Intelligent Braking System with Automatic Pneumatic Bumper

Mr. Nivesh Thepade[1] Mr. Lakhan Thombare[2] Mr. Pritish Varude[3] Prof. Ashish Umbarkar[4]
[1,2,3]Student [4]Assistant Professor
[1,2,3,4]Smt. Kashibai Navale College of Engineering, Pune

Abstract— In almost all of the cases of vehicle accidents, the basic reason cited is failure to apply the brakes at the right time. If the brakes are applied at the right time the accidents can be prevented. Automation can assure higher reliability of braking as compared to fully manual braking. 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 "Intelligent Braking system with Pneumatic Bumper".

Key words: Automatic Pneumatic Bumper, Intelligent Braking System

I. INTRODUCTION

Automobile vehicles have become integral part of our lives. With growing number of vehicles on road, the numbers of traffic accidents are also increasing. It is important to prevent the chances of accidents and to protect the passengers when accidents occur. Air bags provide safety, but they are costly. Safety, being a matter of prime importance, cannot be compromised for cost. Hence our attempt is to provide a reliable and safe system at low cost.

Though there are different causes for these accidents but proper technology of braking system and technology to reduce the damage (such as pneumatic bumper system) during accident can be effective on the accident rates. So, in today's world, implementation of proper (automatic) braking system to prevent the accidents is a must for vehicles. Therefore, pre-crashing system is demanded. Such a system will prevent accidents on roads with poor visibility by using proximity sensors to detect other vehicles, or any other obstacle in the path.

II. OBJECTIVES

The future of any industry is more than just developing new technology. It is integrating shifting the approach to achieve safety. Intelligent Braking System approach represents considerable shift from the traditional approach to safety, by considering safety in terms of firstly, avoiding the possibility of accidents, and secondly, protecting occupants when a crash is unavoidable, we can prevent more accidents, save more lives, decrease material damage to vehicles and reduce medical costs to society.

Following are the main objectives of Automatic Braking System with Pneumatic Bumpers:

- To ensure the braking of vehicle in time.
- To increase the crashing distance during accident.
- To increase the safety during pre-crash.
- To increase external safety to vehicle body.
- To decrease the level of passenger injury by use of external vehicle safety device.
- To reduce the requirement of internal safety devices like air bags.

III. CURRENT TRENDS

In conventional vehicles there are different mechanism operated for braking system like use of hydraulic, pneumatic, or mechanical system. But all these braking mechanisms receive the input signal directly from the driver by application of force on brake pedal. Thus, braking of vehicles is totally manual operated. So, if the driver fails to see the obstacle in front of his driving vehicle or fails to apply proper braking force on the brake pedal, he may lose the control of his vehicle, leading to accident. Also the driver may not able to pay complete attention when driving at night. So there are many chances of accidents. Urgent application of brakes can result in veering of the vehicles due to skidding of tyres. Moreover, due to sudden application of brakes there are chances of other vehicles dashing from back. Hence, there is no provision to minimize the damage of vehicles. Thus, the current designed system only fairly reduces the damage of vehicle and/or passengers.

A. Comparison of Air Bags with Pneumatic Bumper System

- Air bags provide safety in case of severe accidents only, whereas, the pneumatic bumper can provide safety even in case of minor accidents.
- Air bags can provide only internal safety, but pneumatic bumper system provides safety to external body of cars as well as internal safety.
- Air bags can be deployed only once, whereas pneumatic bumper can be used many times. Even if the bumper is damaged, it can be replaced easily.
- The cost of air bags is higher than pneumatic bumper system.

Hence, our project can meet the required objectives satisfactorily.

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 range of the proximity sensors can be controlled by using a potentiometer. If the obstacle detected by the proximity sensors is within the set distance, relay

actuates solenoid valve and stops the motor. The solenoid valve then applies the brakes and extends the pneumatic bumper. Thus, the chances of possible collision of vehicle are greatly reduced.

V. CAD MODEL OF THE PROTOTYPE

The cad model of the prototype was created using AUTOCAD software. The cad model is used only for visualization of the system design, and hence, dimensions are not the same as used in the actual prototype. The screenshot of created cad model is shown below.

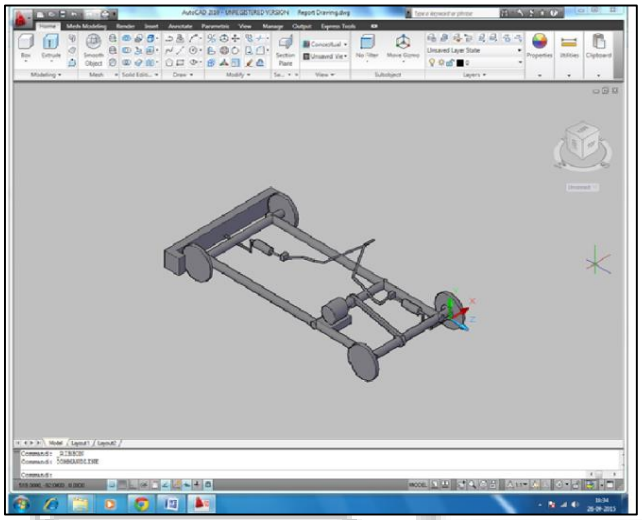

Fig. 1: Screenshot

Important components used in the project, and their specifications and use are described below:

A. *Electronic Circuit*

1) Adaptor
a) Output - 12V, 5 Amperes
– Used to reduce the voltage from 230V ac to 12V dc supply.

