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Smart Braking System

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Abstract: *Now-a-days accidents are mostly caused by delay of the driver to hit the brake or by the negligence by the driver. 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 on relay circuit and some changes in traditional braking system and apply the brake automatically in emergency situation. The resulting system can achieve measurements with high accuracy and improved short distance measurement also. This distance measurement is used to control smart braking system for safety applications. The brain of the system part can be developed on Arduino Nano microcontroller. The Ultrasonic sensors are the eyes of this system, which are cheaper and the system comprises of a less demanding hardware. The braking is done with the help of 3/2solenoid valve which actuates brakes and clutch.*

Keywords: Ultrasonic Sensor, Processor (Arduino Uno), Intelligent Braking System (IBS), Antilock Braking Systems (ABS), Microcontroller, etc.

I. INTRODUCTION

Braking systems of commercial vehicles were always given the highest importance concerning safety issues and in particular active safety. Inappropriate braking of these vehicles may cause heavy accidents due to relatively longer stopping distances and higher energy output of brakes particularly in the case of vehicle combinations. The traditional medium used for brake system (compressed air) can be now controlled with the speed and precision offered by modern electronic abilities. Smart Braking System introduced in commercial vehicles providing rapid brake response and release for every single wheel therefore ensuring safety. The extremely rapid response time provided by the electronic control can be used for crucially shortening the braking distance by introducing advanced control of braking system operation. Such a complex task imposed to the control of braking system cannot be based on the driver abilities and need to be done independently of the driver.

The advanced strategy for the braking force Management, proposed here, is based on Smart controlling of the braking forces distribution between the front and rear axle of power-driven vehicle and/or between towing/trailer combination and/or between tractor/semi-trailer. Smart braking system has a lot of potential applications especially in developed countries were research on smart vehicle. The system when integrated with other subsystems like automatic traction control system, Smart throttle system, and auto cruise system, etc. will result in smart vehicle maneuver. The driver at the end of the day will become the passenger, safety accorded the highest priority and the journey will be optimized in term of time duration, cost, efficiency and comfort ability. The impact of such design and development will cater for the need of contemporary society that aspires quality drive as well as to accommodate the advancement of technology especially in the area of smart sensor and actuator. The emergence of digital signal processor enhances the capacity and features of universal microcontroller.

The overall system is designed so that the value of inter-vehicle distance from infrared laser sensor and speed of follower car from speedometer are fed into the DSP for processing, resulting in the DSP issuing commands to actuator to function appropriately. The most popular systems like Antilock Braking Systems (ABS), Traction Control and Stability Control employ different types of sensors to constantly monitor the conditions of the vehicle, and respond in an emergency situation. A smart Mechatronic system includes an ultrasonic wave emitter provided on the front portion of a car producing and emitting ultrasonic waves frontward in a predetermined distance.

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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.

II. SYSTEM SURVEY

Visiting numbers of workshops like Maruti Suzuki, TATA motors, going through detailed study of the ABS from various sources such as books, internet and carefully understanding mounting of each component of ABS such as ECM, Hydraulic control module warning system got clear idea about the existing advance braking technologies. Workshop technicians got mixed feedback from owners of vehicles with ABS. Drivers reported that they find stopping distance for regular conditions are lengthened by ABS either because there may be errors in the system or because of clinking or noise of ABS may contribute to driver not braking at same rate. Hence concluded that braking system present on vehicle are either so advance that they take the braking control away from driver and increase the risk factor or some of them are not that much advance to perform precisely, so We decided to make such system which can allow the driver brakes manually at the same time system also controlling the brakes to reduce risk factors in panic situation.

An ABS can be expensive to maintain. Expensive sensors on each wheel can cost hundreds of dollars to fix if they get out of calibration or develop other problems. For some, this is a big reason to decline an ABS in a vehicle. Moreover, many commuter vehicles in India don't have the option of ABS because it's very expensive. It's easy to cause a problem in an ABS by messing around with the brakes. Problems include disorientation of the ABS, where a compensating brake sensor causes the vehicle to shudder, make loud noise or generally brake worse.

ABS can only help if the rider applies it in the right time manually and maintains the distance calculations. ABS has its own braking distance. Volvo's laser assisted braking could not work effectively in rainfall and snowfall season and laser is easily affected by atmospheric conditions. In our project we are using Ultrasonic sensors and Microcontroller with which the speed of the vehicle is automatically reduced and voice alarms are given to the user when it approaches an object by automatically sensing the position of the object/vehicle.

