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Study and Development of Sensor Based Automatic Braking System

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ABSTRACT

When compared with olden days life span of human is reduced. Death rate due to accident is drastically increased because vehicles usage is increasing by day by day. Due to brake failure so many accidents are occurring so when we control the brake by automatically we can reduce the effect of accident. 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 Automatic Braking System". 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: Sensor, Automatic braking, Warnining system,

INTRODUCTION :

The first demonstration of forward collision avoidance was performed in 1995 by a team of scientists and engineers at Hughes Research Laboratories in Malibu, California. The project was funded by Delco Electronics, and was led by HRL physicist Ross D. Olney. A small custom fabricated radar-head was developed specifically for this automotive application at 77 GHz. The forward radar-head, plus the signal processing unit and visual-audio-tactile feedbacks were first integrated into a Volvo S40, and shortly thereafter into a Cadillac STS.Brake is a mechanical device used to slowing or stopping a moving vehicle i.e. wheel, axle, or to prevent its motion, most often accomplished by means of friction.

Stopping distance consists of three factors:

1. Driver's reaction time
2. Brake lag
3. Braking distance

Air brake system is used heavy vehicles because they need higher impact of braking. Piston cylinder arrangement is made for braking. Compressed air is used to hit the brakes, for that a compressor is provided in the vehicles. Braking time is small and less by using pneumatics in heavy vehicles.

Braking is basically a mechanical action applied for slowing down of vehicles or even making the vehicle coming to halt depending upon the circumstances.

Most brakes commonly use friction between two surfaces pressed together to convert the kinetic energy of the moving object into heat, though other methods of energy conversion may be employed. For example, regenerative braking converts much of the energy to electrical energy, which may be stored for later use. Other methods convert kinetic energy into potential energy in such stored forms as pressurized air or pressurized oil. Eddy current brakes use magnetic fields to convert kinetic energy into electric current in the brake disc, fin, or rail, which is converted into heat. Still other braking methods even transform kinetic energy into different forms, for example by transferring the energy to a rotating flywheel.

Brakes are generally applied to rotating axles or wheels, but may also take other forms such as the surface of a moving fluid (flaps deployed into water or air). Some vehicles use a combination of braking mechanisms, such as drag racing cars with both wheel brakes and a parachute, or airplanes with both wheel brakes and drag flaps raised into the air during landing.

Brakes may be broadly described as using friction, pumping, or electromagnetics. One brake may use several principles: for example, a pump may pass fluid through an orifice to create friction:

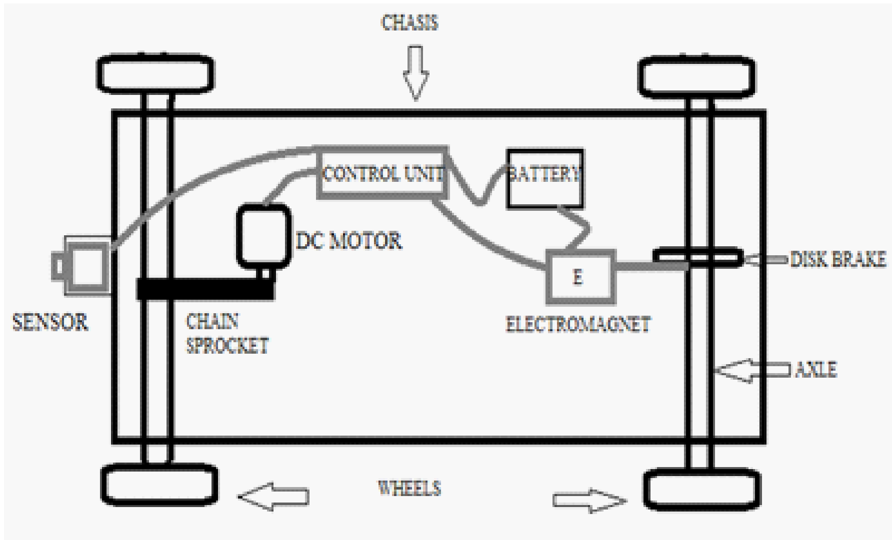

Figure1. Proposed drawing

DESIGN AND CALCULATIONS

As we are designing the prototype model for Maruti 800, calculation for braking system for Maruti 800 are needed.

