DESIGN AND DEVELOPMENT OF MOTION BASED AUTO BRAKING SYSTEM

Dr. Narayanaswamy K S Director, School of Mechanical Engineering, REVA University, Bengaluru.
Karthik S Assistant Professor, School of Mechanical Engineering, REVA University, Bengaluru.
Mohammed Ismail, Student Scholar, School of Mechanical Engineering, REVA University, Bengaluru.
Mohammed Danish, Student Scholar, School of Mechanical Engineering, REVA University, Bengaluru

Abstract
Two-wheeler vehicles are the essential part of transportation, bicycle, bikes, and other vehicles are everywhere and we can say that they are one of the important parts of human needs. The transportation vehicles that are made today haven't changed from many years; means they need an upgradation in terms of braking. Road safety is an issue of worldwide concern on human life and property. The development of collision avoidance system is the improvement in which it can bring out vehicular safety. The collision avoidance system consists of a radar sensor which is installed in the vehicle undergoes constant scanning. If any obstacle found on the road, it sends the signal to the driver in the form of warning. Hence there is a need to convert the signal from milli volts to micro volts which is done using filtering circuit. The amplified signal is passed to the microcontroller for steering operations. Microcontroller process the data and showcases it on LCD. Microwave motion sensor of HB series works in X-band which is designed for movement detection. It consists of Dielectric Resonator Oscillator (DRO), microwave mixer and patch antenna. Increased in road accidents due to pedestrians, blind spot vehicles or dark spot vehicles, poor visibility, crossing animals is happening now a day and it is gradually increasing day by day. Because of this both the sides will suffer. Conventional available proximity devices have its own limitations by sensing range or sensing speed. For this reason, ARS441 Doppler radar-based system is designed. Since human negligence or error is the main cause for occurrence of accidents where rear end collisions are the most common form, it is critical to equip with safety systems in vehicles. The safety systems can be either active or passive. The latter such as seatbelts, airbags and crumple zones have been widely employed for many years and it has almost reached its full potential in reducing the number of casualties. As far as we are concerned, we are focusing on making the braking more efficient and effective both in terms of safety of life and braking of the vehicle safely, hence this system will help in saving lives.
Keywords: Auto-Braking System, Collision Avoidance, IoT.

Introduction

The present invention relates to the development of advanced automated braking system or instrument or apparatus or device or equipment for enhancing braking in automobiles. More particularly, the invention relates to the development of advanced automated braking system or instrument or apparatus or device or equipment for carrying out safe and secure braking automatically without drivers' assistance. The invention also pertains to the fabrication method for advanced automated braking system or instrument or apparatus or device or equipment for efficient braking in automobiles to enhance road safety. Further, relates to practicing the use of advanced automated braking system or instrument or apparatus or device or equipment by farmers in the field for automatic braking system in automobiles.

Statement of the Problem

Automobiles these days need advanced features to operate as the traffic is getting bottle neck these days. To avoid accidents due to sudden intrusion of ongoing vehicles or trespassers or any other unwanted intruders on the highways and expressways. At higher speeds to avoid collision which leads to fatality we need a device which will automatically operates the brakes without the driver effort. The present invention relates to the development of advanced automated braking system or instrument or apparatus or device or equipment for enhancing braking in automobiles. More particularly, the invention relates to the development of advanced automated braking system or instrument or apparatus or device or equipment for carrying out safe and secure braking automatically without drivers' assistance. The invention also pertains to the fabrication method for advanced automated braking

system or instrument or apparatus or device or equipment for efficient braking in automobiles to enhance road safety. Further, relates to practicing the use of advanced automated braking system or instrument or apparatus or device or equipment by farmers in the field for automatic braking system in automobiles.

Objectives of the study

- To conceptualize the automatic braking system as low-cost feature.
- To fabricate the ergonomic design of the prototype.
- To analyze the performance of the prototype installed with collision avoidance system.

Review of Literature

[1] Sandeep Thorat et.all: This project aims to distinguish between systems currently in production like traction control (TC), electronic brake force distribution (EBD), brake assist (BA) and electronic stability control (ESC) functions and future systems that are currently in development. The project aims to develop a prototype system that offers a collision functionality in production vehicle, a system which can operate automatically with the help of high-profile sensors-based relay circuit and some modification in traditional braking system that can alert the driver in front collision and apply the brake automatically in emergency or critical situation.

