ANTI-LOCK AND AUTOMATIC BRAKING SYSTEMS

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Abstract - This paper presents an Anti-lock and Automatic Braking system using ultrasonic sensors. Sensors placed at the front end of the vehicle measures the distance between the obstacle and the vehicle and regulate the anti-lock mechanism. Arduino Uno microcontroller board is used for the implementation of the model. The sensors measure the speed of the vehicle and detect the obstacle ahead, thereby, initiating automatic braking. If the speed of the vehicle is above a set velocity for a predefined safety distance, then the microcontroller based system performs the actuating mechanism to bring back the vehicle to a safe speed thereby minimizing the chances of accidents.

Index terms - Arduino, Ultrasonic sensor, Hall Effect sensor, Automatic braking, Antilock braking.

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]. In order to implement an advanced vehicle control system while obtaining desired vehicle motion, and providing safety, vehicle traction control should be realized. Traction control systems can be designed to satisfy various objectives of a single vehicle system or a platoon of closely spaced vehicles, such as assuring ride quality and passenger comfort [2].

Antilock Braking System (ABS) is used in advanced automobiles to prevent slip and locking of wheels after brakes are applied. It is an automobile safety system in which the controller is provided to control the necessary torque to maintain optimum slip traction. It's an automated system that runs on principles of threshold braking and cadence braking which were practiced by skillful drivers with previous generation braking system. ABS generally offers advanced vehicle control and minimizes the stopping distance on slippery and dry surface, conversely on loose surface like gravel or snow covered pavement. ABS can significantly increase braking distance, although still improving vehicle control [3]. The introduction of Anti-lock Braking System (ABS) has provided building blocks for a wide variety of braking control systems. Additional hardware allows brake pressure to be increased or reduced as per demand. Additional software control algorithms and sensors allow traction control (TC), electronic brake force distribution (EBD), brake assist (BA) and electronic stability control (ESC) functions to be added. Automatic Over speed Control System (A.O.C.S.) is a concept that stresses on preparing a control system that is based on automatic braking for a motor-cycle. Here automation is done by a Microcontroller. Whenever the speed of a vehicle increases beyond a pre-defined critical high speed, the Microcontroller based system actuates the clutch as well as brake and brings speed of the vehicle down to a lower pre-defined safe speed [4].

The number of vehicles is increasing day by day and proportionally the numbers of accidents are also increasing. These accidents are mostly caused by the delay of the driver to hit the brake. To prevent the accidents caused by this delay, ultrasonic braking system is used in automobiles. The main target of the ultrasonic braking system is that, cars should automatically brake when the sensors sense the obstacle. This is a technology for automobiles to sense an imminent forward collision with another vehicle or an obstacle, and to brake the car accordingly, which is done by the braking circuit [5]. Ultrasonic (US) sensors exhibit a dead zone directly in front of the sensor plane. In this dead zone, accurate measurements cannot be taken with reasonable efforts (higher hardware complexity, etc.). In comparison to US sensors, capacitive sensing technology offers the advantage of a volumetric measurement principle which can be used also for short distance sensing. This technique allows for both, detection and classification of objects. Combined with US sensors, this can be exploited to design an improved distance measurement system, which provides the possibility to classify the object [6, 7].

ABS control is highly nonlinear due to the complicated relationship between its components and parameters. The research that has been carried out in ABS control systems covers a broad range of issues and challenges. Many different control methods for ABS have been developed and research on improved control methods is continuing. Most of these approaches require system models, and some of them cannot achieve satisfactory performance under the changes of various road conditions [8].

With the increasing number of vehicles on the road each year, the number of accidents has undergone a

steep rise. According to a report released by the Indian Government, 5 lakh accidents occurred in the year 2015 killing 146,000 people i.e., approximately 16 deaths per hour. Most of the accidents can be rooted to over-speeding vehicles. Most of these accidents are caused due to the delay of the driver to hit the brakes. The main aim to undertake this project is to address the issue of delayed braking. AABS allows the car to automatically implement skid-free braking. The vehicle detects the obstacles and other speeding vehicles using ultrasonic sensors installed at the front end of the car.

II. METHODOLOGY

The project aims at ensuring safety in vehicles by using AABS Technology. It basically controls the speed of the vehicle by continuously monitoring the distance of the obstacle or any other vehicle ahead using ultrasonic sensors and checking the speed of the vehicle in concern using wheel speed sensors. The components used are an arduino board, ultrasonic sensors, Hall Effect sensors and motors.