III. METHODOLOGY

Smart Braking system includes an ultrasonic wave emitter provided on the front portion of a car producing and emitting ultrasonic waves frontward in a predetermined distance. 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. The 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.

The extremely rapid response time provided by the electronic control can be used for crucially shortening the braking distance by introducing advanced control of braking system operation. The control of commercial vehicle's braking system operation is related not only to vehicle speed but also to lateral acceleration together with the yaw moment control and significantly reducing the possibilities of the vehicle rolling over. Obviously, such a complex task imposed to the control of braking system cannot be based on the driver abilities and need to be done operated independently of the driver.

1. **Development of an idea:**
   Detail study of literature
   System survey
   Drawbacks in existing approach
   Cost estimation and specification for standard parts
   Load distribution analysis

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Braking force and pressure analysis
Experimentation
Results and discussion

2. **Factors Considered:**
Factors considered in designing the system are:
Brake force
Distance of obstacle in front.
Brake torque

3. **Brake Force**
Brake force, also known as Brake Power, is a measure of braking power of a vehicle.
Brake force= M.d.g
Where, M= Mass of the system d = Deceleration
g = Acceleration due gravity

4. **Distance of obstacle in front:**
The distance of any obstacle, a parked or a moving vehicle or a road block is sensed using an Optical sensor and it is fed to microcontroller.
The distance is found between 60 cms for alarm and LED system.
Then for actuating the brake we found that 15cms (approx) obstacle distance.

5. **Brake Torque:**
Brake torque is the force applied at the brake wheel to stop the motion of the moving equipment.
Assuming the operating conditions for the equipment is constant; a brake having a retarding torque equal to the full load torque of the motor to which it is applied is usually satisfactory.
Formula: - T= 2μ×Fr Where, T= Brake torque μ= Coefficient taking 0.5 F= Force on each pad (N)
R= Mean radius (from centre wheel to centre of pad (m).

6. **Parts of system:**
Frame, Wheel Shaft
Ultrasonic Sensor
Microcontroller Unit
Relays 5. Buzzer
LED light
Double Acting Cylinder and Pipes
½ Pneumatic Valve
DC Motor (12V)
Wheel with Disc Assembly
Battery (12v), (6v)
External Equipment (Pneumatic compressor).

7. **Working of system:**
Ultrasonic waves of 40 KHz frequency will be sent from the transmitter of the sensor. The ultrasonic waves have the property that they are not affected by environmental changes. This ultrasonic wave will be reflected back from the obstacle. An ultrasonic receiver present in the same sensor receives these waves after reflection. The time difference between transmission and receiving is calculated and the distance is

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estimated by program present in the ASIC (Application Specified Integrated Chip) present in the sensor.

The ultrasonic sensor measures the distance which senses the obstacle in front of the vehicle. The ultrasonic sensor consists of two parts namely ultrasonic transmitter and ultrasonic receiver. Ultrasonic transmitter emits ultrasonic waves, when obstacle comes in front of vehicle the ultrasonic waves reflect back and these reflected waves are received by ultrasonic receiver.

Now ultrasonic receiver feed these signals to the microcontroller. Microcontroller calculates safe breaking distance. And then Microcontroller sends the current to the Relay. Relay allows the battery current to flow through the pneumatic solenoid operated valve to actuate the Disc brake. (And also stop the Motor).

IV. CONCLUSION

In this report the innovative idea of implementing Smart braking system is discussed and thereby analysed its various Parameters for regular realistic application. Smart braking is one of the smart options which can be implemented in various applications for stopping a moving body without jerky motion. The previous research study clearly explains that Ultrasonic sensor and microcontroller action plays vital role in determining Smart braking torque generated by brake actuation assembly.

Design of Smart brake applications basically depends upon effectiveness of Ultrasonic sensor. In the present work various experiments were conducted to check the effect of various parameters such as obstacle distance, output current and sensor position on moving vehicle braking. The parameters were varied using different arrangements of sensors, varied amount of current which leads to various conclusions. In the present work, a prototype of an ultrasonic distance measurement for stationary obstacle is obtained. And controlling the speed of vehicle accordingly to predetermined distance is shown. An ultrasonic sensor, cheaper and less demanding of hardware than other types of sensors presently used, such as the sensors based on computer vision or radar, is used to measure the distance between vehicle and the obstacle.

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