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Automatic Braking System using Ultrasonic wave

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Abstract: An automatic Braking system is an intelligent mechatronic system includes an Ultrasonic wave emitter provided on the front portion of a car producing and emitting Ultrasonic waves. An Ultrasonic receiver is also placed on the front portion of the car operatively receiving a reflective Ultrasonic wave signal. The reflected wave (detected pulse) gives the distance between the obstacle and the vehicle. Then a microcontroller is used to control the speed of the vehicle based on the detection pulse information to push the brake pedal and apply brake to the car stupendously for safety purpose. Automotive vehicles are increasingly being equipped with collision avoidance and warning systems for predicting the potential collision with an external object, such as another vehicle or a pedestrian. Upon detecting a potential collision, such systems typically initiate an action to avoid the collision and/or provide a warning to the vehicle operator. The aim is to design and develop a control system based on an automatic, intelligent and electronically controlled automotive braking system for automobiles is called as "Sensor based Electromagnetic Braking System". This Braking system consists of IR transmitter and receiver circuit and the vehicle. The IR sensor is used to detect the obstacle. There is any obstacle in the path, the IR sensor senses the obstacle and giving the control signal to the microcontroller, which in turn sends a signal to the motor to stop and also to the Electromagnet so as to stop the vehicle as programmed. This project facilitates electromagnetic braking system using solenoid. Here in fabrication module include a vehicle prototype frame associated with a dc motor and a electromagnet.
Keywords: Ultrasonic, Braking System, Electromagnet, IR transmitter, IR receiver, IR Sensor.

I. INTRODUCTION

Automatic Braking is a technology for automobiles to sense an imminent collision with another vehicle, person or obstacle; or a danger such as a high speed approach to a stop sign and to respond with the braking system by either pre- charging the brakes or by applying the brakes to slow the vehicle without driver input[1].

When a safety factor of a vehicle is considered a primary factor that flashes in mind is its brakes or braking system. So, a braking system is such a vital component that is necessarily required when a vehicle is considered. It reduces the kinetic energy of the vehicle in conditions when a vehicle must slow down or also it has to be stopped. Thus, making sure the vehicle and the passengers inside it are safe. Thus, a braking system is always needed to ensure the safety of the drivers and passengers uncountable valued lives.

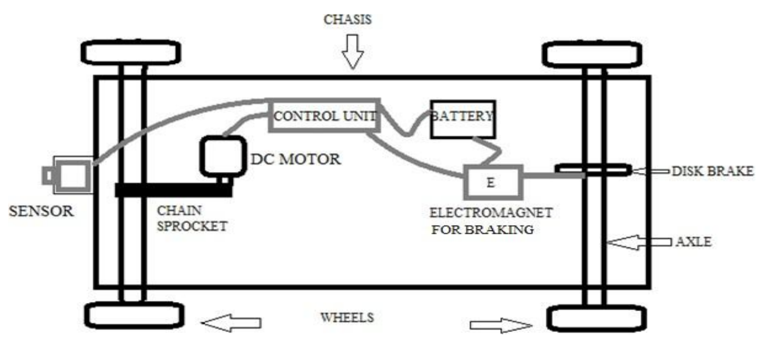

Fig.1 Conceptual Diagram

Lot of vehicle owners take their braking systems for granted. Every time you get to a stop and press on the brake pedal, your vehicle stops. Your vehicle's braking system is by far the most important safety feature it has. The ability to stop or slow down at a split second significantly helps stop incidents and accidents. However, when you closely look at the sheer mechanics of how the braking system works, you'll begin to appreciate its function. Several components of your braking system work together to help keep the driver safe. Therefore, keeping them well maintained will make the difference between encountering a huge accident or even a potential tragedy. Due to the importance of your braking system, it's a wise idea not to overlook its importance.

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II. RELATED WORK

Fletcher et al. [2] applied the fuzzy logic controller to a two-stage high-pressure gas reduction station. Harris [3] applied the fuzzy logic controller to the gas filter. They concluded that fuzzy controller can give as good, if not better results than PID controller in spite of the limit cycle which could be reduced or eliminated by proper controller tuning. Zlokovitz [4,5] has developed adaptive predictive control of pressure control of gas station. This method utilizes one 65 5 Tikrit Journal of Eng. Sciences/Vol.15/No.3/September 2008, (64-76) controller at the district regulator station and one controller at the system low pressure point.