2) Voltage Regulator
a) LM 358
– Used to reduce 12V dc supply to 5V dc supply.

3) Capacitor
a) Electrolyte capacitor
– Used to rectify the fluctuations in pulsating dc.

4) Sharp IR Sensor
a) Range: 10 cm to 150 cm.
– Used to detect presence of obstacle

5) Comparator
a) LM 358
– Used to compare the signal from proximity sensors.

6) Resistor
a) 1 Kilo-Ohms
– Used to limit current in transistor

7) Transistor DC 547
– Used as input to the relay.

8) P-N Junction Diode
– Used to prevent the damage to transistor due to possible reverse voltage from the relay coil.

9) Relay
– Used as a switch between the motor and pneumatic circuit.

10) Motor
– Used to provide power to drive the vehicle

B. *Pneumatic Circuit*

1) Compressor
a) Pressure 2-3 bars
– Used to provide compressed air

2) Connecting Cables
– Used for connecting the compressor air to solenoid valve and pneumatic cylinders.

3) Solenoid Valve
– Used to actuate the pneumatic circuit

4) Pneumatic Cylinders
– Used to apply brakes and extend/retract the bumper.

C. *Mechanical Circuit*

1) Body Frame
a) Material- Mild steel

2) Wheels
a) Wheels of TVS Scooty.

3) Shafts
a) Diameter- 12mm
b) Material- C30.

4) Bearings
a) Bearing no.- 6201

5) Extendable bumper
a) Material- Aluminium sheet mounted on square pipe of mild steel.

6) Chain
a) No. of links- 98

7) Sprocket
a) Pitch circle diameter- 60.4mm

8) Other parts
a) Nuts and bolts for fitting.
b) Wooden support to mount circuit on

VI. DETAILS OF CALCULATIONS

For calculations, V. B. Bhandari and Design Data book were used as reference material. Suitable values in certain cases were taken directly, as per the empirical relations or from standard values and from the internet. Formulas used for calculations are as below:

A. *Calculation of Pneumatic Cylinder Dimensions*

– Assumption: Maximum force acting on bumper is assumed to be 90N

Considering factor of safety as 1.25, we design bumper for 90x1.25 =112.5N force

Also, pressure used is 4bars=0.4N/mm^2

1) For Applying Brakes

For out-stroke

$$F_{o/s} = P \times A$$
$$112.5 = 0.4 \times 0.7854\ D^2$$
$$D^2 = 358.0978\ mm^2$$

So, D =18.92mm

Selecting standard value of 20mm bore diameter, we calculate inner diameter.

Assuming In-stroke force to be equal to outstroke force, we assume instroke force to be 90N.

For factor of safety of 1.25, instroke force is 90x1.25=112.5N.

For in-stroke,

$$\text{Piston rod area} = \frac{\pi}{4} \times d^2$$
$$\text{Effective area} = \frac{\pi}{4} \times (D^2-d^2)$$

$$= 0.7854\ (20^2\text{-}d^2)mm^2$$

So,

$$F_{i/s} = 0.4 \times 0.7854(20^2\text{-}d^2)$$
$$112.5 = 0.31416(20^2\text{-}d^2)$$

On solving, we get d= 6.47mm

Hence, selecting from standard values, inner diameter is 7mm.

Keeping stroke of 50mm for applying brakes, we get the cylinder dimensions as

Cylinder bore = 20 mm

Cylinder stroke=50 mm

Similarly, we calculate for Bumper.

2) For Bumper:

For out-stroke

$$F_{o/s} = P \times A$$
$$112.5 = 0.4 \times 0.7854\ D^2$$
$$D^2 = 358.0978\ mm^2$$

So, D =18.92mm

Selecting standard value of 20mm bore diameter, we calculate inner diameter.

Assuming In-stroke force to be equal to outstroke force, we assume in stroke force to be 90N.

For factor of safety of 1.25, instroke force is 90x1.25=112.5N.

For in-stroke,

$$\text{Piston rod area} = \frac{\pi}{4} \times d^2$$
$$\text{Effective area} = \frac{\pi}{4} \times (D^2\text{-}d^2)$$
$$= 0.7854\ (20^2\text{-}d^2)\ mm^2$$

So,

$$F_{i/s} = 0.4 \times 0.7854(20^2\text{-}d^2)$$
$$112.5 = 0.31416(20^2\text{-}d^2)$$

On solving, we get d= 6.47mm

Hence, selecting from standard values, inner diameter is 7mm

So, for both the double acting pneumatic cylinders, bore diameter is 20mm.

To increase the crashing distance in case of accidents, we increase the stroke length of cylinder used for extending the bumper.

