30cm (Adjustable using potentiometer)
- Current Consumption: at 3.3V : ~23 mA, at 5.0V: ~43 mA
- Active output level: Outputs Low logic level when obstacle is detected

Pneumatic Cylinders

Double acting pneumatic cylinders operate on both ends of the piston. One element is for the outstroke, while the other is used for in stroke. A double-acting hydraulic cylinder has a port at each end, supplied with hydraulic fluid for both the retraction and extension of the piston. The base cap and bearing cap are made of cast material, aluminum or malleable cast iron. The two caps can be fastened to the cylinder barrel by tie rods, threads or flanges.

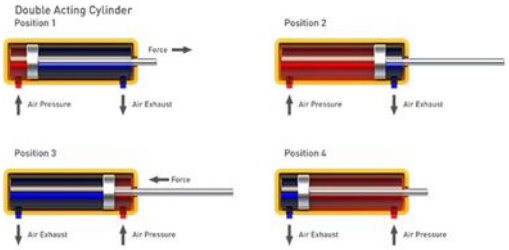

Figure 3: Double Acting Pneumatic Cylinder

Peripheral Interface Controller

The term PIC, or Peripheral Interface Controller, is the name given by Microchip Technologies to its single – chip microcontrollers. These devices have been phenomenally successful in the market for many reasons, the most significant ones are mentioned below. PIC micros have grown in steadily in popularity over the last decade, ever since their inception into the market in the early 1990s. PIC micros have grown to become the most widely used microcontrollers in the 8- bit microcontroller segment. The PIC16F877 is 40 pin IC. There are six ports in this microcontroller, namely PORT A, PORT B, PORT C, PORT D and PORT E. Among these ports PORT B, PORT C and PORT D contains 8-pins, where PORTA contains 6-pins and PORT E contains 3-pins.

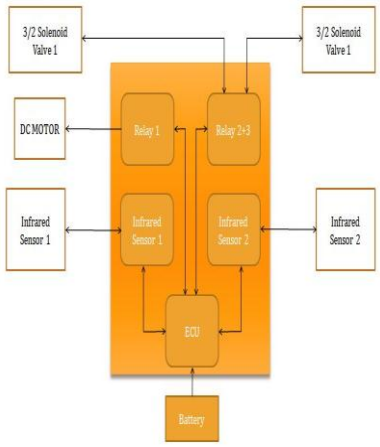

Figure 4: ECU Layout

Construction

The square tubes are measured and cut for a specified dimensions and welded to form a frame which act as a chassis for our system. This resides the pneumatic and electronic drives on it. Four wheels are mounted at the bottom side of chassis and on its opposite side, at its front end portion bumper are mounted with the help of pneumatic cylinder on both sides of the chassis. Another pneumatic cylinder is connected to a brake lever of a wheel. These cylinders are directly coupled to a solenoid valve which is controlled by an infrared sensor placed at front and rear side of the vehicle.

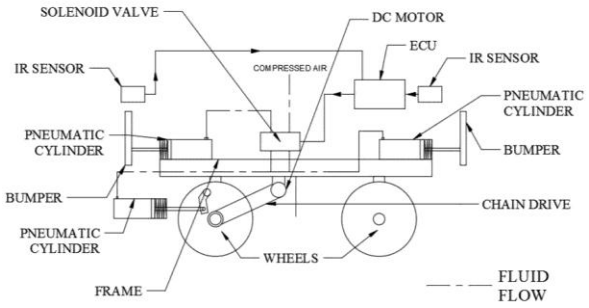

Figure 5: Construction Layout

Working Principle

When any obstacle, human, animal or vehicle comes in front of the vehicle then the installed infrared sensor senses the obstacle. The range of distance between the vehicle and obstacle is variable. This range is varied according to the speed of the vehicle. The signal received by IR sensor is provided to the control unit. When any obstacle, humans, animals or vehicle comes in front of the vehicle, the installed infrared sensor senses that obstacle.