Calculation for Maruti 800 are:

Braking system for Maruti 800-

Mass of vehicle = 1000 kg

Max. Velocity = 144 km/hr

=144 * 5/18 = 40 m/s

Kinetic energy = 1/2 MV2

= 1/2 (1000) (40)2

K.E = 800 kJ.

Force that should be restored to stop the vehicle,

F = m * a

F = 1000 * (v-u/t)

= 1000 * (40-0/10)

Where, t=10 (vehicle should come to zero from 40 m/s in 10 sec)

F = 4000 N On single wheel

F = 4000 / 4 (here 4 is number of wheel)

F = 1000 N

This force should be converted into friction force- F = μ. R {weight of vehicle contributed by each wheel}

F = μ * 250 * 9.8

μ = 0.408

Tyre material should be selected which have μ >= 0.408

Natural rubber having coefficient of friction 0.5 to 0.7 is chosen.

The coefficient of friction of friction pad 0.35 to 0.45

Radial force = 1000/0.42

R = 2380.95 N

This radial force must be applied on disc by two friction pad.

Force applied on single brake pad = 2380.95/2

= 1190.475 N

Now, Radial force = P.Aw

Consider wheel cylinder area (Aw) =400 mm

P = 1190.45/400

P = 2.976 N /mm^2

Consider master cylinder area

Am = 2000 mm^2

By pascals law,

P1 Aw = P2 Am

1190.475 = P2 * 2000

P2 = 0.5952 N/mm^2

This amount of pressure should be applied by

actuator to stop the vehicle.

Calculation of Prototype-

RPM of motor 55

Mass of assembly = 15 kg

Radius of wheel = 25 cm = 0.25 m

Calculation of prototype

RPM of motor =55

Mass of assembly = 15 kg

Radius of wheel = 25 cm

=0.25 m

w = 2 π N / 60

= 2* π*55/60

w = 5.75 rad/sec

V= r*w

=0.25*5.75

V=1.44 m/s

K .E =1/2 M V2

= 1/2 *15*(1.44)2

K. E = 15.552 J

Force that should be retarded to stop vehicle:

F = m * a

= 15 * (v – u/t)

= 15 * (1.44-0/1)

F = 21.6 N

The force should be converted into friction force

F = μ * R

21.8 = μ *(15/4) 9.8

μ =0.593

Natural rubber should be selected with coefficient of friction 0.5 to 0.7

Design of shaft-

Material Used -M.S.

Tensile Strength- 700N/mm^2

Yield strength- 350 N/mm^2

Torque- (π /16) x d3xT

Power of motor =50 watt

N = 55rpm

Torque of shaft-1

P =2πNT/60

50 =(2×3.14×55×T)/60

T= 8.68 Nm = 8.68 ×103 N-mm.

Shear stress t=ultimate strength

Factor of safety FOS= 4.

t=700 /4=175N/mm^2

T = π/16 x d3 x t

= π/16x d3 x 175

D = 6.31 mm

So we select diameter is 20 mm which is safe

Design of bolt-

Bolt is to be fastened tightly also it will take load due to rotation.

Stress for C-25 steel $f_t = 120\ N/mm^2$. Std nominal diameter of bolt is 8 mm.

Let us check the strength: -

Also initial tension in the bolt when belt is fully tightened.

$P = 1420\ d\ N$

$P = 1420 \times 8\ N$

$P = 1420\ d\ N$

$P = 11360\ N$

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,

$2965 = (\Pi/4\ d_c^2) \times f_t$

$2965 = (\Pi/4)\,(8 \times 0.84)^2 \times f_t$

$f_t = 83.59\ N/mm^2$

The induced f_t 83.59 N/mm^2 is less than the maximum f_t 120 N/mm^2 hence our design is safe.

