AUTOMATIC PNEUMATIC BRAKING SYSTEM

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Abstract— Vehicle accidents are ubiquitous in recent years. This is because of heavy increase in population of vehicles, due to its high demand. They pose a serious threat to life and property. A system must be designed to minimize the effects of these accidents. The aim of the present study is to design a device which can successfully scan the surroundings during driving and apply brake to avoid front end collision of the vehicle, along with extension of bumper. The technology of pneumatics plays a major role in the field of automation and modern machine shops and space robots. The aim is to design and develop a control system based intelligent electronically controlled automotive bumper activation and automatic braking system is called automatic bumper system. IR sensor provided on the front end of the vehicle detects the presence of the obstacle. The use of pneumatic system can prove to be useful in automation due to its simplicity and ease of operation. So, the aim is to design and develop a system based on* automatic control of vehicle. So, we aim to design *"Automatic Pneumatic Braking System*".

Index Terms— IR transmitter, IR sensor, bumper, and proximity sensor, braking.

I. INTRODUCTION (HEADING 1)

In the present study a model was designed to automatically forecast upcoming collision and take appropriate action and avoid collision by automatic braking and thus reduce the damage by automatic bumper circuit and to decrease response time by using high frequency waves. A safety system was designed to reduce property damage and passenger injury. All the conventional vehicles are equipped with brakes that are operated manually. The consequence of collision depends on driver's reflex to vary the driving environment. Vehicle accidents might be a consequence of rash driving, driving under influence, fatigue etc. Most of these can be mapped down to a single cause, driver's inability to hit the brakes at right time. If this work is replaced by automatic means, most of the collision can be controlled.

Automated collision avoidance system is one among such system to avoid the severity of accidents. It is an electrically controlled pneumatic circuitry, which aims to avoid forward collision of the vehicle and improve crashing safety.

This is achieved by means of automatic pneumatic circuits. The aim is to design and develop a control system based on intelligent electronically controlled automotive bumper activation system is called "automatic pneumatic braking system". The project consists of IR transmitter and Receiver circuit, Control Unit, Pneumatic bumper system. The IR sensor senses the obstacle. There is any obstacle closer to the vehicle (within 1feet), the control signal is given to the bumper and break activation system. This bumper activation system is activated when the vehicle speed above 40-50 km per hour. The speed is sensed by the proximity sensor and this signal is transfer to the control unit and pneumatic bumper activation system.

In collision mitigation system, the sensors detect the possibility of collision but will not take immediate action. A warning will be sent to the driver in the form of a signal or a voice message. There is a threshold safe distance calculated by the system and if the driver fails to respond even when the vehicle crosses that region, then only brakes will be applied automatically.

II. LITERATURE REVIEW

The existing approaches in preventing accidents are: Honda's idea of ABS (Anti-lock Braking System) which helps the rider get a hassle free braking experience in muddy and watery surfaces by applying a distributed braking and prevents skidding and wheel locking. Volvo is all set to launch its new XC60 SUV which will sport laser assisted braking which will be capable to sense a collision up to 50 mph and apply brakes automatically.

III. PNEUMATICS

The word 'pneuma' comes from Greek and means breather wind, for automation. Pneumatic systems operate on a supply of compressed air 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 first time, however it wills indeed the necessary to deal with the question of compressed air supply.

IV. PROPOSED SYSTEM

The Warning systems in any device are integrated with safety systems designed to warn the user about the potential threat. Such a system monitors the dynamic state of the possible danger in real time by processing information from various sensors. It assesses the potential threat level and decides whether a warning should be issued to the user through auditory and/or visual signals.

Most of the accidents can be avoided if proper braking is applied in right time. In our project, the proximity sensors (Sharp IR sensors used in the project) monitor the distance of nearby obstacles from vehicle, and gives signal to the comparator circuit (LM 358) which gives output to the transistor circuit. The transistor circuit output is coupled to the relay, which controls the motor (connected to normally closed switch) and the pneumatic circuit actuator, such as a solenoid valve (connected to normally open switch).

The compressed air from the compressor at the pressure of 5 to 7bar is passed through a pipe connected to the Solenoid valve with one input. The Solenoid Valve is actuated with Control Timing Unit. The Solenoid valve has two outputs and one input. The air entering into the input goes out through the two outputs when the timing control unit is actuated. Due to the high air pressure at the bottom of the piston, the air pressure below the piston is more than the pressure above the piston. So these moves the piston rod upwards which move up the effort are, which is pivoted by control unit.

