Automatic Breaking System and Automatic Pneumatic Bumper

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Abstract— 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 BREAKING SYSTEM AND AUTOMATIC PNEUMATIC BUMPER. This project consists of IR transmitter and Receiver circuit, Control Unit, Pneumatic bumper system and pneumatic braking system. The IR sensor senses the obstacle. There is any obstacle closer to the vehicle (within 3-4 feet), the control signal is given to the bumper activation system and pneumatic braking system simultaneously. The pneumatic bumper and braking system is used to product the man and vehicle. This bumper and braking activation system is only activated the vehicle speed above 30-40 km per hour. This vehicle speed is sensed by the proximity sensor and this signal is given to the control unit and pneumatic bumper and braking activation system.

Key words: IR Transmitter, IR Sensor, Bumper, Proximity Sensor

I. INTRODUCTION

We have pleasure in introducing our project "AUTOMATIC PNEUMATIC BUMPER AND BREAK ACTUATION BEFORE COLLISION" Which is fully equipped by IR sensors circuit and Pneumatic bumper and braking activation circuit? It is the project which has been fully equipped and designed for auto vehicles. 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 on intelligent electronically controlled automotive bumper activation system is called "automatic pneumatic bumper and break actuation before collision". 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.

A. Introductions to Safety Systems

The aim is to design and develop a control system based on pneumatic breaking 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.

B. 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.

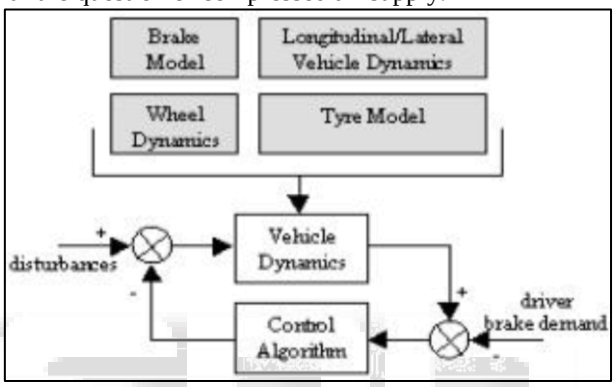

Fig. 1: Automation

The volume expressed is that of the air at intake conditions namely at atmosphere pressure and normal ambient temperature. The usual written as PV = C (or) P_1V_1 = P2V2 in this equation the pressure is the absolute pressured which for free.

C. IR Sensor

A sensor is a transducer used to make a measurement of a physical variable.

Fig. 2: Sensor

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.

D. Characteristics of Optical Sensor

Optical sensors are characterized specified by spectral, radiometric and geometric performance the spectral characteristics are spectral band and band width, the central wavelength, response sensitivity at the edges of band, spectral sensitivity at outer wavelengths and sensitivity of polarization. Sensors using film are characterized by the sensitivity of film and the transmittance of the filter, and nature of the lens. Scanner type sensors are specified by the spectral characteristics of the detector and the spectral splitter. In addition, chromatic aberration is an influential factor. The radiometric characteristics of optical sensors are specified by the change of electro-magnetic radiation which passes through an optical system. They are radiometry of the sensor, sensitivity in noise equivalent power, dynamic range, signal to noise ratio (S/N ratio) and other noises, including quantification noise. elements. IFOV is defined as the angle contained by the minimum area that can be detected by a scanner type sensor. For example, in the case of an IFOV of 2.5 mill radians, the detected area on the ground will be 2.5 meters x 2.5 meters, if the altitude of sensor is 1,000 m above ground. In our project IR transmitter and IR receiver are used to detect the obstacle. These sensors are fitted at the front side of the vehicle.

E. IR Transmitter and IR Receiver

The IR transmitting circuit is used in many projects. The IR transmitter sends 40 kHz (frequency can be adjusted) carrier under 555 timer controls. IR carriers at around 40 kHz carrier frequencies are widely used in TV remote controlling and ICs for receiving these signals are quite easily available. The transmitted signal reflected by the obstacle and the IR receiver circuit receives the signal and giving control signal to the control unit. The control unit activates the pneumatic breaking system, so that break was applied.

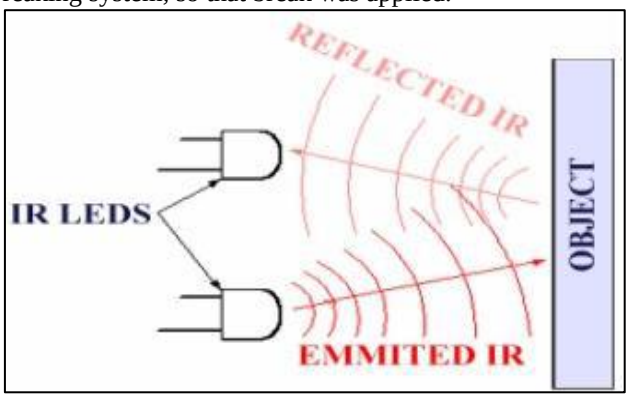

Fig. 3: IR Sensor Rays

II. COMPONENTS AND DESCRIPTION

A. Selection of Pneumatics

Mechanization is broadly defined as the replacement of manual effort by mechanical power. Pneumatics is an attractive medium for low cost mechanization particularly for sequential or repetitive operations. May be economic and can be advantageously applied to other forms of power. The main advantages of an all-pneumatic system are usually economy and simplicity, the latter reducing maintenance to a low level. It can also have outstanding advantages in terms of safety.

