Design and Analysis of Intelligence Braking System

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***Abstract*— Road accidents are a common place in today's scenario. Accident prevention has been one of the leading areas of research. In Indian scenario normally vehicles are equipped with ABS (Anti-Lock Braking System), traction control, brake assist etc. for driver's safety. This paper focuses on a system known as 'Intelligent braking system' (IBS) which employ several sensors to respond when emergency conditions occur. The system includes an ultrasonic wave emitter provided on the front portion of the car. An ultrasonic receiver is also fitted to receive the signal. The reflected wave gives the distance between the obstacle and the vehicle. Then a microcontroller is used to detect the pulses and apply brakes to the vehicle. IBS car provides the glimpse into the future of automotive safety. By IBS system we can prevent more accidents and save more lives.**

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.

A. 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.

II. LITERATURE REVIEW

Garrest N. and Vanderplaats (1979), suggests the technique of automated design using numerical optimization. Numerical optimization first involves the concept description in physical terms to give a basic understanding of the iterative procedure employed by these methods. Next, the typical engineering task is presented and converted to a form amenable to solution by numerical optimization. Basic algorithm for solving this problem is identified. The state of the art allows for the routine solution of nonlinear design problems of approximately 20 independent variables subject to 100 or more constraints. In many applications, much larger design problems may be solved. The basic approach of this study is incorporated in this design optimization work along with the following optimization procedures in the ensuing literatures.

Dixit, Beohar and Bal (2000), suggests that, stochastic signomial geometric programming is an effective tool for the optimum design of a brake disc considering random nature of design variables. This program also takes into account the probability of satisfying constraint equation, so that, the design approach is more realistic. The calculation equations in this approach are as such introduced for the design of a brake disc for a light duty passenger vehicle.

Das A.K. and Pratihar (2002) suggests that, optimization through genetic algorithm yields better results in the machine element design under certain circumstances. The same design through traditional methods has some drawbacks such as there is a chance for the solutions get trapped into local minima. The algorithm developed for one type of problem, may not be suitable to solve another type of problem. In this context, the real coded genetic algorithm proved to be a versatile design optimization algorithm for design of machine elements. The design

optimization procedure adopted by these authors is as such incorporated in this work to determine the exact dimensions of a brake disc.

Hand book of statistical quality control (SP : 28 - 1985) (Source Indian standards (IS : 7300 - 1974), deals with methods of regression and correlation. This method deals with the statistical methods of regression and correlation in the case of two variables. Regression deals with situation where the variation of one variable is dependent on the variation of second variable. This technique is as such incorporated in this work to determine the inner and outer radius of the brake disc by satisfying the constraint of maximum torque transmission by the brake disc.

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.

- 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.

IV MATERIAL SELECTION

A)CONTROL UNIT

In automotive electronics Electronic Control Unit (ECU) is a generic term for all embedded system that controls one or more of the electrical system or subsystems in a motor vehicle.

SINGLE PHASE AC MOTOR

The typical household supply of 220 volts can drive the single phase A.C. Motor. This power supply is limited to the motor; it does not power up any other part of the circuit. The single phase A.C. motor drives the wheel and pulley arrangement and rotates at a speed of 1400 RPM. Since the motor is connected directly to the control unit circuit, the motor will be turned off or stopped whenever electromagnetic plunger hits the brake, which will prevent any internal damage to the motor.

V)ASSEMBLEMODEL

VI) DETAIL OF CALCULATION

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 x A

112.5 = 0.4 x
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, in stroke force is 90x1.25=112.5N.

For in-stroke,

Piston rod area = $\pi/4$ x d^2
Effective area = $\pi/4$ x
(D^2-d^2) = 0.7854 (202-d^2)
mm^2

So,

F i/s = 0.4 x 0 .7854(202-
d^2) 112.5 = 0.31416(202-
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 x A
112.5 = 0 stroke,

Piston rod area = $\pi/4$ x d^2
Effective area = $\pi/4$ x (D^2-d^2)
= 0.7854 (202-d2) mm^2
So,
F i/s = 0.4 x 0 .7854(202-d^2)
112.5 = 0.31416(202-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. 112.5=0.4 x 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, in stroke force is 90x1.25=112.5N.

For in-stroke,
Piston rod area = $\pi/4$ x d^2
Effective area = $\pi/4$ x (D^2-d^2)
= 0.7854 (202-d^2) mm^2
F i/s = 0.4 x 0 .7854(202-d^2)
112.5 = 0.31416(202-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.

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VII) 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.

VIII) REFERENCE

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