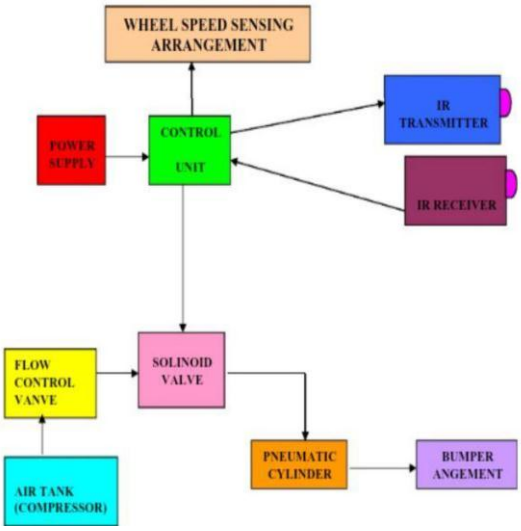

Figure 6: Working Layout

The control unit then activates the solenoid valve which will allow the compressed air to flow through it. Compressed air is provided as an Input to the Solenoid Valve which has two Outputs both connected to the Double Acting Pneumatic Cylinder. This pneumatic force of the compressed air through the Solenoid Valve is transferred to the Bumper System. The pneumatic force provides forward motion to the Bumper and it also retracts the bumper slowly reducing the impact. Hence, when the external body is kept safe, there will be no chance of internal damage.

Analysis

Stress Analysis

As we can see from the figure 7, the bumper member has maximum stress of 5.07 kN/mm2 at the points where it has been fixed to the pneumatic cylinders. This tells us that the ideal way to decrease the stress build up is by increasing the area of the fixed points. The ideal way to do this is to have an intermediate connector to the pneumatic cylinder. The minimum stress developed is at the edges because the load acting is least there.

The bend at the centre is because of absence of support at the centre. Stress can be reduced by increase the area of the support from the chassis or by increasing the number of supports. Conical supports with the base attached to the bumper and the apex attached to the pneumatic cylinder should be an ideal way to increase stress resistance. Incorporating triangular structures will also create a sturdier structure capable of withstanding higher force

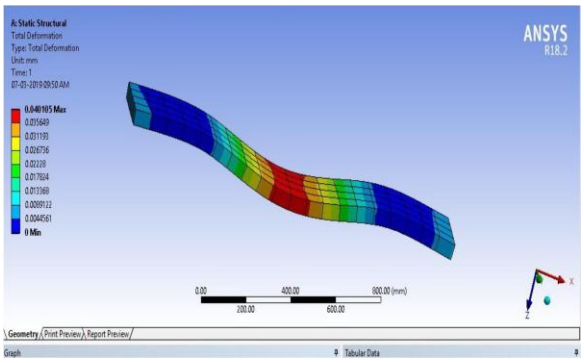

Figure 7: Stress Analysis

Displacement Analysis

The displacement analysis shows that the bumper is susceptible to maximum displacement at the centre. The fig 8 infers that the lack of support increases the chances of damage to the bumper. The maximum displacement at the centre is 0.04 mm. Displacement of the member can be decrease my increase the fixed points and improving the strength of the bumper. The head on collision causes the deformation that can damage the engine and the passengers. Having this member in the way will prevent a lot of damage.

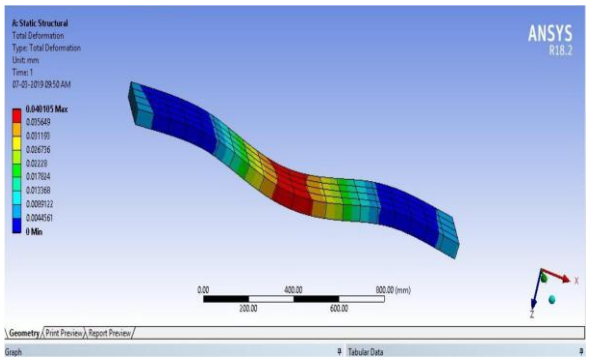

Figure 8: Displacement Anaalysis

Conclusion

The driving interference of braking and give the responsibility to an intelligence sensor which will take decision and initiate the response to give warning alarm first and if distance of impact is closing it will apply brake automatically and stop the vehicle in advanced. Since distracted driving is a major contributor to accident death, by implementing this system we can reduced the close impact potential accident. By extending the front and rear bumper we can increase the distance, time and intensity of direct impact. This will decrease the chances of passenger fatality by a lot and the damage to other parts of the car will also be reduced.

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