B. Pneumatic Components and its Description

The pneumatic bearing press consists of the following components to fulfill the requirements of complete operation of the machine

C. Pneumatic Single Acting Cylinder

Pneumatic cylinder consists 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.

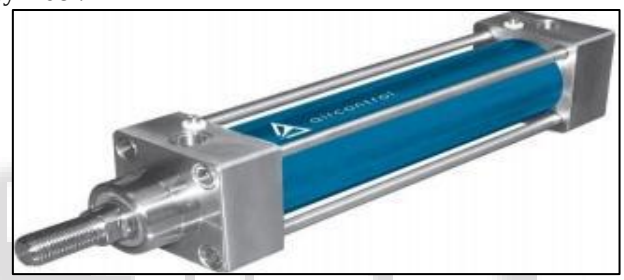

Fig. 4: Single Acting Cylinder

One hose takes the output of the directional Control (Solenoid) valve and they are attached to one end of the cylinder by means of connectors. One of the outputs from the directional control valve is taken to the flow control valve from taken to the cylinder. The hose is attached to each component of pneumatic system only by connectors.

D. Technical Data

Double acting pneumatic cylinder Stroke length: Cylinder stoker length 160 mm= 0.16 m, Quantity: 1, Seals: Nitride (Buna-N) Elastomeric, End cones: Cast iron, Piston: EN –8 Media: Air, Temperature: 0-80 º C, Pressure Range: 8 N/m².

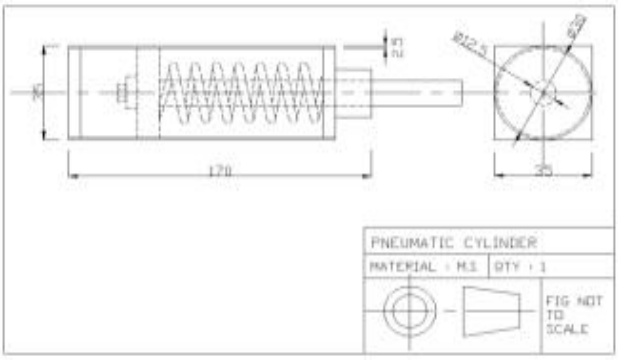

Fig. 5: Pneumatic Cylinder

E. Solenoid Valve with Control Unit

The directional valve is one of the important parts of a pneumatic system.

Fig. 6: Solenoid Valve

F. 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.

G. IR Sensor Unit

The IR transmitter and IR receiver circuit is used to sense the obstacle.

1) Normal Condition:

The IR transmitter sensor is transmitting the infrared rays with the help of 555 IC timer circuit.

2) Obstacle Condition:

At Obstacle conditions the IR transmitter and IR receiver, the resistance across the Transmitter and receiver are high due to the non-conductivity of the IR waves.

H. Wheel and Braking Arrangement

The simple wheel and braking arrangement is fixed to the frame stand.

Fig. 7: Wheel

I. PUCONNECTIORS, Reducer and Hosecollar

In our pneumatic system, there are two types of connectors used; one is the hose connector and the other is the reducer.

Fig. 9: Hose Collar & Collector

J. Stand

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

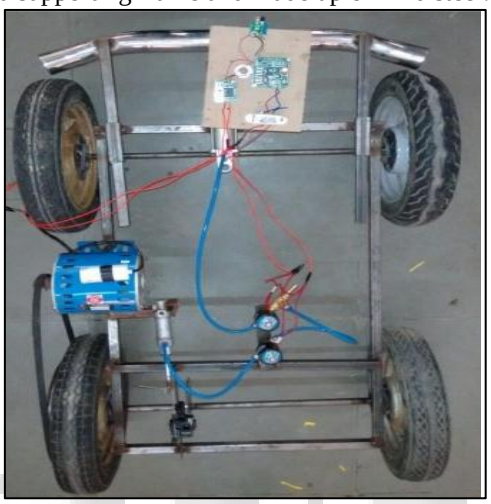

Fig. 10: Frame

1) 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.