V. IR SENSOR

A sensor is a transducer used to make a measurement of a physical variable Types of sensor: Passive sensors detect the reflected or emitted electro-magnetic radiation from natural sources, while active sensors detect reflected responses from objects which are irradiated from artificially generated energy sources, such as radar

The most popular sensors used in remote sensing are the camera, solid state scanner, such as the CCD (charge coupled device) images, the multi-spectral scanner and in the future the passive synthetic aperture radar. Laser sensors have recently begun to be used more frequently for monitoring air pollution by laser spectrometers and for measurement of distance by laser altimeters.

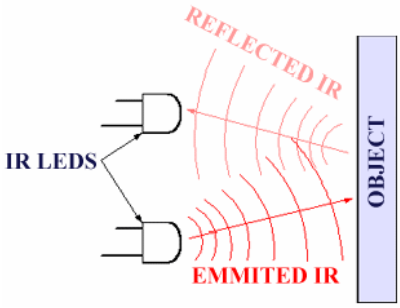


Fig 1.IR Sensor Rays

VI. PNEUMATIC COMPONENTS AND ITS DESCRIPTION

i. PNEUMATIC SINGLE ACTING CYLINDER: Pneumatic cylinder consist of A) PISTON B) 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

ii. SOLENOID VALVE WITH CONTROL UNIT: The directional valve is one of the important parts of a pneumatic system.These are also used to operate a mechanical operation which in turn operates the valve mechanism.

Fig 3. Solenoid valve

iii. BRAKES: Brake is a mechanical device which inhibits motion, slowing or stopping a motion object or preventing its motion. Brake is generally applied to rotating axles or wheels, but may also take other form such as the surface of a moving fluid.

iv. IR SENSOR UNIT: The IR transmitter and IR receiver circuit is used to sense the obstacle.

- **A)** NORMAL CONDITION: The IR transmitter sensor is transmitting the infrared rays with the help of 555 IC timer circuit.
- **B)** OBSTACLE CONDITION: At Obstacle conditions the IR transmitter and IR receiver, the resistance across theTransmitter and receiver is high due to the non-conductivity of the IR waves.

v. WHEEL AND BRAKING ARRANGEMENT: The simple wheel and braking arrangement is fixed to the frame stand.

vi. STAND: This is a supporting frame and made up of mild steel.

vii. IC 555 TIMER**:** The IC SE / NE 555 monolithic circuit is a highly stable controller capable of producing accurate time delays or oscillations. Additional terminals are provided for triggering or resetting if desired. both accurately contributed with the external RC constants.

VII. WORKING PRINCIPLE

The compressed air from the compressor at the pressure of 5 to 7bar is passed through a pipe connected to the Solenoid valve with one input. The Solenoid Valve is actuated with Control Timing Unit. The Solenoid valve has two outputs and one input. The air entering into the input goes out through the two outputs when the timing control unit is actuated. Due to the high air pressure at the bottom of the piston, the air pressure below the piston is more than the pressure above the piston. So these moves the piston rod upwards which move up the effort are, which is pivoted by control unit. This force acting is passed on to punch/rivet which also moves downwards. The IR TRANSMITTER circuit is to transmit the Infra-Red rays. If any obstacle is there in a path, the Infra-Red rays reflected. This reflected Infra-Red rays are received by the receiver circuit is called “IR receiver”. The IR receiver circuit receives the reflected IR rays and giving the control signal to the control circuit. The control circuit is used to activate the solenoid valve. The operating principle of solenoid valve is already explained in the above chapter.

