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Automatic Braking Systems Using Sensors

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ABSTRACT

Now days the number of accidents are so high and uncertainly occurring. Accident occurs frequently and causes worse damage to them and their family's. Most of the accidents will cause serious injury and even death. Mainly accident's takes place due to driver mistakes in recognition, judgments or vehicle operation. Not so long ago, it would have seemed incredible that your car would be able to "see" other vehicles or pedestrians, anticipate collisions, and automatically apply the brakes or take corrective steering actions. But more and more cars can do that to some degree, thanks to a growing list of collision-avoidance systems. This paper is about a system known as "Automatic braking system" (ABS) which employ several sensors to respond when emergency conditions occur. The system includes an ultrasonic sensor wave emitter provided on the front portion of the vehicle. An ultrasonic receiver is also fitted to receive the signal. The reflected wave gives the distance between the obstacle and the vehicle. Then a microcontroller is used to detect the pulses and apply brakes to the vehicle without driver's input and hence it can increases safety.

Keywords:—*Ultrasonic emitter, Ultrasonic Receiver, Microcontroller or Arduino UNO, ABS etc.*

I. INTRODUCTION

Road accident is most unwanted thing that happens to travellers due to some mistakes. Sometimes this accidents to be death. Mainly the any type of accidents is occurs by human mistakes. These type accidents are mainly caused by the drivers applying brakes late. The main approach of this paper is to design a system which will prevent such accidents by continuously keeping the record of the distance between two vehicles. In ABS, ultrasonic sensor trigger the waves to reach the destination and receives back to the echo to sense the distance to apply brakes to prevent collision with another vehicle, person or obstacle and the microprocessor in the system activate the brakes and it will slow down the vehicle or bring it to stop if needed. This ABS has to be work with ABS (antilock braking system) equipped in vehicle in order to increase control over vehicle while emergency braking. The main objective for this paper is to develop a safety braking system using ultrasonic sensor and to design a vehicle with less human attention to the driving. The paper is organized as follows: section 2 describes Related Work and section 3 describes various components used in the system. Section 4 proposed system, section 5 concludes the paper.

II. Related Work

Author proposed that when the driver comes to know that the vehicle is going to collide, they become tense and they don't apply the brakes correctly or apply's brakes with insufficient manner than that of required by the vehicle to slow down and come to stop and hence it get's collide with the obstacle. Majority of accident occurs in this way. ABS eliminates such types of problems like semi applied brakes, reaction time, stopping distance and distance between two vehicles to avoid such accident.

2.1 I Knight, I Simmons, P Massie, C Grover, F Okoro, G Couper and B Smith, "Automated Breaking Systems: Technical requirements cost and benefits", Published Project Report. 2008

The literature claims that the Honda CMBS is effective at detecting, large vehicles, cars, larger motorcycle in the centre of the lane, parked vehicles, and road side furniture. However, there are some limitation as described followed:-

1. The sensor system is unable to accurately identify relative speeds less than 15 KM/hr.
2. Pedestrians cannot be detected.
3. Smaller motorcycles and two wheeler travelling in the edge of the road, diagonally parked vehicles and small objects such as fallen rock may not detected.
4. The system will not function when the distance between vehicles is very short or when the conflict is very sudden sudden as at junctions.
5. The system may not function in the adverse weather conditions.
6. "AUDI Q7" in 2006 introduced BRAKING GUARD radar assisted forward collision warning system
7. FIAT and MAZDA's autonomous emergency braking system is a urban low speed crash avoidance system.

2.2 Minoru tamura, Hideaki tnoue, Takayuki watanable and Nuoki maruko, Nissan motor co., Ltd "Research on Brake assist System with a preview Function."

Nissan's intelligent brake assists uses laser radar sensors to detect the distance to proceeding vehicles and the relative velocity when there is risk of collision with the vehicle in front and the driver must take avoidance action immediately the system sounds a warning to prompt action by the driver to help avoid a rare end collision. When a rare end collision cannot be avoided by the drivers action the system activates the brake to decelerate the vehicle at maximum deceleration of 0.5 g, thereby helping to reduce occupant injuries resulting from the collision.