2.1 ARDUINO UNO

The Arduino Uno Rev3 is a microcontroller board based on the Atmega328. It has 14 digital input/output pins. Arduino is an open source physical computing platform based on an I/O board that uses a development environment that implements a wiring/processing language.

2.2 ULTRASONIC SENSOR

The module used is the HCSR04 ultrasonic sensor. It has 4 pins, ground, vcc, trigger and echo. It emits a sonic burst at 40KHz which travels through air and if there is an obstacle in the path, then it bounces back to the module. When the sonic burst leaves the module, then the echo pin of the arduino which was initially low becomes high. When the wave hits an obstacle, it bounces back and reaches the echo pin and the pin becomes low. The arduino microcontroller calculates the time for which the echo pin was high and hence measures the distance between the vehicle and the obstacle.

2.3 HALL EFFECT SENSOR

The module uses a (module_name) Hall Effect sensor. This sensor works on the principle of Hall Effect. The Hall Effect states that if a magnetic field is applied in a direction perpendicular to the flow of current in conductor then it leads to development of a potential difference. This voltage is used to detect if the sensor is in the presence of a magnet or not. The arduino can detect this voltage change through its interrupt pin and determine if the sensor is near a magnet or not. The sensor has three pins namely vcc, ground and the output pins. When the sensor detects a magnet, it outputs a high voltage to its output pin. This outpin pin is connected to the interrupt pin of the arduino microcontroller which detects the rising voltage.

III. WORKING MODEL AND FLOWCHARTS

The working model prototype will have Automatic Braking system and Antilock system interfaced together for the proposed AABS system.

3.1 Automatic Braking System

The system has a defined safe distance. If the obstacle is present at a distance less than the safe distance then the vehicle automatically applies brake.

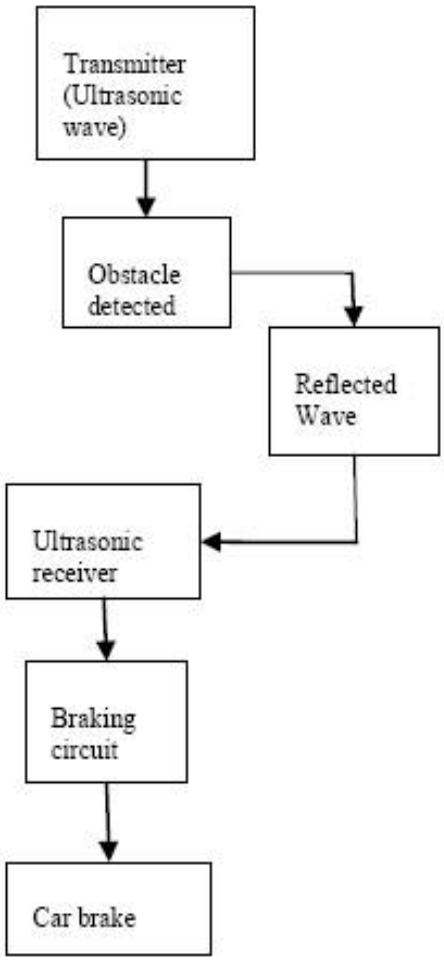


Fig1: Automatic Braking

3.2 Antilock System

The antilock part of the system uses two speed limits s1 and s2, s1 being the higher speed limit and s2 being the lower limit. S is the speed measured by the Hall Effect sensor. The microcontroller continuously takes input from the speed sensor. When the speed increases beyond the higher speed limit (s1), the stepper motor turns by a predefined number of turns and engages the clutch and brake. The motor gets locked by the microcontroller. The microcontroller measures the speed subsequently to check if it has gone down below the lower speed limit. The motors remain locked till the speed goes below s2.After this

point, the motor retracts, thereby disengaging the clutch and brake.