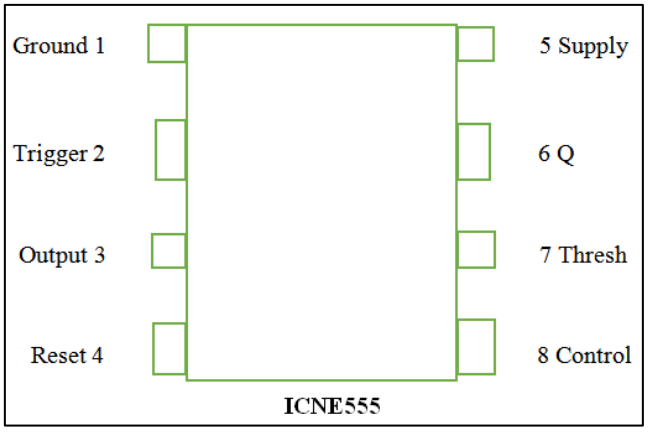

Fig. 10: Pin Diagram

- PIN NO: 1 it is ground terminal.
- PIN NO: 2 the trigger voltage to the lower comparator is applied. It has constant voltage that is at least one third of the supply voltage, when trigger voltage falls below this level the flip-flop changes its state and output becomes high.
- PIN NO: 3 It is the output terminal, in low state output is equal to zero and when at higher state output is equal to Vcc.

- PIN NO: 4 It controls the flip flop directly. It turns the device to its original position when reset pin is connected to ground the output is approximately equal to zero. When reset is not used it is connected to Vcc.
- PIN NO: 5 It is the control voltage terminal. It is connected to ground through a capacitor of 0.01 μF. Any external voltage at pin: 5 will change both the threshold voltage and the trigger voltage reference level.
- PIN NO: 6 Threshold voltage of upper comparator is applied from this terminal. The resistor Rt connected to Vcc and pin: 6 is grounded by an external capacitor. The output is high capacitor charges by resistor Rt. When the capacitor changes to the threshold level, the output becomes low.
- PIN NO: 7 It is the discharge pin for external capacitor. Usually pin: 7 is connected with pin: 6 directly to by a resistor. When the output becomes low then the external capacitor discharges by internal discharge transistor remains at cut-off and the external capacitor charges to Vcc.
- PIN NO: 8 It is the positive supply terminal. A dc voltage from +5 to + 15 can be applied. The important features of IC555 can be summarized as follows.

1) Timing range from microseconds to hours.
2) Mono-stable and Actable operations are possible through IC555.
3) The duty cycle can be adjusted according to our necessity.
4) It can operate from a wide range of supply Voltage.
5) The output of 555 is compatible with CMOS, DTL and TTL, logic.
6) Output can be operated as normal ON and normal OFF.
7) RC timers, 555 provide a time intervals that is virtually independence of Supply voltage Vcc. This because that, the charge rate of CT and the reference Voltage to the threshold comparator are all directly proportional to the supply Voltage