2.3 G.V. Sairam, B. Suresh, CH. Sai Hemanth, K. Krishna sai, IJETAE

1. Honda's idea of ABS which helps the rider get hassle free braking experience in muddy and watery surfaces by applying a distributed braking and prevents skidding and wheel locking.
2. Volvo launched XC60 SUV which was equipped with laser assisted braking. This is capable to sense a collision up to 50 mps and apply brakes automatically.

Drawbacks in the existing approaches:-

- ABS can only help if the rider applies it in right time manually and maintains the distance calculations.

ABS has its own braking distance. Moreover most of the commuter bikes in India don't have ABS because it's very expensive.

- Volvo's laser assisted braking could not work effectively in rainfall and snowfall season and laser is easily affected by atmospheric conditions.

III. Description of Components

The devices used were Ultrasonic distance measurement sensor, Hall sensor, microcontroller kit or Arduino UNO and brakes.

3.1 Hall Sensor

A Hall sensor is a transducer that varies its output voltage in response to changes in magnetic field density. Hall sensors are used for proximity switching, positioning, speed detection, and current sensing applications. In its simplest form, the sensor operates as an analogy transducer, directly returning a voltage. With a known magnetic field, its distance from the Hall plate can be determined. Using groups of sensors, the relative position of the magnet can be deduced. The alternatives for speed measurement can be tachometers but interfacing of conventional tachometers with the microcontroller is difficult. So use of tachometers for speed measurement is ruled out. Hall Effect devices when appropriately packaged are immune to dust, dirt, mud, and water. These characteristics make Hall Effect devices better for position sensing than alternative means such as optical and electromechanical sensing.

- Specifications
- 25V DC, 25 mA
- Make: TT Electronics, OPTEK Technology.

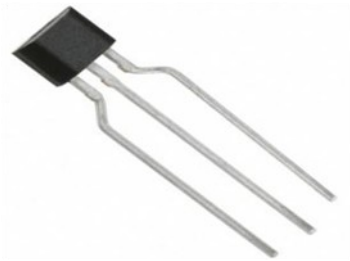

Figure 1 : Hall Sensor

3.2 Microcontroller or Arduino Uno

It is a powerful microcomputer providing highly flexible and cost effective solution too many embedded control applications. Interfacings of the ports of the microcontroller two were used as input ports one for ultrasonic sensor and other for proximity sensor.

- Specifications
- Make : Atmel
- Microcontroller : ATMEGA8-16PI

Arduino UNO is used in different kinds of IOT application development. This acts as a micro controller and controls the different operations which programmed to it by the developer.

Figure 2 : Microcontroller

Figure 3 : Arduino UNO

3.3 Ultrasonic Distance Measurement Sensor

This senses the distance of the obstacles from its location and it gives an equivalent analog output for the distance sensed.

Working Principle

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

Figure 4 : Ultrasonic Sensor

Ultrasonic distance measurement sensor consists of:-

1) Ultrasonic transmitter:

It is consist of ultrasonic wave generator which generates an ultrasonic wave and it being transmitted by ultrasonic transmitter. In that part, there is timing instruction which generates an instruction signal for intermittently providing ultrasonic waves. This signal will be sent to an ultrasonic wave generator for generating ultrasonic waves based on the instruction signal from the timing instruction (transform electrical energy into sound wave). After the ultrasonic wave is produced, the ultrasonic transmitter transmits the ultrasonic waves towards a road surface to detect the obstacle. The range in which the obstacle detected is depends on the range of ultrasonic sensors used.

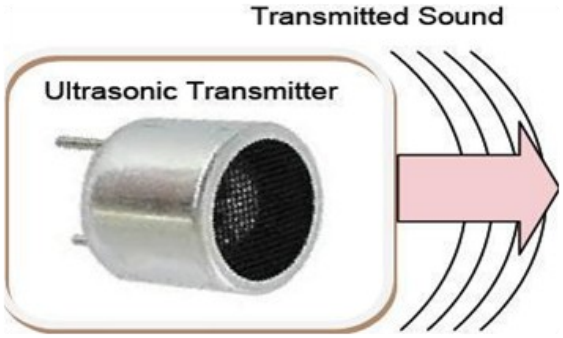

Figure 5 : Ultrasonic Transmitter

2) Ultrasonic Receiver

It receives the ultrasonic wave reflected from obstacle. An ultrasonic receiver is used for receiving the ultrasonic waves reflected from the road surface to generate a received signal. There is an ultrasonic transducer which will transform back the sound wave to electrical energy. This signal is amplified by an amplifier. The amplified signal is compared with a reference signal to detect components in the amplified signal due to obstacles on the road surface. The magnitude of the reference signal or the amplification factor of the amplifier is controlled to maintain a constant ratio between the averages of the reference signal.

