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"Fabrication of 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**". The system is based on intelligent electronically control system known as "**Automatic pneumatic braking system**". This system is used in four wheeler vehicle & heavy vehicles. Automatic braking system use the infrared sensor (IR), which is used to sense the vehicle coming from front of our vehicle and which is responsible for accident. Then sensor send feedback signal to microcontroller and apply brakes to the wheels. During the working of Automatic braking system simultaneously the driver also try to stop the vehicle by applying brake pedal. This system provides pre-crash safety to the vehicle. As well as it improves the response time of vehicle braking to keep safe distance between the vehicles. By using this system we can obtain control over the speed of vehicle in short distance.

Keywords: Automatic Pneumatic Braking System

INTRODUCTION

India is the developing country in the world. India is the largest country in the use of various type of vehicles sector. While the available resources to run the vehicles like roads quality & new technologies in vehicles are being developed to avoid accidents. The number of people dead during the vehicle accidents, is very large as compared to the other causes of death. Though there are different causes for accidents but proper technology of braking system and technology to reduce the damage during accident wants to be developed. Hence there is need of proper braking system to prevent the accidents and to reduce the damage to vehicle is necessary. To achieve this goal, we design this Automatic Pneumatic braking system. Our main aim is to design & develop automatic control system based on intelligent electronic control automotive brake activation system called "AUTOMATIC PNEUMATIC BRAKING SYSTEM ''. It consist of IR sensor which has IR transmitter & IR receiver circuit, micro-controller, Control unit, Pneumatic System. IR sensor is used to detect the obstacle coming in front of vehicle. If there is any obstacle close to the vehicle, the control signal is given to the electronic microcontroller and at the same instance odometer reading is also sensed, then Pneumatic Braking System is used to protect the driver & vehicle.

Degrees of automation are of two types:

· Full automation.
· Semi automation.
In semi automation a combination of manual effort and mechanical power is required whereas in full automation human participation is very negligible.

1.1 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.

1.2 IR SENSOR

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

FIG 1 – IR 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.

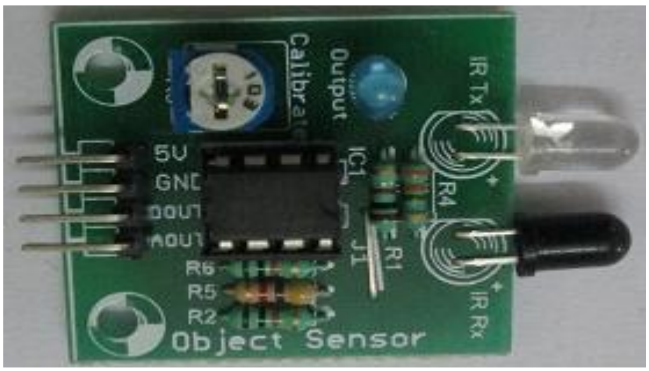

FIG 2 - SENSOR COMPONENTS

1.3 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 milli 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.

1.4 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 control. 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.

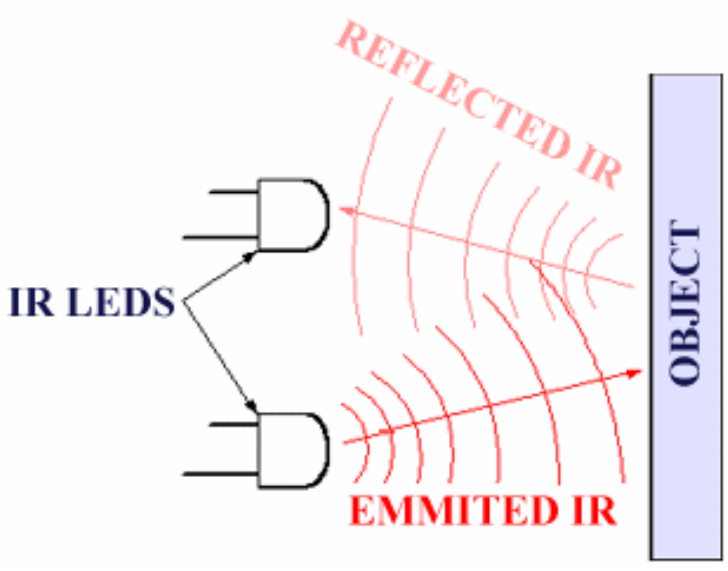

FIG 3 - IR SENSOR RAYS

LITERATURE REVIEW

Study of Presently Available Braking techniques used in Automobiles.

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 has launched its new XC60 SUV in which sport laser assisted braking is capable to sense a collision up to 50 mph and apply brakes automatically.

Dr. Kripal Singh, "Automobile Engineering – Vol.1"

We referred this book for more information about the pneumatic components and its working in the automobiles.

Automatic pneumatic bumper and break actuation before collision. – IRJET (July 2015).

In this research paper they have designed the model of Automatic pneumatic bumper and break actuation system that works under the use of sensors only.