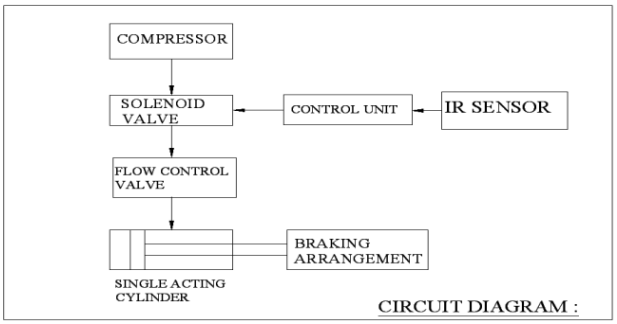
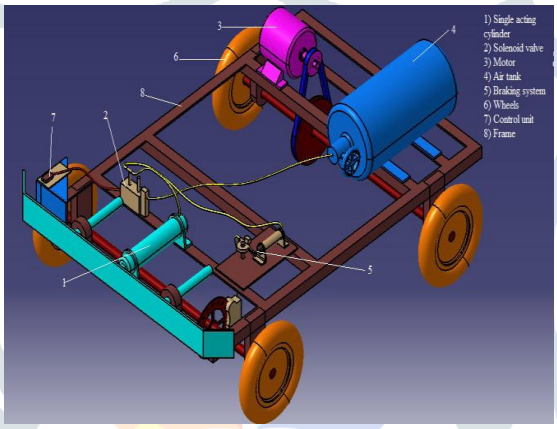


Figure 4.Circuit Diagram

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. If the piston moves forward, then the breaking arrangement activated. The breaking arrangement is used to break the wheel gradually or suddenly due to the piston movement. The breaking speed is varied by adjusting the valve is called "Flow Control Valve". In our project, we have to apply this breaking arrangement in one

Wheel as a model. The compressed air drawn from the compressor in our project. The compressed air flow through the Polyurethane tube to the flow control valve. The flow control valve is connected to the solenoid valve as mentioned in the circuit diagram.

VIII. DESIGN & CALCULATION



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Abbreviations and Acronyms (Heading 2)

A. $D_{Braking}$ = Braking distance
B. μ = coefficient of friction
C. g = acceleration due to gravity
D. V = Velocity before applying brakes
E. v = final velocity
F. u = initial velocity
G. a = acceleration
H. s = braking distance
I. F= Force

Units

A. $D_{Braking}$ = m = Meters
B. v = final velocity = m/sec =meter/sec
C. u = initial velocity= m/sec =meter/sec
D. a = acceleration = m/sec^2=meter/sec^2
E. s = braking distance = m= meter
F. F= Force = N = Newton

Equations

Total stopping distance = Human perception distance+human reaction distance +braking distance + distance covered in 1msec

Braking distance,

$D_{Braking} = \frac{v^2}{2\times\mu\times g}$ m ……..(1)

Where, V = Velocity before applying brakes

μ = coefficient of friction = 0.7 (for dry surfaces)

g = acceleration due to gravity (9.81)

$D_{Braking}$ = Braking distance**,**

$D_{Braking} = \frac{4.167^2}{2\times0.7\times9.81}$ = 1.26 m

Here the human perception time and human reaction time are equal to "zero" because it is an automatic braking system.

Total stopping distance = 1.26 m
Total braking distance = 1.26
Bumper actuation length = 1.26 +0.100 = 1.36 m ,Hence the sensors sensing range is set at 1.5 m

IMPACT FORCE CALCULATION

Mass of the vehicle = 22 kg
Velocity of the vehicle = 15km/h = 4.167m/sec
Braking distance = 1.26 m
By motion equation 2as =$v^2 - u^2$…….(2)
Where, v = final velocity
u = initial velocity
a = acceleration
s = braking distance
$2\times a \times 1.26 = 0^2 - 4.167^2$
a = - 6.89 m/sec^2
Force, F = mass× acceleration ……(3)
= 22× (-6.89)
F = 151.58 N

Table no 1: List of material

SR. NO.	PARTS	QTY.
01	Single Acting Pneumatic Cylinder	03
02	Flow Control Valve	01
03	Wheel	04
04	Solenoid Valve	01
05	Single Phase induction motor	01
06	Sensor Unit	01
07	Pulley	02
08	Stand (Frame)	01
09	IR sensor	01
10	Disk brake	01

IX. 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

X. LIMITATIONS

1. System has few limitations in densely traffic road.
2. Hard and thick materials cannot be riveted.
3. Due to the linkages there will be frictional losses.
4. Maintenance will be more due to the number of moving parts.
5. Stroke length is fixed.

XI. 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.

XII. CONCLUSION

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We are feeling that we have completed the work within time successfully. The is working with satisfactory conditions. Thus we have prepared an **"Automatic Pneumatic Braking System"** which helps to know the how to achieve low cost product.

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