Johan [6] treats methods to handle nonlinearities in a throttle unit. The approach has been to first design a linear controller based on the results from system identification, and then to develop an adaptive updating law estimating uncertain parameters of the throttle. John [7] described the application of pressure control in gas/liquid phase separator includes a fluid inlet, a vapor outlet, a liquid outlet, and first and second valves disposed in fluid communication with liquid outlet.

Bernd et al. [8] developed pressure control method by using computer control. This method relates to the pressure control for program -controlled drive of at least one pressure actuating member in order influence the hydraulic constellation in a transmission via the pressure.

III.EXPERIMENTATION

The braking system includes a vehicle chassis with dc motor and electromagnet attached to single disc in center of rear axle. The transmitter senses the approaching vehicle, represented by field lines, and generates a detection signal that is transferred to the controller. The controller determines whether the detection signal is greater than the pre-determined magnitude, constituting that the approaching vehicle is within a pre-determined distance and/or is accelerating toward or approaching the target vehicle.

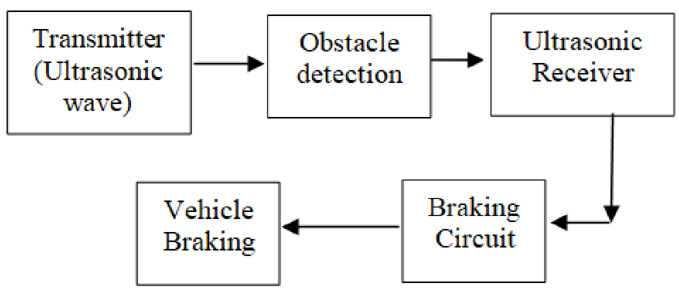

Fig.2 Block Diagram

After receiving the error signal, the controller warns the operator of approaching vehicle by a warning signal and the brake is applied automatically by stopping the motors, which is running in normal conditions. In addition, the microcontroller sends the signal to the solenoid actuator, which gets activated to generate magnetic field in the disc provided. This magnetic field generated will oppose the moment of the disc, which is mounted on the wheel of the vehicle thus making the vehicle come to halt.

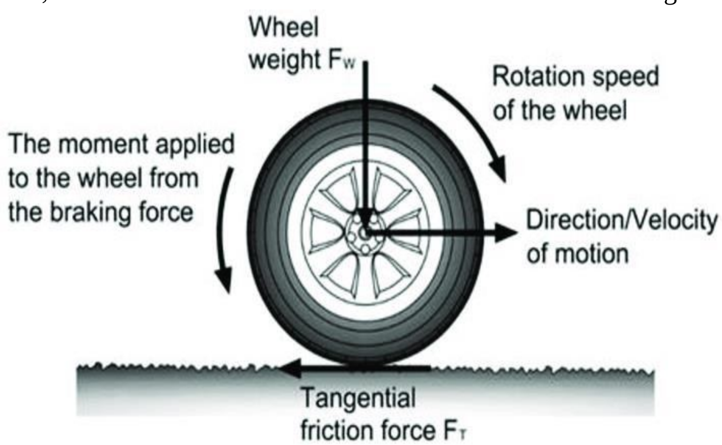

Fig.3 Forces acting on a single wheel

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IV. CALCULATIONS

The braking system includes a vehicle chassis with dc motor and electromagnet attached to single disc in center of rear axle. The transmitter senses the approaching vehicle, represented

A. *Design of Shaft:*

Material Used -M.S.	Tensile Strength- 700N/mm²	Yield strength- 350 N/mm²
Torque- (π /16) x d3Xt	Power of motor =50 watt	N = 55rpm

Torque of shaft-1

P = 2πNT/60 (1)

50=2x3.14x55xT/60

T=8.68 Nm = 8.68 ×103 N-mm.

