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Expandable and Retractable Pneumatic Bumper with Braking System

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Abstract: Due to increasing demands of vehicle and also increasing population of peoples there is high quantity of vehicles being use. Vehicle should be safe to drive and simple to operate. Now a day's vehicle accident is the major problem. Sometimes driver fails to apply brake of the vehicle also due to non-metallic body of vehicles are not able sustain the accidental force. Our breaking system is an innovative project for the purpose of preventing accidents that happens in the restricted roadways. Also provides safety to vehicle before collision.

The expandable and retractable pneumatic bumper with braking system consists of IR transmitter and Receiver circuit, Eye blinker sensor, Control Unit, Pneumatic bumper system and braking unit. The IR sensor is used to detect the obstacle. If there is any obstacle closer to the vehicle, the IR sensor will detect the obstacle and send signal to control unit simultaneously eye blinker also works when driver sleeps then the eye blinker sensor system sends the signal to the control unit and it activates bumper and braking system and thus it is used to provide safety to the man and vehicle.

Keywords— Braking system, Double acting pneumatic cylinder, Bumper, IR sensor, eye blinker sensor, compressor, solenoid valve, flow control valve.

I. INTRODUCTION

Today India is the developing country in the world its population is large and uses various types of vehicles the available resources to run these vehicles like quality of roads, and unavailability of new technologies in vehicles are causes for accidents. Road Traffic Accidents says, 'An event that occurs on a way or street open to public traffic; resulting in one or more persons being injured or killed, where at least one moving vehicle is involved'. It is the collision between vehicles, pedestrian, animals, architectural obstacles etc. main causes of accidents are distracted driving, accelerating the vehicle, drunken drive, careless driving, night driving, rain, wrong way driving, improper turns, late application brake, teenage drivers, road crossing etc.[6]The number of peoples who dies during the vehicle accidents is also very large as compared to the other causes of death. Though there are different causes for these accidents but proper technology of braking system and technology to reduce the damage during accident mainly affects the accident rates. So today implementation of proper braking system to prevent the accidents and pneumatic bumper system to reduce the damage is must for vehicles. [2]

The total number of road accident increased by 2.5% from 4,89,400 in 2014 to 5,01,423 in 2015. the total number of persons killed in road accident is increased by 4.6% from 1,39,671 in 2014 to 1,46,133 in 2015. road accident injuries also increased by 1.4% from 4,93,474 in 2014 to 500279 in 2015. The severity of accidents measured in terms of number of person killed per 100 accidents. And it is also increased by 28.5 to 29.1 from year 2014 to year 2015. the analysis of road accident data says that about 1,374 accidents and 400 deaths take place on Indian road every day that is 57 accident and 17 deaths every hour take place.[3]

Profile of road accident- a total road accident was reported by all states/ Union Territories. Of these 26.3 percent were fatal accidents. The following table shows the number of accidents and number of persons affected.

TABLE 1- NUMBER OF ACCIDENTS AND PERSON AFFECTED

Number of road accidents and number of persons affected					
Year	Number of accidents		Number of person		Accident severity
	Total	Fatal	Killed	Injured	
2013	486476	122589	137572	494893	28.3
2014	489400	125828	139671	493474	28.5
2015	501423	131726	146133	500279	29.1

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The percentage share of total number of persons killed in road accident (%) in 2015 as shown above [3]

II. METHODOLOGY

The systems consist of IR sensor, eye blinker and control unit. If vehicle is running on the road and suddenly an obstacle comes in front of the vehicle, then the IR sensor gets activated and sends the signal to the control unit. After that the IR sensor will detect the obstacle and suddenly signal is generated and transmitted to the control unit. And the control unit uses the flow control valve to control and direct the air flow which is high pressure generated by compressor. Due to this the one of the pneumatic cylinder piston is pushed forwards which is connected to bumper and in this way the bumper expands and retracts and simultaneously flow control valve sends working air to another pneumatic cylinder which applies drum brake and hence the break is applied.

Now assume our vehicle is running at night at this time mostly Indian drivers feel drowsy or they are drunk in this case eye blinker sensor will work when driver eye blinking frequency gets reduce and it sends the signal to control unit, and further working is same as like in IR sensor, but to activate all this systems vehicle have to proceed a specific speed limit.

III. OBSTACLE DETECTION

When any obstacle comes in front of vehicle it is then detected by IR sensor. IR sensor is having IR transmitter and receiver unit for detection. IR signal is transmitted through IR transmitter when the obstacle comes in front of vehicle in between the described range of sensor the signal reflect from the obstacle and received by receiver unit. And thus detection of any obstacle takes place.[8]

IV. EYE BLINK DETECTION

Eye blinker sensor is used to detect the blinking frequency of eye. If the frequency measured by this sensor is less than the normal frequency this way eye blink sensor gives signal to control unit and thus the eye blink detection system works. At the close position of eye there will be less frequency or zero frequency. For example if the driver is in fatigue condition the eye blinking frequency is less and thus the system activate and send signal to control unit. [1]

V. BUMPER WORKING

Bumper is a device which having a high strength and force absorb capacity. When the obstacle collides to the vehicle, the bumper should have capacity to absorb that force. To sustain this force bumper should be design to withstand at that force. [4]

The one pneumatic cylinder is connected to bumper which is located front of vehicle. After obstacle sensing the control valve activates solenoid valve and the flow control valve is open and flow of high pressure air expands the pneumatic cylinder. Due to forward movement of piston rod moves the bumper forward. When obstacle collides with greater force the bumper moves backward resulting in the retraction of pneumatic cylinder. For the forward and backward movement of bumper the expandable and retractable pneumatic cylinder is used. Thus the safety of vehicle and driver take place. [5]

VI. BREAKING OF VEHICLE

To break the vehicle or to stop the vehicle break is applied by paddle, by forcing the paddle the shoe expands and create friction by this friction effect the wheel of vehicle stops that is break is applied.