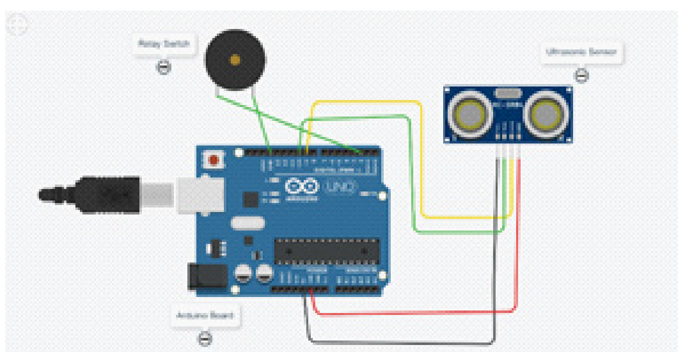

Figure2. Simulation

Simulation of actual pin connection diagram of arduino that we used in our prototype.

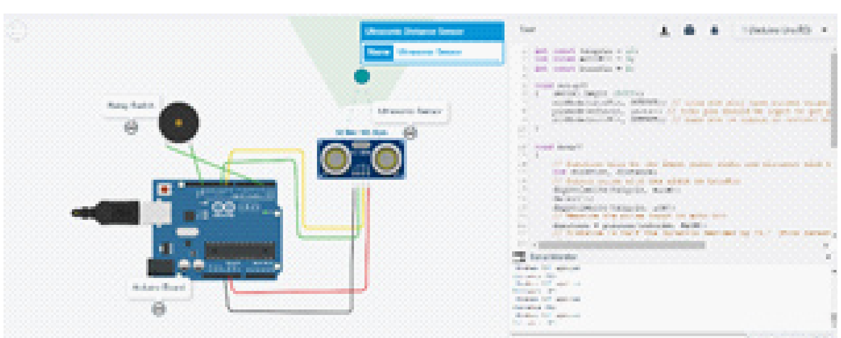

Figure3. Obstacle not range

It shows obstacle is not in range of ultrasonic sensor.

In program output shows the obstacle is out off range and shows 'BRAKES NOT APPLIED'

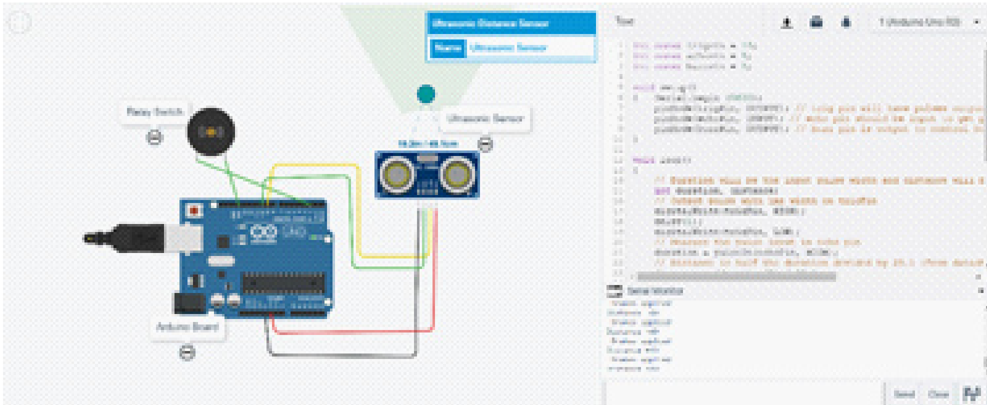

Figure4. Obstacle in range

In program output shows the obstacle is in range and shows 'BRAKES APPLIED'

CONCLUSIONS

The automatic braking system, if executed in auto it deflects heaps of mishaps and can spare human lives and property. Execution of such a propelled framework can be made mandatory like wearing of safety belts with the goal that mischance's can be deflected to some degree. Our Infrared Braking System gives a look into the eventual fate of car wellbeing and the amount more propelled this individual framework can be for staying away from mischances and ensuring vehicle tenants when they are incorporated into one framework. The fate of car security is more than simply building up another innovation; it is moving the way to deal with wellbeing. The automatic braking system approach speaks to a huge movement from the conventional way to deal with well being, yet it is crucial to accomplishing the significant advantages.

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