Shear stress t = ultimate strength Factorof safety FOS=4.

t=700 /4

=175N/mm²

T= π/16 x d3 x t (2)

= π/16 x d3 x 175

d= 6.31 mm

So, we select diameter is 20 mm which is safe

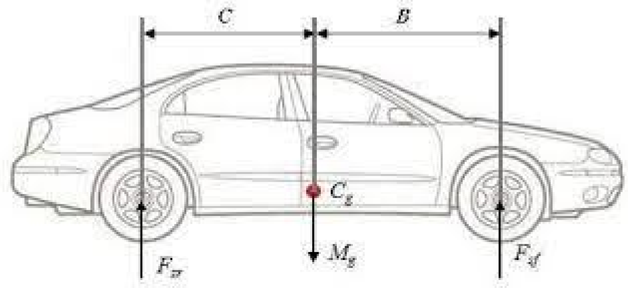

Fig.3: Forces acting on half car model

B. *Design of bolt*

Bolt is to be fastened tightly also it will take load due to rotation. Stress for C-25 steel ft =120 N /mm2. Std nominal diameter of bolt is 8 mm. Let us check the strength, Also, initial tension in the bolt when belt is fully tightened.

P = 1420 d N P = 1420 x 8 N P = 1420 d N P = 11360 N

Therefore, the total load on bolts,

P = 11360 + 500 N P = 11860 N

Being the four bolts, the load is shared as P= 11860/4 =2965 N.

Also,

2965 = (Π /4 dc2) x ft

2965 = (Π /4) (8x 0.84)2) x ft

ft = 83.59 N / mm2

The induced ft 83.59 N / mm2 is less than the maximum ft 120 N /mm2 hence our design is safe

C. *Design of bearing*

D=20 mm	Fa=100 N
Fr= 250 N	Nd=150 rpm

Proposed bearing SKF

Required life =1000 hours

From table 24.60 for SKF 6204

Basic static load rating capacity

Cor =7800 N Basic load rating capacity Cr= 14000 N Fa/Cor= 100/7800=0.01282

Assume minor shock & bearing works at normal temperature

Kt=1 from table 24.29. For minor shock load application factor Ka =1.5

Therefore,

Fe=Fr x Ka x Kt (3)
=250x1x1.5
=375
Dynamic load rating,
Cr= Fe{(Ld/Lr) x(Nd/Nr)}1/m (4)
Lr= Rated life =500 hours Nr = Rated speed = 33.33 rpm Cr= 14000 N
M= exponent = 3 for ball bearing 14000
= 375{(Ld/500) x (150/33.33)}1/3 (14000/375)3 = (Ld/500) x (150/33.33)}1/3
Therefore,
Ld = 1605.98 hours
Since designed life is more than the require life, the selected bearing is suitable. Hence the proposed SKF 6204 is suitable for the expected life of 1000 hours.
.

D. *Design of welded joint*

Checking the strength of the welded joints for safety
The transverse fillet weld welds the side plate, and the edge stiffness plates,
The maximum load which the plate can carry for transverse fillet weld is
P = 0.707 x S x L x ft (5)
Where,
S = factor of safety,
L = contact length = 25mm
The load of shear along with the friction is 50 kg = 500N
Hence,
500 = 0.707 x 3 x 35 x ft
Hence let us find the safe value of 'ft'
Therefore,
ft = 500/ (0.707 x 3 x 35)
ft = 6.73536 N/mm2
Since the calculated value of the tensile load is very smaller than the permissible value as ft=56 N/mm2.
Hence welded Joint is safe.

V. ADVANTAGES AND DISADVANTAGES

A. *Advantages*

1) Drum distortion is reduced significantly in electromagnetic disk brake systems.
2) Potential hazard of tire deterioration and bursts due to friction is eliminated.
3) There is no need to change brake oils regularly.
4) There is no oil leakage.
5) The practical location of the retarder within the vehicle prevents the direct impingement of air on the retarder caused by the motion of the vehicle.

B. *Disadvantages*

1) Dependence on battery power to energize the brake system drains down the battery much faster.
2) Due to residual magnetism present in electromagnets, thebrake shoe takes time to come back to its original position.

VI. CONCLUSION

With all the advantages of electromagnetic brakes over friction brakes, they have been widely used on heavy vehicles where the Brake fading problem exists. The same concept is being developed for application on lighter vehicles. The concept designed by us is just a prototype and needs to be developed more because of the above-mentioned disadvantages. These electromagnetic brakes can be used as an auxiliary braking system along with the friction braking system to avoid overheating and brake failure.