Internal expanding Shoe this type of drum break is used. The rim type internal expanding shoe is widely used for braking systems in automotive applications and is generally referred as internal shoe drum brake.

Drum break is used in our project. But the break application is not manual, break is applied automatically. After sensing obstacle control unit activate solenoid valve then flow control valve flows the high pressure air towards the pneumatic cylinder which create the forcing action on the drum break. And this way break is applied.[8]

VII. DESIGN SPECIFICATION

Components	Material	Dimensions	Calculations
Frame	Mild steel- Square pipe	Area=25.4*25.4 mm ²	Crippling load= 326.11KN
		Thickness=3mm	
		Length=762mm	
Double acting	Stainless steel	Diameter=20mm	Outstroke force= 125.66N

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pneumatic cylinder		Length=50mm	Instroke force= 110.26N
		Pressure=0.4 N/mm ²	
Chain-06B	Mild Steel	Chain -06 B Pitch -9.525mm	Approximate centre distance, $a=40p=40*9.525 =381\text{mm}$
		Roller diameter, $d_1=6.35\text{mm}$	
		$z_1=18, z_2=18$	No. of links=98
Brake (Internally expanding brake- Drum Brake)	Cast Iron	Brake drum (Front) = 110 mm	Braking Torque (Leading)=10.89 N-m
		Brake Drum (Rear) = 110 mm	
		Drum radius=55mm	Braking Torque (Trailing)= 4.1745 N-m
		Face Width= 30mm	Total Braking torque Capacity=15.0645 N-m
Sprocket (For Chain 06B)	Mild Steel	For Z=18 Pitch, P=9.5 mm	Pitch circle diameter= 54.85mm
			Top diameter (D_a)= 60.4 mm
			Root diameter=48.19mm
		Roller diameter, $d_1=6.35\text{mm}$	Tooth flank radius
		Transverse pitch $p_t=10.24\text{mm}$	$(r_e)_{\text{max}}=25.6\text{ mm}$
			$(r_e)_{\text{min}}=15.24\text{mm}$

VIII.MODEL ON CAD

For modelling purpose the CATIA software is used. It is applicable for four wheel vehicle the frontal area is covered with bumper system and at the rear wheel the breaking system is located.

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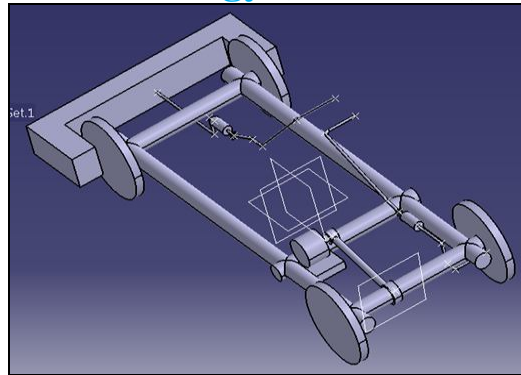


Figure 1- Model

IX. BLOCK DIAGRAM AND WORKING

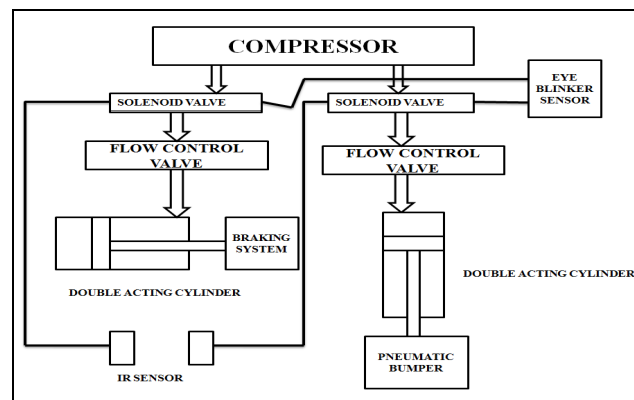


Figure 2- Block diagram showing working

The working of the system is shown in figure 2. The IR sensor is located at front so that it can detect the obstacle easily. Then the next is control unit which has solenoid valve and flow control valve. The compressor is located at rear side of vehicle; it compresses air up to 10 bar pressure as per signal of control unit. Pneumatic cylinder expands due to high pressure air from compressor. Then the bumper movement and braking takes place.

X. CONCLUSION

The project is combination of the mechanical and Electronics, which is fairly known as the Mechatronics. Our aim is to provide safety before collision and if in case collision happens the system should be able to save the passenger using the by absorbing accidental force. Now a day's vehicle accident is the major problem. This breaking system used an automatic concept for the purpose of preventing accidents. To overcome this problem developed system is helpful for the reduction of road accidents. The IR sensor with braking provide pre-crash safety and Bumper unit prevent further damage to the vehicle in case of accident. Thus the system provides safety to passenger as well as vehicle.

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