[2] Mr. Kushal V. Gawande et.all: The aim of this project was to design and develop a control system based intelligent electronically controlled automotive bumper activation and automatic braking system is called automatic bumper system. IR sensor provided on the front end of the vehicle detects the presence of the obstacle. 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 "Automatic Pneumatic Braking System".

Research Methodology

Construction of Auto Braking System

3D model is made in CATIA accordingly the components required for the model is bought and tested. The base is made from the wood and the supporting structure is made by iron bar (L-shaped), which is welded according to the 3D model. Pulsar wheel are attached at the rear ends on the supporting structure made with the help of screw and bolt. They are arranged in such a way to enable free motion of the wheel when the motor drives. A motor (AC motor) 0.5hp is attached to the rear wheel with the aid of a driving mechanism (chain driven) to drive the rear wheel. Supporting frame is fabricated out of the cast iron according to the dimensions. Suitable iron frame is tooled, by measuring the distance between two supporting frame. To which the main driving motor is 3 fixed, which has free axis of rotation. The sprocket is attached to the motor shaft using the coupler. Also the disc was removed and another disc of mild steel material was installed to enable welding.

2.2 Components:

2.2.1 Wheel: The wheel is driven by the motor using chain. When the motor starts running the rotates and we can demonstrate automatic braking.

Fig 1: Wheel

2.2.2 AC Motor: AC motors are of great industrial importance. The main advantage of a AC motor is that it is amenable to different methods of speed control to provide a wide range of speeds and good speeds regulation. A machine that converts ac power into mechanical power is called a AC Motor.

Fig 2: AC Motor

2.2.3 Chain: Roller chain that transfers power from the pedals to the drive- wheel of a bicycle, thus, propelling it. Most bicycle chains are made from plain carbon or alloy steel, but some are nickel plated to prevent rust, or simply for aesthetics.

Fig 3: Chain

2.2.4 Axle: A rod or spindle (either fixed or rotating) passing through the center of a wheel or group of wheels. An axle is a rod or shaft that rotates the wheels and supports the weight of your vehicle.

Fig 4: Axle

2.2.5 Sprocket: Toothed wheel whose teeth engage the links of a chain. 2: a cylinder with teeth around the circumference at either end that project through perforations in something (such as motion-picture film) to move it through a mechanism (such as a projector).

Fig 5: Sprocket

2.2.6 ARS441 Radar Sensor: It is a premium long range radar sensor for forward looking functions especially made for braking systems. The radar sensor can be upgraded with high resolution algorithms to improve the spatial detection including road boundaries. The sensor is designed for an installation behind a plastic cover in the front of a vehicle.

Fig 6: Advanced Radar Sensor

2.2.7 Electromagnetic Brakes: These are used to slow or stop motion using electromagnetic force to apply mechanical resistance. They are currently being used in locomotives and hoisting cranes in industries wherein stoppage at stage is done by using these electromagnetic brakes.

Fig 7: Electromagnetic Brakes

2.3 Fabrication

The model has been fabricated by assembling all the components, the main aim of this model is to demonstrate the working of automatic braking system. The fabricated model is a prototype which will be able to show how the working of the auto braking system will be and can be tested to know how it will react when on the roads. The fabrication included the assembling of the wheel to the supporting frames which are welded to the shape and bolted to the wooden base. The electromagnetic braking system is connected to the motor shaft using the additional shaft which is connected to the motor shaft which has the chain sprocket in the center which helps to drive the wheel when the chain is connected to the rear sprocket which is connected to the rear wheel.

