Automatic Breaking System Using Ultrasonic Sensor

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***Abstract*- The World's population is increasing day by day, due to this the usage of automobiles is also increasing. As Automobiles increasing the death rate due to road accidents is also rising. Thousands of people are losing their lives due to major reason like brake failure, drunk and drive, late applying of brakes etc., to overcome from this risks, advanced ultrasonic braking system is introduced. It is an automatic braking system consists of Ultrasonic transducer, Ultrasonic receiver, Arduino UNOR3 band with PIC microcontroller, DC gear motor, servomotor and a mechanical braking arrangement. This is an effective mechatronic system. In this system the ultrasonic wave emitter provided on the front portion of the car to produce the ultrasonic waves. And also, an ultrasonic receiver is placed in front of the car to receive reflected ultrasonic wave. This detected pulse is taken by the microcontroller to, control the speed of the vehicle. As the evolving of the different types of IC engines, in this modern era speed is a major factor and leads to catastrophic incidents. So, by using Ultrasonic braking system we can prevent the death rate of road accidents.**

***Indexed Terms*- Ultrasonic waves, Ultrasonic sensor, Arduino, Microcontroller, Mechanical Braking Arrangement**.

I. INTRODUCTION

The main objective of this paper to design speed control & automatic braking system in the vehicle. The speed control & automatic braking system will involve the electronic circuits such as sensor, relay, control system, microcontroller, signal transmitter and signal receiver, Peripheral Interface Circuit (PIC). In this project we will apply the skill and knowledge in designing electronic circuit for the speed control & automatic braking system. We will use the software Proteus to design the circuit. The concept in designing the speed control & automatic braking system is strategic control of an accident being vehicles. We will use ultrasonic sensor for detection the obstacle & IR sensor for automatic braking system purpose. The system will be design to prevent the driver and passenger inside the vehicle from accident. Automation is fundamentally changing the role of people in many systems, and driving is no exception. An increasing number of vehicles are being equipped with speed control system. This system uses ultrasonic sensor to detect the obstacle or moving vehicle ahead and warns to driver about collision risk. When following another vehicle, the speed control system (SCS) will automatically give signal about distance between car and obstacle through LED display to the driver to reduce the speed of vehicle. The ultrasonic sensor is fitted in front of vehicle. This ultrasonic sensor transmits the signal continuously towards the obstacle and when obstacle is detected this signal is reflected from obstacle and receiver received this echo-signal from obstacle. The receiver sends this signal to the microcontroller for the control system purpose. The controller controls the speed of motor as per the distance. and reduces the speed of Motor and warns to the driver to reduce the speed. When diver or user is was fail to reduce the speed of vehicle then by controller automatically reduce the speed and when the distance between the car & obstacle is minimum, means if accidents like situation is detected by IR sensor then the controller take total charge to control the speed of vehicle from driver or user and microcontroller make its own decision to activate the automatic braking system and our vehicle stop automatically. Means in simple language it gives the signal to driver to reduce the speed & about the danger.

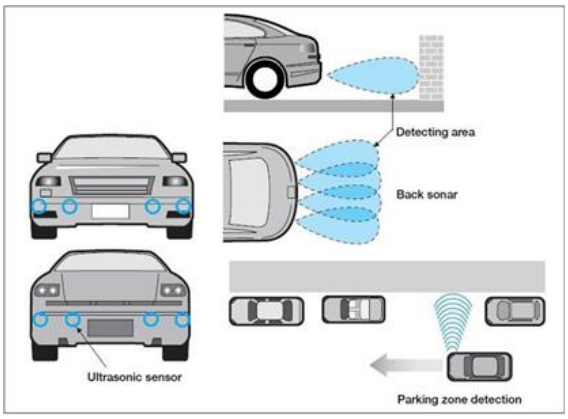
II. LITERATURE SURVEY

The literature survey is carried out to understand the state of art behind sensor technology used in Automotive engineering. Below are the following journals. Hemalatha B K, [1], Paper comprises the use of Infrared sensors for obstacle detection with help of

PIC microcontroller. This supported microcontroller technology for aggregation information associated with speed and transmittal it through a transceiver to a base station that analyzes the transmitted information and takes applicable choices associated with regulation and management necessities [3], paper comprises of the use of ultrasonic sensors with help of PIC microcontroller, transducers and servo motor braking mechanism. It is supposed to use in vehicles wherever the drivers might not brake manually, however the speed of the vehicle is reduced mechanically thanks to the sensing of the obstacles.