STUDY FROM TRAFITEC

The present method, as described in the Danish Road Standards and Guidelines, is based on measurements of friction of friction values for tyre/roadway and the physical laws of deceleration. Here the braking distance is obtained from the speed, coefficient of friction and the roadway grade by applying the following formula:

$$I_{brake} = \frac{V^2}{2 * g * (\mu_{brake} + s) * 3.6^2} \quad \text{… eq. 2.1}$$

I_{brake} = braking distance (m)

V = speed (km/h)

g = acceleration due to gravity ($9.81 m/s^2$)

μ_{brake} = mean coefficient of friction

s = roadway grade.

The friction values applied are obtained from measurements on wet, but clean road surface. As a rule, the coefficient of friction is not constant, in that it increases during braking as speed diminishes. In determining the coefficient of friction, a men value is therefore applied for the given speed. The coefficient of friction is also dependent on whether the road being driven is curved or straight. The recommended friction values from the Danish Road Standards and Guidelines are shown below.

Speed (km/hr)	Resulting Coefficient of friction (straight road)	Braking Coefficient of friction (curve)
130	0.28	0.27
120	0.29	0.28
110	0.30	0.29
100	0.31	0.30
90	0.33	0.31
80	0.34	0.31
70	0.35	0.31
60	0.36	0.31
50	0.38	0.31

Table 1. Coefficients of friction from the Danish Road Standards and Guidelines

For braking in a curve in the road, the right- hand column containing braking coefficients of friction is used, while the resulting coefficients of friction are used for braking on a straight road. Braking in curves produces longer braking distances, as friction has to be "expended" on simultaneously steering the vehicle along the curve. Applying the values from above table in the above formula produces the braking distance for a straight, level road, as followed:

Speed (km/hr)	Braking distance (m)
80	74
110	159
130	234

Table 2. Braking distance on a straight, level road.

International methods for determining braking distance:

In the latest version of the AASHTO Green Book, determination of the braking distance for the use in calculating stopping sight distances has been altered from the more traditional calculation method using coefficients of friction (like the Danish) to a calculation method based on behavioral recordings and measurements from braking trails.

Based on the findings of a large- scale measurement program, the following method has been adopted for calculating braking distance.

The approximate braking distance for a vehicle driving along a level road can be determined by applying the following formula:

$$d = 0.039 * \frac{V^2}{a} \qquad \ldots \text{eq. 2.2}$$

where,

d = braking distance (m)

V = speed (km/h)

a = deceleration (m/s^2)

Braking studies indicate that by far the majority of all motorists brake with a deceleration of more than 4.5m/s^2, when the stopping for an unexpected object on the road. Approximately 90% of all motorists brake with a deceleration of more than 3.4m/s^2. This deceleration enables the motorist to keep the vehicle in lane without losing control when braking on a wet roadway. Thus 3.4m/s^2 is used as the recommended deceleration value in the above formulaic expression, 3.4m/s^2 is also regarded as being a comfortable rate of deceleration for majority of motorists.

The underlying assumption is thus the braking system and tyre/roadway friction is actually capable of this rate of deceleration. Measurements indicate that by far the majority of vehicles are fitted with brakes and tyres capable of decelerating at a rate of 3.4m/s^2.

By applying 3.4m/s^2, we obtain braking distances as shown in the table below:

Speed (km/hr)	Braking distance (m)
20	5
30	10
40	18
50	29
60	41

70	56
80	73
90	93
100	115
110	139
120	165
130	194

Table 3. Design braking distances – Green Book (2001)

A comparison of braking distances calculated using the Danish Road Standards and Guidelines and the Green Book is shown in figure. It should be noted that the Danish Road Standards and Guidelines operate with an extra safety margin of +20km/h, i.e. the braking distance for example 80km/h is obtained by using 80+20km/h. The extra safety margin is not reflected in the Figure , which would result in appreciably greater differences between the Danish Road Standards and Guidelines and the Green Book.