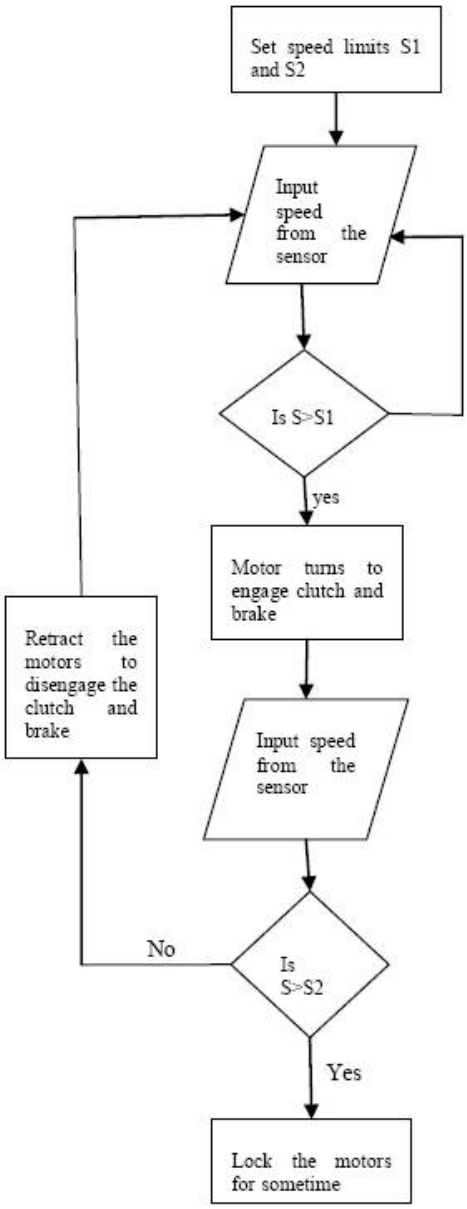


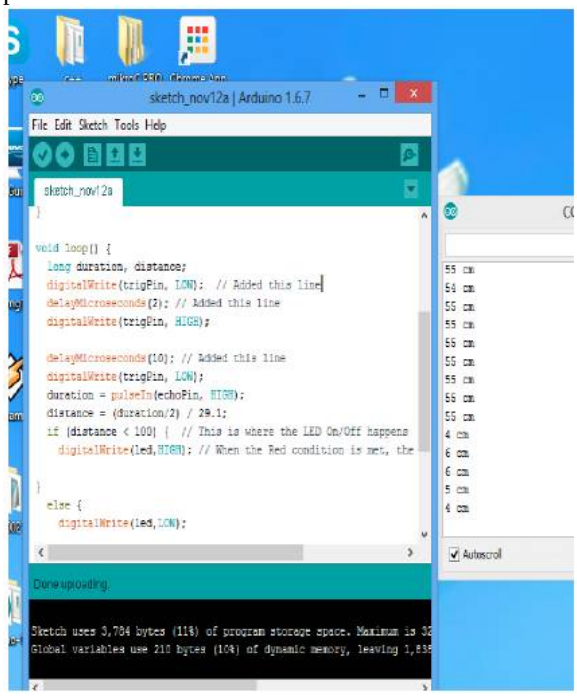
Fig2: Antilock System

IV. VARIOUS CASES FOR AABS IMPLEMENTATION

The anti-lock and automatic braking system uses both speed and distance as attributes to control the clutch and brake. Two distance limits SD1 and SD2 are used along with the above mentioned speed limits.SD1 is the minimum safety distance, i.e., the distance below which the automatic and anti-lock braking system is put to effect and SD2 is the suitable safety distance. When distance is greater than SD, AABS is not implemented. S and D are the measured speed and distance respectively. When S>S1, the clutch and brake are engaged at a higher speed of the motor till the speed becomes less than S2 and distance becomes greater than SD2.This is done so that a heavily speeding vehicle can be gradually brought under control at a faster rate and collision is prevented as the distance between obstacle and the vehicle is increased. When S<S1, the clutch and brake are engaged, but at a slower rate. The rate is given by the stepper speed of the stepper motor.

V. RESULT

The simulation for the automatic braking system using ultrasonic sensor and arduino has been performed and the result is shown below.



CONCLUSION

The automatic and anti-lock braking system thus merges two mechanisms into one. Automatic braking simply applies the brakes but does not ensure skid free movement of the vehicle after the brakes are applied. As a result, an obstacle is detected but the mechanism that is put into effect might not prevent collision. The anti-lock system allows the vehicle to apply brakes in a controlled manner thereby slowing down the vehicle gradually unlike suddenly. For future work, we plan to implement the codes to build a hardware model.

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