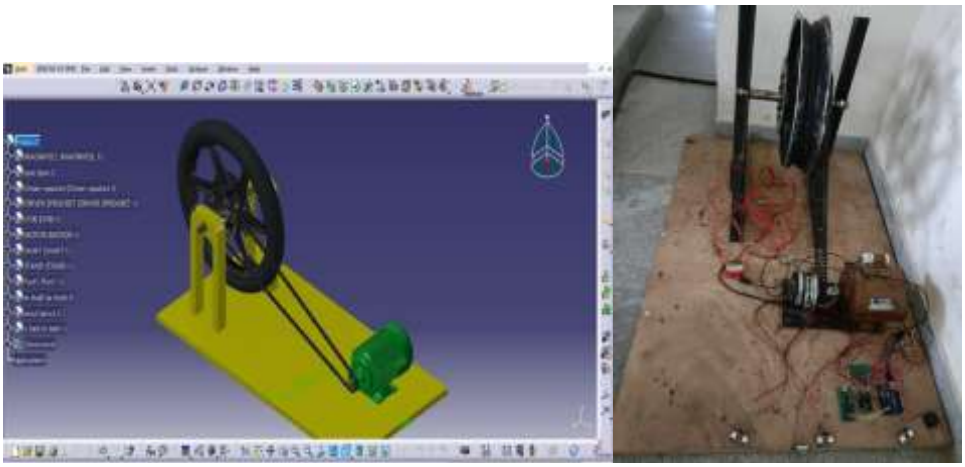

Fig 8: Fabricated model

3. Results and Discussions

Results and Discussion

1. Brake pedal force, Fbp = Fd * (L2/L1)

Fbp = 400*(6/1) = 2400 N

Where, Fbp – Force output of the brake pedal assembly.

Fd – Force applied to the pedal pad by the driver.

L1- Distance from the brake pedal arm pivot to the output rod.

L2 – Distance from brake pedal arm pivot to the brake pad.

2. Force generated by caliper, Pcal = Fbp/Amc

= 2400/285.02 = 8.42 N/mm2

Acal = (π*d2)/4 = (3.14*362)/4 = 1017.87 mm2

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Fcal = Pcal*Acal = 8.42*1017.8 = 8570.46 N

where, Fcal – One sided linear mechanical force generated by the caliper.

Acal – Effective area of the caliper found on one half of the caliper body.

d – Diameter of caliper piston.

Pcal – Pressure generated by caliper piston.

Amc – Area of the hydraulic piston.

3. Caliper clamp load, Fcal = Fcal*2 = 8570.46*2 = 17140.93 N

4. Force on disc by brake pads, Ffriction = Fcl*µbp
   Ffriction = 17140.93*0.4 = 6856.37 N
   Ffriction = 17140.93*0.1 = 1714.093 N
   µbp 0.4 = dry pads.
   0.1 = wet pads.
   where, Ffriction – Frictional force generated by the magnetic fields opposing the rotation of the rotor.
   7µbp – Coefficient of friction between the electromagnetic disc and the rotor.
5. Torque of rotor, Tr = Ffriction*Reff
   = 6856.37*170 = 1165.58 Nm
   where, Reff – Effective radius of the rotor,
   Reff = 170 mm
6. Friction on a tire, Ftire = Tr/Rt
   Force on wheels, Ftire = 1165.58/0.2921
   = 3940.34 N
   where, Rt – Rolling radius of the wheels = 292.1 mm.
7. Total force, Ftotal = 3990.34 + 3990.34 = 7980.68 N
8. Deacceleration of vehicle, av = 7980.68/(140*9.81) = 5.81 m/sec2
9. Stopping distance, SDv = Vv2/(2*av)
   SDv = 13.88/(2*5.81) = 1.194 m
   where, Vv – Velocity of the bike = 50 kmph = 13.88 m/s.
10. Stopping time, St = Vv/av
   St = 13.88/5.81 = 2.389 seconds

Conclusions

The conclusions of the project work are as follows:

•The automatic electromagnetic braking system was incorporated and tested successfully.

•The sensor module and the programming were tested in real time situation and considerable results were brought out.

•The performance of braking system has been enhanced by the usage of the advanced radar sensor and the electromagnetic braking system.

References

1. Ahmad, S. (2002), “Service failures and customer defection: a closer look at online shopping experiences”, Managing Service Quality, Vol.12, No.1, pp.19-29.
2. Sandeep Thorat ,SanketThorve, Jaydatta Upase and Agampal Singh Dhupar –“Design and Implementation of Automatic Emergency Braking System”, IRJET, Vol.07, Issue: 04.
3. Karan M Kewalranam, Prayojot, Vivek Rai – “Design of Auto Collision Avoidance system”, IRJET, Vol.08, Issue: 05
4. Transport Research Wing, “Road Accidents in India”, Ministry of Road Transport and Highways, India, 2011.
5. MI lanes, V. Onieva, E. Perez, J. De Pedro, T. Gonzalez, C. Control of Velocidad Adaptativo para Entornos Urbanos Congestionados. Rev. Iberoam, automat. Informat. Ind.2009, 66-73.