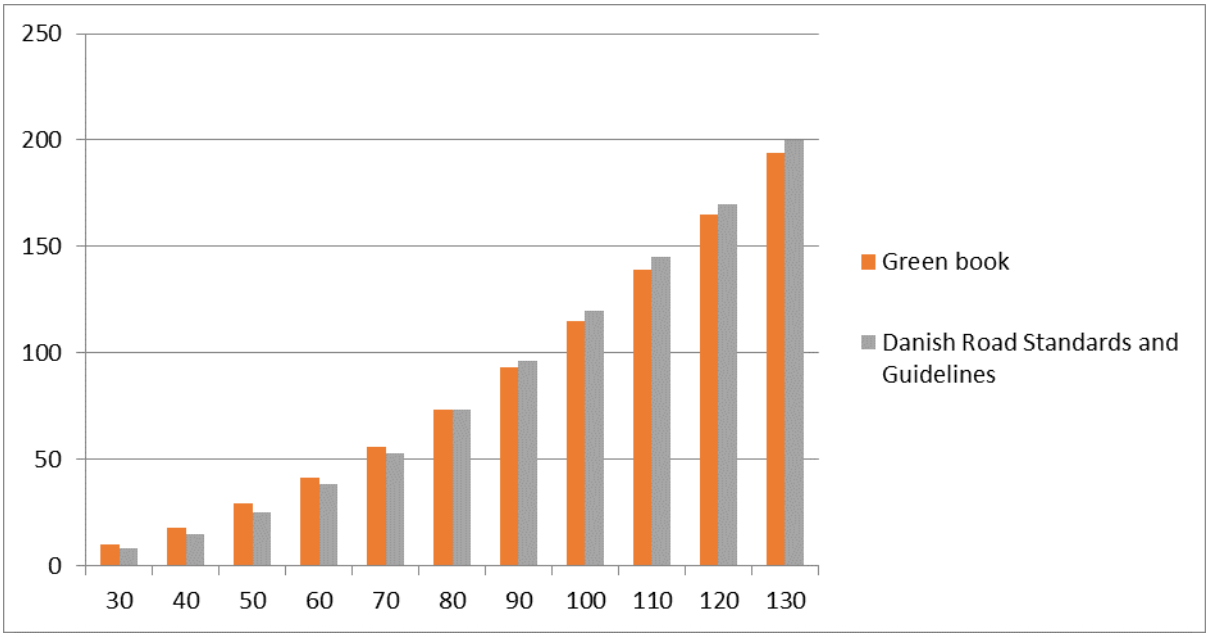

Fig 7 - Represents the braking distance (m) verses speed (km/h)

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.

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. 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 Solenoid valve.

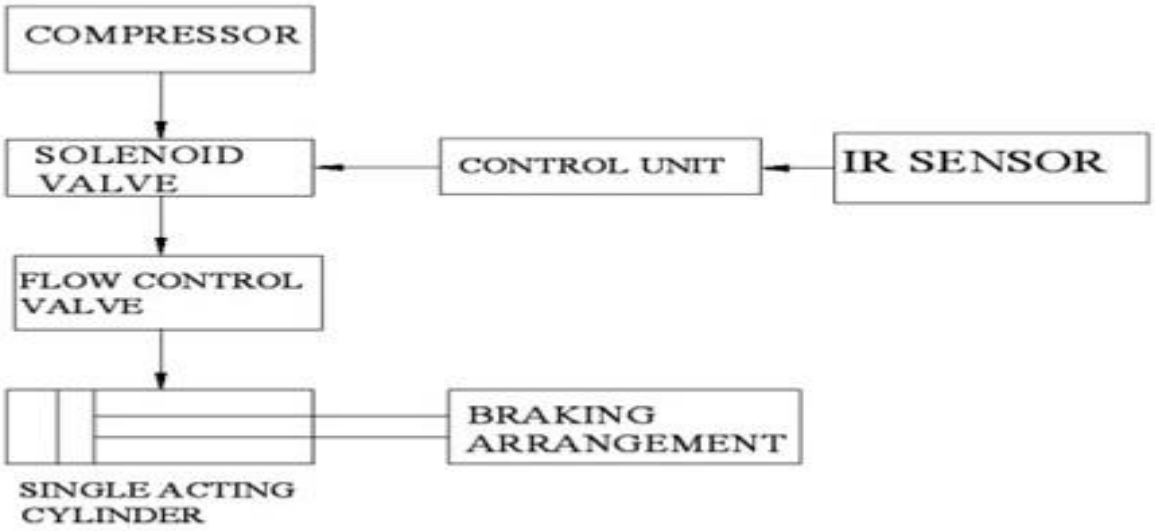

FIG 8 - BLOCK DIAGRAM OF WORKING PRINCPLE

ADVANTAGES LIMITATIONS AND APPLICATIONS

ADVANTAGES

1. It able to Increase the sureness in braking system**.**
2. System able to increase the pre-crash safety.
3. System able to provide more safety to the passengers.
4. The system is capable of both i.e. sensing the distance of the obstacle and also speed from the odometer.
5. System plays an important role to save human life in road accidents.

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. 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.

APPLICATIONS

1. This system may be applicable in all types of light vehicles like cars, Rickshaws, Tempos.

2. This system also can be successfully installed in the heavy vehicles like buses, trucks, trailers, etc.

CONCLUSION AND FURTURE SCOPE

In this project a working model was made successfully which was able to sense the obstacle from a safe distance and also it was able to sense the speed of the model from the odometer and apply brakes according to the rule the lesser the best. This system doesn't depends on the reflex of the driving or the capability of the driver to apply the brakes at the right time but it sense the distance of the obstacle from the vehicle if the obstacle is in the required range than it apples the **brake automatically**.

In the future design of this system an anti braking system (ABS) can be made by the programming of the microcontroller and the study of the time required for the braking at various speeds of the vehicle and distance covered by the vehicle to bring the vehicle at complete rest.

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