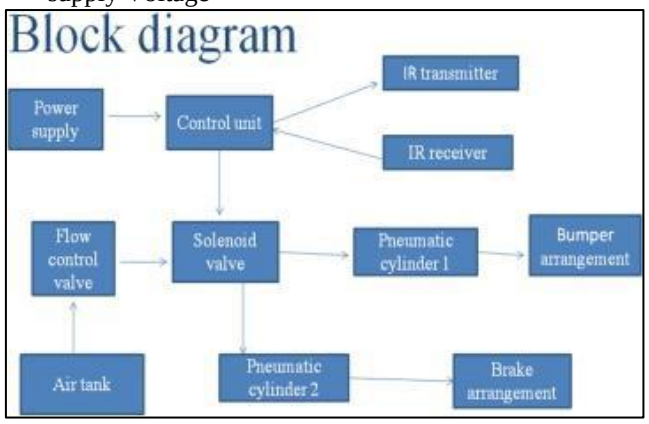

Fig. 11: Block Diagram of Project

III. 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 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

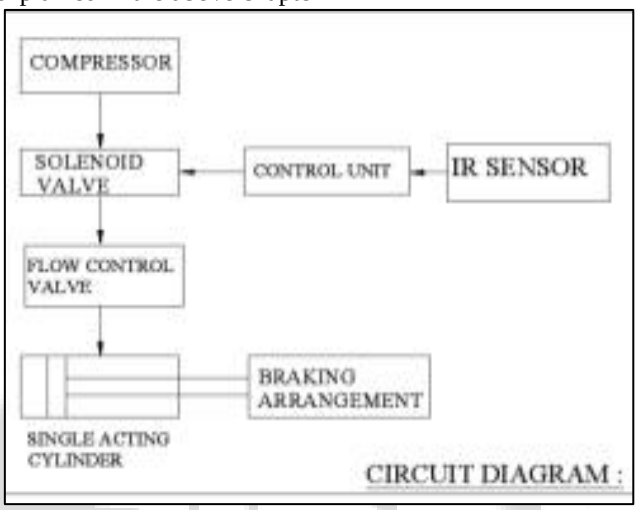

Fig. 12: Circuit Diagram

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 block diagram

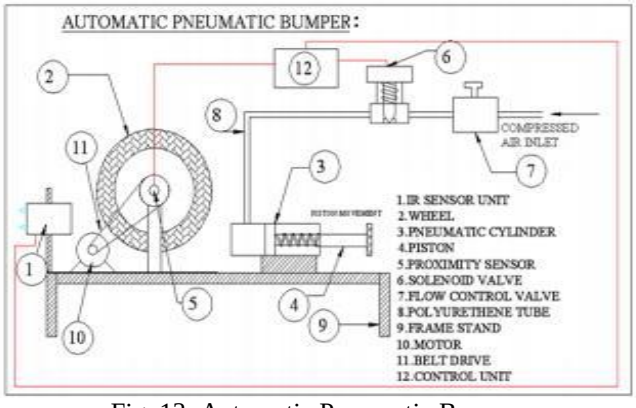

Fig. 13: Automatic Pneumatic Bumper

IV. DESIGN & ANALYSIS

A. PNEUMATIC Cylinder

1) Design of Piston rod

Load due to air Pressure.
Diameter of the Piston (d) = 40 mm
Pressure acting (p) = 6kgf/cm2
Material Used for rod = C 45
Yield stress (σy) = 36 kgf/mm²
Assuming factor of safety=2
Force acting on the rod (P)= Pressure x Area
= p x (Πd² / 4)
=6 x {(Π x 4²) / 4}
p = 73.36 Kgf
Design Stress(σy) = σy / F0 S
= 36 / 2
= 18 Kgf/mm²
= P / (Π d² / 4)
∴ d = √ 4 p / Π [σy]
= √ 4 x 75.36 / {Π x 18}
√ 5.33 = 2.3 mm
∴ Minimum diameter of rod required for the load=2.3 mm
We assume diameter of the rod

2) Design of cylinder thickness = 15 mm

Material used = Cast iron
Assuming internal diameter of the cylinder= 40 mm
Ultimate tensile stress = 250 n/mm2 = 2500gf/mm2
Working stress = Ultimate Tensile stress / factor of safety
Assuming FOS = 4
Working Stress (ft) = 2500/4 = 625 Kgf/cm2
According to Lames Equation, Minimum Thickness of cylinder (t) = Ri {√ (ft + p) / (ft –p) -1 }
Where Ri = radius of inner cylinder
Ft = Working stress
p = Working pressure in Kgf/cm²
∴ Substituting values we get,
t = 2.0 {√ (625 + 6) / (625 –6) -1}
t = 0.019 cm = 0.19 mm
We Assume thickness of cylinder = 2.5 cm
Inner dimeter of barrel = 40 mm
Outer dimeter of barrel = 40+2t = 40+(2 x 2t) = 45 cm

3) Length of piston rod:

Approach stroke = 160 mm
Length of threads = 2 x 20 = 40mm
Extra length due to front cover = 12 mm
Extra length of accommodate head = 20 mm
Total length of the piston rod = 160 + 40 + 12 + 20
=232 mm
By standardizing, length of the piston rod = 230 mm

V. LIST OF MATERIALS

The list of materials or components used in automatic pneumatic bumper & brake actuation before collision.

Sr No.	Parts	Qty
1	Single Acting Pneumatic Cylinder	2
2	Flow Control Valve	1
3	Wheel	4
4	Solenoid Valve	2
5	Single phase induction motor	1
6	Sensor Circuit	1
7	Pulley	2
8	Polyethylene tube	-
9	Hose Collar and Reducer	-
10	Stand (frame)	1
11	IR Sensor	1
12	Disk brake	1
13	Iron rods	-

Table 1: List of Materials

Sr No.	Parts	Qty	Cost
1	Single Acting Pneumatic Cylinder	2	3000
2	Flow Control Valve	1	300
3	Wheel	4	8000
4	Solenoid Valve	2	1100
5	Single phase Induction Motor	1	2200
6	Sensor Unit	1	1800
7	Pulley	2	700
8	Polyethylene tube	-	400
9	Hose collar and Reducer	-	500
10	Stand (frame) including fabrication cost	-	3000
11	Wires, Nuts, Bolts, Electrodes & Other	-	1000

Table 2: Cost of Material

VI. 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
6) Life in road accidents.

A. 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.

B. 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.

VII. 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 PNEUMATIC BUMPER & BRAKE FOR FOUR-WHEELER is working with satisfactory conditions. Thus, we have prepared a "PNEUMATIC BUMPER & BRAKE FOR FOUR-WHEELER" which helps to know how to achieve low cost product.

VIII. WORKING STILLLS

Fig. 14: Cutting Extra Metal

Fig. 15: Polishing

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