So, for bumper, cylinder stroke of 100mm is suitable.

VII. Advantages and Limitations

A. Advantages

1) Simple construction of the prototype vehicle.
2) It provides safety to passengers in the vehicle as well as to the vehicle body.
3) It reduces accident intensity and impact.
4) This system increases the response time of vehicle braking by keeping safe distance between two vehicles.
5) The design also increases the crashing distance by providing extra space due to extension of the bumper, decreasing the chances of injuries to commuters.

B. Limitations

1) IR sensor range is small.
2) Proximity sensors may sense obstacle due to presence of dirt
3) Sensors may stop working due to random reasons

VIII. Conclusion

Behind the designing of this system, our main aim is to improve the technique of prevention of accidents and also reducing the hazard from accidents like damage of vehicle, injury of humans, etc. The application of pneumatics produces smooth operation. By using more techniques, they can be modified and developed according to the applications. By implementing this project we can reduce cost of high end cars by giving similar kind of safety.

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We have gained practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. Towards the end of completion of the project, we felt that the project has helped us to bridge the gates between institution and industries.

In conclusion remarks of our project work, we have developed an "INTELLIGENT BRAKING SYSTEM WITH PNEUMATIC BUMPER FOR FOUR WHEELER" which helps to achieve low cost automation. We are proud that we have completed the work with the limited time successfully. We have done the project to our ability and skill making maximum use of available facilities and we are able to understand the difficulties in maintaining the tolerances and also quality. We also observed that the prototype manufactured is working with satisfactory conditions and our work is able to achieve all the objectives which are necessary.

IX. Future Scope

Our future work deals with incorporating this system with various different features to provide enhanced protection by the intelligent braking system in real time application. For that, some of the possible changes are:

1) Infrared sensors can be replaced by ultrasonic sensors.
2) Regular bumpers can be replaced by hydraulic bumpers.
3) Infrared sensors can sense eye blinking and give signal to solenoid valve when driver sleeps.
4) Limit switch can be used to limit the minimum speed above which the system gets triggered.
5) PIC can be implemented in system for further modifications like gradual slowdown of vehicle.
6) Bumper design can further be enhanced to act as external air bags.
7) With some modifications, the project can be used with timer circuits so as to apply brakes and extend the bumper after a delay of few milliseconds so that the bumper does not extend unless the vehicle just reaches the crashing distance.

Acknowledgment

It indeed is a great pleasure and moment of immense satisfaction for us to have successfully completed the project of "Intelligent Braking System With Automatic Pneumatic Bumper" 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. A. M. Umbarkar

for his everlasting guidance. It was his inspiration and encouragement which helped us in completing our project. Our sincere thanks and deep gratitude to Head of Department, Dr. A. P. Pandhare and other faculty member; and to our Institute's Principal, Dr. A. V. Deshpande for providing us infrastructure and technical environment.

We also wish to thank Mr.Amit Jadhavrao for giving us this project opportunity in SS Tech Buzz Firms. We also wish to extend gratitude to our project mentor Mr.Hrushikesh for his everlasting guidance.

At last but not least we express our sincere thanks to all those individuals involved both directly and indirectly for their help in all aspect of the project.

REFERENCES

[1] Srinivasa Chari.V, Dr.Venkatesh P.R, Dr.Prasanna Rao N.S, Adil Ahmed S "Automatic Pneumatic Bumper And Break Actuation Before Collision", 2015, International Research Journal Of Engineering And Technology (Irjet) Volume: 02 Issue: 04, Pp1015-1023
[2] Dr. P. Poongodi. Mr. P. Dineshkumar, "Automatic Safety System For Automobiles"
[3] Dr.Eung Soo Kim,"Fabrication Of Auto Braking System Using Sensor", International Journal Of Control And Automation, Vol-2, And No1.
[4] Takahiro Wada, "A Deceleration Control Method Of Automobile For Collision Avoidance Based On Driver Perceptual Risk" IEEE International Conference On Intelligent Robots And Systems, Oct 4881-4886.
[5] Lee, "A Theory Of Visual Control Of Braking Based On Information About Time To Collision", Perception, Vol 5, Pp 437-459
[6] J. T. Wang, "An Extendable And Retractable Bumper"
[7] Jadhav N. D., Gulmire S.M., Ghutukade R.S., Gaikwad A.S., Prof.Fegade S.G. "Automatic Braking With Pneumatic Bumper System" 2015,Ijsart Volume 1 Issue 5, Pp
[8] Katore S.R., Kadlag S.C., Mane P.V., Pawar G.V., Prof.Londhe B.C., "Automatic Braking With Pneumatic Bumper System", 2015, International Journal Of Engineering, Education And Technology (Ijeet), Volume 3, Issue 2
[9] Erik Coelingh, Lottajakobsson, Henrik Lind, Magdalena Lindman, "Collision Warning With Auto Brake - A Real-Life Safety Perspective", Volvo Car Corporation Sweden Paper Number 07-0450
[10] Personal Contacts and the Internet.