III. WORKING OF ULTRASONIC BRAKING SYSTEM

Each carmaker has its own automatic braking system technology, but all of them believe some sort of sensor input. The ultrasonic sensor contains transmitter and receiver units, and the ultrasonic transmitter detects the obstacle by transmitting the signals and reflects back to the ultrasonic receiver unit. The ultrasonic sensor input is then used to determine if there are any objects present in the path of the vehicle. If an object is detected, the system can then determine if the speed of the vehicle is bigger than the speed of the thing ahead of it. By which through Arduino dumped C Program the calculations will take place through PIC microcontroller according to the given maximum distance, and distance between the automatic system and obstacle. The DC gear motor rotates uniformly at a set rpm and gradually decreases speed while automatically breaking the system through servomotor braking mechanism phenomena. A significant speed differential may indicate that a collision is probably going to occur, during which case the system is capable of automatically activating the brakes.



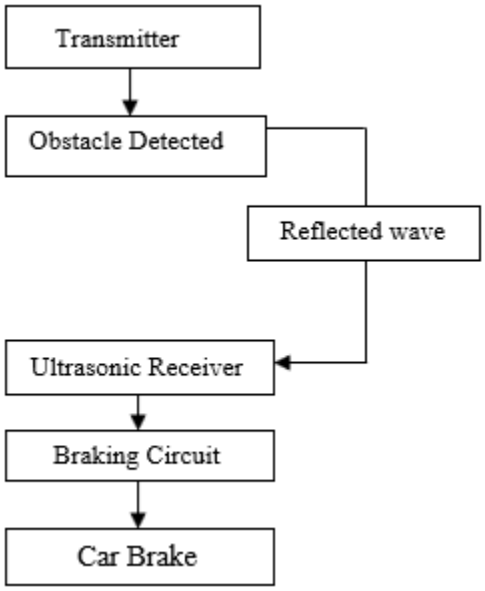


Fig. Ultrasonic Braking system block diagram

COMPONENTS USED IN THE ULTRASONIC BRAKING SYSTEM:

- Ultrasonic Sensor (transmitter and receiver)
- Arduino UNO
- Electric motor (DC gear motor)
- Servomotor
- Mechanical Braking system

ULTRASONIC TRANSMITTER

Before the ultrasonic transmitting wave, there is a part which is an ultrasonic wave generator that functions to create the ultrasonic wave. In that part, there is a timing instruction means for generating an instruction signal for intermittently providing ultrasonic waves. This signal will send to an ultrasonic wave generator for generating ultrasonic waves based on the

instruction signal from said timing instruction means (transform electrical energy into a sound wave). After an ultrasonic wave was produced, the ultrasonic transmitter transmits the ultrasonic waves toward a road surface to find out the obstacle. The range that obstacle detected is depends on the range of ultrasonic sensors used.

ULTRASONIC RECEIVER

Whenever the ultrasonic wave detects the obstacle, it produces a reflected wave. An ultrasonic receiver is employed for receiving the ultrasonic waves reflected from the paved surface obstacle to get a reception signal. There is an ultrasonic transducer that will transform back the sound wave into electrical energy. This signal amplified by an amplifier. The amplified signal is compared with a reference signal to detect components within the amplified signal thanks to obstacles on the paved surface. The magnitude of the reference signal or the amplification factor of the amplifier is controlled to take care of a continuing ratio between the types of the reference signal and therefore the average of the amplified signal.

Ultrasonic of signal	Range
maximum	1 meter
minimum	2 centimeters

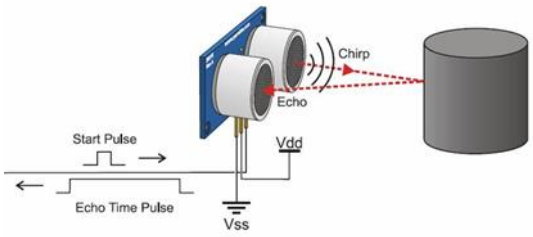


Fig. Ultra-Sonic transmitter and receiver

Working voltage	DC 5v
Working Current	15mA
Working Frequency	40Hz
Measuring Angle	15 degrees
Trigger Input Signal	10uS TTL pulse
Echo Output Signal	Input TTL lever signal and the range in Proportion
Dimension	45x20x15mm

Table. Specifications of Transmitter & Receiver

TIMING DIAGRAM

The timing diagram is shown below. You only need to supply a short 10uS pulse to the trigger input to start the ranging, and then the module will send out an 8-cycle burst of ultrasound at 40kHz and raise its echo. The echo is a distance object that id pulse width and the range in proportion. You can calculate the range through the time interval between sending trigger signal and receiving echo signal.

Formula:

µS/58 = Centimeters (or) µS / 148 = inch;

(or)

The range = high level time * velocity (340 M/S) / 2

In order to prevent trigger signal to the echo signal always, use over 60ms measurement cycle.