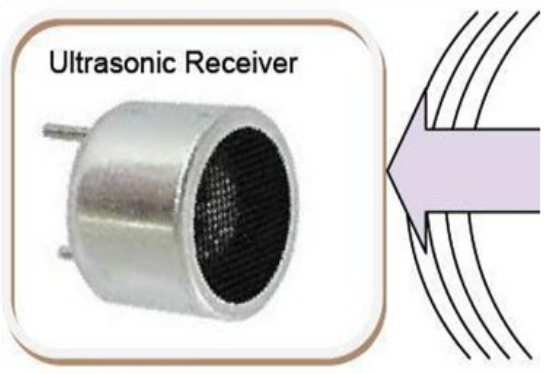

Figure 6 : Ultrasonic Receiver

3.4 Brakes

Current brake systems fall into two types: drum brakes and disk brake. Both have distinctive strengths and weaknesses.

1) Drum brake

Drum brake has been used in automobiles for a long time. Its reliability and excellent braking performance have accounted for the popularity today. In drum brake, two semi-circular brake pads are inserted onto the inner wheel ring and slow or stop the car via friction between pads and wheels following the principle of leverage theory. Drum brake is mostly applied to big-tonnage cars (and mostly used in the rear wheels). Here's the working principle: with two semi-circular brake pads in the inner ring of wheels, The drive stomps on the brake, hydraulic piston rods connected to the brake pad will put the motionless pads in contact with wheels in speedy motion and create a tremendous amount of friction force, Thus reducing wheels' rotation speed or stopping the car. Its strengths include great force of braking force and the function of automatic tightening-braking. The processing and composition of parts are relatively simple and easy to handle. Another strength is its low production cost.

2) Disk brake

As the disk brake has its pads exposed to air in the outer ring of the wheel, heat can be well dissipated and pads won't heat-fade with successive braking actions. So, the disk brake has a higher level of safety and becomes the major trend (mostly used in front-wheel-driven cars). Many disk brakes also have ABS(Anti-lock Braking System) to improve its level of safety (refers to that an air sac inside the valve body, creates friction between the wheel and brake pad owing to its instant pressure on brake oil. The air sac then retracts and continues to apply pressure on the brake oil. The process will go on and on. This system can prevent instant wheel locking in braking and cars side slipping or turning over caused by inertia. Disk brake works via two brake pads located on both sides of a wheel. When the driver stomps on the brake, two pads will get closer, clamp the moving wheels and apply friction to stall the car. Strengths of this brake system include: its dissipation effect is better than that of the drum brake; in the case of successive brakes, there won't be heat-fading; it lasts long; brake response speed is fast and suitable for high-frequency braking cases. The structure of the disk brake system is easier than that of the drum disk, thus facilitating debugging and maintenance. The weaknesses of the disk brake include: its braking force isn't as strong as that of the drum brake; it's hard to mount a disk brake; moreover, the cost of disk brake is higher than that of drum brake.

Braking Distance Calculation:-

Braking distance is one of the important factor of IBS. It is the distance between point of application of brakes and point at which vehicle comes to rest.

Braking Distance : $\mathbf{d=v^2/2\ \mu g}$

μ=coefficient friction of road = 0.8

g=acceleration due to gravity=9.8m/s

Table 1 :Calculations

Velocity (km/hr)	Braking Distance (m)
60	17.69
50	12.28
40	7.86
30	4.42
05	0.2

In this formula the condition of brakes and the road condition are not considered for coefficient of friction.