ABS usage can be neglected by simply using a micro controlled electromagnetic disk brake system. These find vast applications in heavy vehicles where high heat dissipation is required. In rail coaches it can used in combination of disc brake to bring the trains moving in high speed. When these brakes are combined it increases the life of brake and act like fully loaded brakes. These electromagnetic brakes can be used in wet conditions which eliminate the anti-skidding equipment, and cost of these brake are cheaper than the other types. Hence the braking force produced in this is less than the disc brakes if can be used as a secondary or emergency braking system in theautomobiles.

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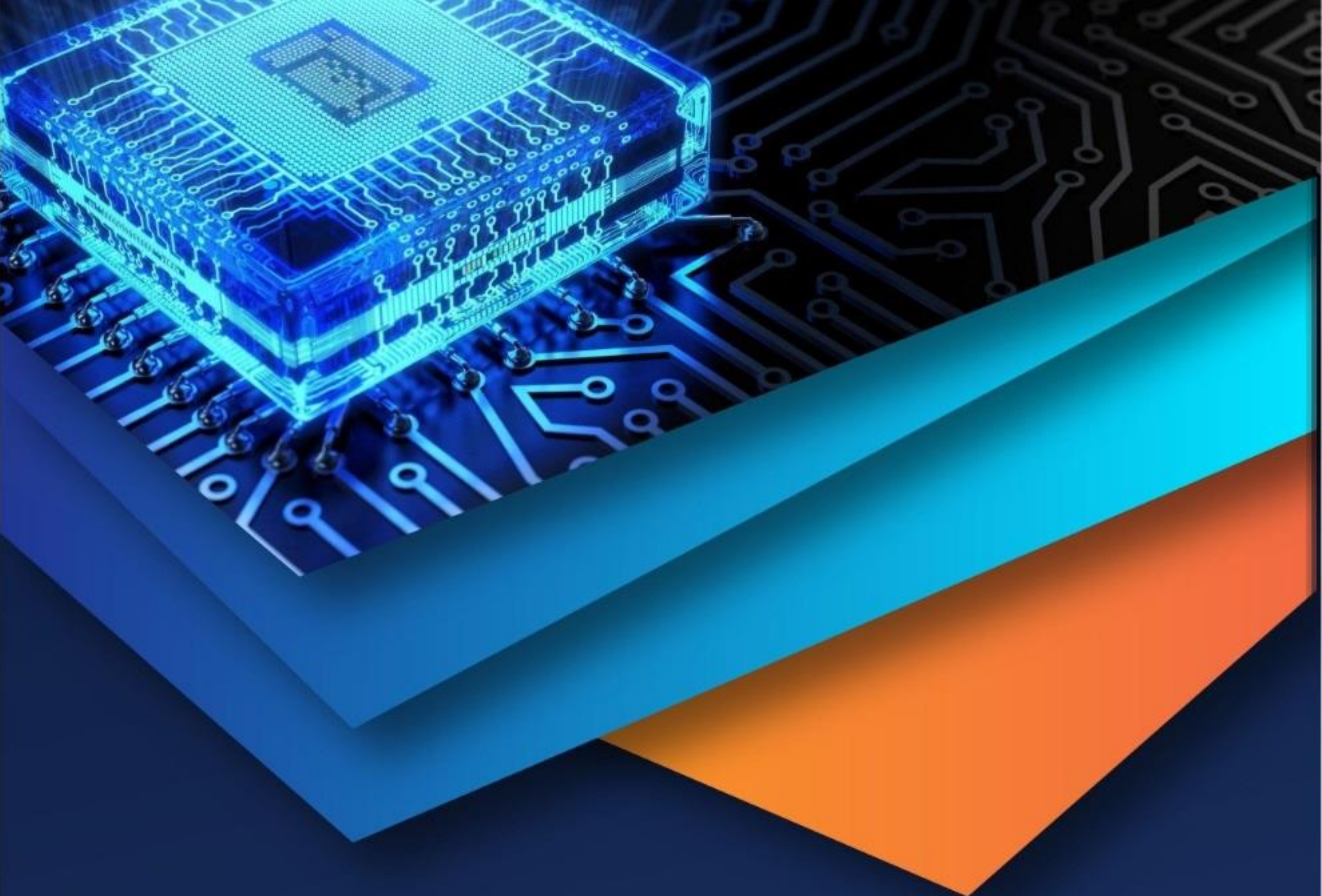

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