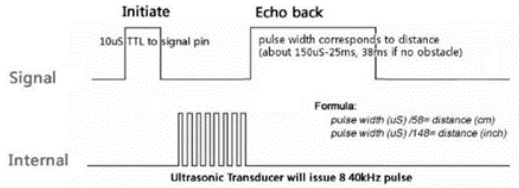


Fig. Timing diagram for ultrasonic transducer HC-SR04

ARDUINO UNO

Arduino is an open-source platform used for producing electronics projects. Arduino consists of both a microcontroller and a bit of software, or IDE (Integrated Development Environment) that runs on your computer, accustomed write and upload code to the physical board. The Arduino doesn't need a separate piece of hardware (called a programmer) so as to load new code onto the board – you'll be able to simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to find out to program.

Fig. Arduino Uno Layout

Brand name	Arduino
Height	25 millimeters
Width	5.5 Centimeters
Weight	91 Grams
Dimensions	8x5.5x2.5 Centimeters
RAM Size	8 kb
Voltage	5 Volts
Digital Pins	14

Table. Technical specifications of Ardunio Uno

DC GEAR MOTOR

A DC gear motor may be a fairly simple electric gear motor that uses electricity, gearbox, and magnetic flux to supply torque, which turns the motor. At its most simple, the DC gear motor requires two magnets of opposite polarity and an electric coil, which acts as an electric magnet. The repellent and attractive electromagnetic forces of the magnets provide the torque and cause the DC gear motor to turn. A gearbox is present just after the DC motor and a rotary shaft are connected to it, with the help of this DC gear motor setup the vehicle wheels can be rotated in this project.

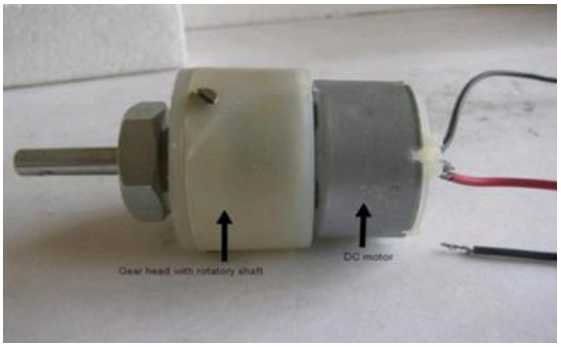


Fig. DC gear motor

Length	80mm
Volts	12v
Stall Torque	12kg-cm
Speed	100rpm
Shaft Diameter	6mm
Weight	281g

Table. Specifications of DC gear motor

SERVOMOTOR

The output shaft of the servo motor is capable of traveling somewhere around 180 degrees. A normal servo motor is employed to regulate an angular motion between 0 and 180 degrees, and it's mechanically unable of turning any farther thanks to a mechanical stop built onto the most output gear. The angle through which the output shaft of the servo motor needs to travel is determined according to the nature of the signal given to the motor as input from the PIC. Because of the rotation of the servomotor in 180 degrees, the brakes can be applied and released through the given brake's mechanism.

Fig. Servomotor

Weight	9 grams
Gear Type	Plastic
Operating Speed	0.12 Second/60^0
Operating Voltage	(3.0-7.2) V
Angle of Rotation	(0-180) degrees

Table. Specifications of Servomotor

TIMING DIAGRAM

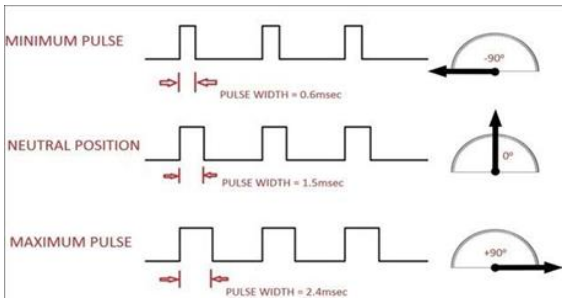


Fig. Servo motor movement timing

From the above figure, the duration of the pulse dictates the angle of the output shaft (shown as in indicator with the arrow). Note that the times here, are illustrative and the actual timings depend on the motor manufacturer. The principle, however, is the same.

CALCULATIONS

The braking distance is the main factor considered in this system. Braking distance for a particular speed is the distance between the point of application of the brakes and the point at which the vehicle comes to a complete stop from the present speed. It is calculated by using following formula.

Braking Distance = $V/2\mu g$ (meters)
Where
V = Velocity of the vehicle (m/sec)
μ = coefficient of friction of road = 0.8
g = Acceleration due to gravity = 9.81 (m/sec^2)
In this formula the condition of brakes and the road conditions are not considered for coefficient of friction μ.

Velocity (km/hr)	Braking Distance (m)
60	17.69
50	12.28
40	7.86
30	4.42
05	0.12

Table. Velocity vs. Braking Distance

CONCLUSION

The Ultrasonic 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. Ultrasonic braking approach speaks to a huge movement from the conventional way to deal with wellbeing, yet it is crucial to accomplishing the significant advantages.

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