IV. Proposed Methodology

With the proposed system, these sorts of accidents can be averted. Using a Hall sensor the system will sense the speed of the vehicle and using an Ultrasonic distance sensor, the system will sense any moving or stationary obstacles in front and continuously keep track of its distance. The microcontroller will calculate the braking distance, that is the distance required to bring the vehicle to a complete stop for that speed. In the case of moving vehicles, if the vehicle goes very close to the vehicle in front, the system will apply the brakes. The distance of the obstacle in the front is continuously sensed and it is given as input to microcontroller. Simultaneously the speed of the vehicle is sensed and given to the microcontroller. The program in the microcontroller judges the position of the vehicle and if the vehicle is within the critical limits then the brakes will be activated automatically.

4.1 Circuit Diagram

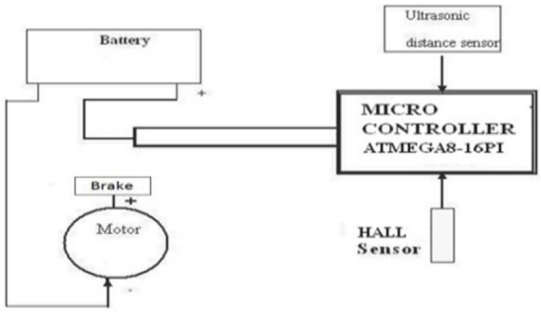

Figure 7 : Circuit Diagram Microcontroller

The ultrasonic distance measurment sensor which senses the obstacle in front of the vehicle. The ultasonic sensor consist of two parts namely ultrasonic transmitter and ultrasonic receiver. Ultrasonic transmitter emmits ultrasonic waves, when obstacle comes in front of vehicle the ultasaonic waves reflect back and these reflected waves are received by ultrasonic receiver. Now ultrasonic receiver feed these signals to the microcontroller. At the same time hall sensor monitor the vehicle speed and feed these inputs to microcontroller. Microcontroller calculates safe breaking distance and output of microcontroller is then fed to the breaking system and the breaks are apllied automatically.

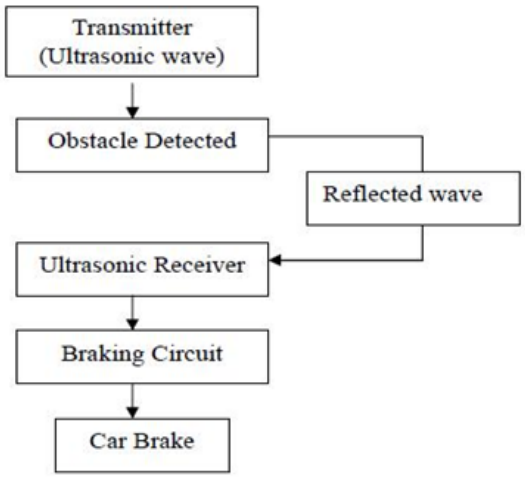

Figure 8 : Flowchart of Ultrasonic Wave

V. Conclusion

ABS has very large potential to eliminate accidents and reduce the severity of those that occur. Indeed it can be considered as one of the most powerful collision avoidance system in present. As ultrasonic sensor can detect any kind of obstacle hence this can also work with less human attention to driving. People have higher expectation of cars and need safer, smarter and more comfortable cars. Therefore, the safety system of cars will be better developed and also will have more demand in upcoming time. Implementation of such an advance system can be made compulsory as similar to wearing seat belt so that accident can be advert to some extent.

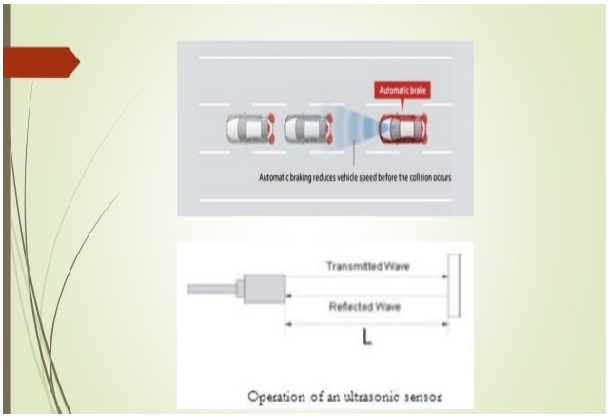

Figure 9 : Real Time Working Principle

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