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Electromagnetic Braking System using Ultrasonic Sensor

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Abstract**—** *The concept of our paper is based on the automatic braking system. As we know that most time the accident takes place due to loss of control, drunk & drive and much more breaking reason.In our system there is a sensor that detects the speed of movement of the vehicle and an ultrasonic sensor, that sense the distance of the object in front of the vehicle. The sensor system will sense the speed of the vehicle or object in the front while the microcontroller calculates the distance required to stop the moving vehicle. The whole system is automatic and the braking application will take place without any manual input therefore it will decrease the rate of error hence the rate of road accidents.*

Keywords**— Embedded System, Ultrasonic Sensor, Microcontroller, Transmitter, Automatic Braking**

I. INTRODUCTION

A most important part of a vehicle system is a braking system. In a conventional braking system, the kinetic energy is converted into thermal energy. But in this system, we are going to use an electromagnetic braking system with a combination of sensors and microcontrollers. In an electromagnetic braking system, we use the electromagnetic property such as lenz law and farady law. We have used an ultrasonic sensor and microcontroller so that we can control and calculate the distance required for safe breaking with high efficiency.

Fig1 Project Prototype

A. Problem Statement:

The motive of the project is "Safe Drive, Save Life" therefore we have designed a fabricated automatic braking system to decrease the rate of accidents due to Driver's irresponsibility.

B. Solution Proposed

An automatic braking system using an ultrasonic sensor which can detect the obstacle in the way of the vehicle and can take the decision of brake application.

II. UTILITIES USED

A. Ultrasonic Sensor

It is an electronic device that measures the distance between the source and the obstacle in front of it**.** It has two main component transistor and receiver.[4] The speed of ultrasonic waves is faster than the speed of audible sound. There are two main components in the ultrasonic sensor: the transmitter and the receiver. The transmitter emits the ultrasonic wave while the receiver detects the wave after reflection from the obstacle in front.[4]

Fig. 2 Ultrasonic Sensor

B. Electromagnetic Coil

An electromagnetic coil is an electrical component. It is made up of an electrical conductor such as conducting wire in the shape of a spiral, coil or helix. In many mechatronic system, we use the coil as a temporary magnet.

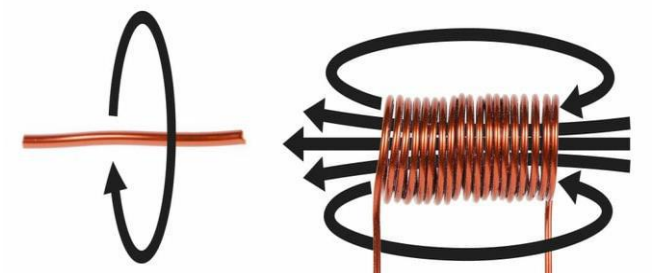

Fig. 3 Electromagnetic Coil

C. DC Motor

DC motor is an electronic device that converts electrical energy into mechanical energy. Since it works on direct current therefore it is called as DC motor..

Fig. 4 DC Motor

D. Arduino UNO

The Arduino UNO is ATmega328 based microcontroller. It has 20 digital input/output pins, a 16 MHz resonator, a USB connection, a power jack, rest button and an in-circuit system programming (ICSP) header. [5] We can use USB cable or external 9-volt battery for powering it, though it works between 7 to 20 volts.

Fig.5 Arduino UNO

E. BC548

BC548 is a transistor. It is an NPN transistor in which the collector and emitter will left open. It works on reversed biased**.**

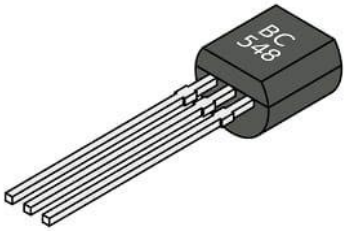

Fig.6 BC548

F. Crystal Oscillitor

A crystal oscillator is an electronic oscillator circuit. It is used for the mechanical resonance of a vibrating piezoelectric crystal. It creates an electrical signal with a given frequency.

Fig.7 Crystal Oscillator

G. PCB

PCB also known as printed circuit board provide mechanical support electrical connection between the electric component. It uses conductive tracks, pads and other features echoed from one or more sheet layers of copper laminated onto and/or between sheet layers of a non-conductive substrate.

Fig.8 Printed Circuit Board

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III. CONFIGURING AND CALCULATIONS

A. *Code Configuration*

```
inttrigPin = 9;
intechoPin = 10;
int led1 = 8;
void setup() {
Serial.begin(9600);
pinMode(led, OUTPUT);
pinMode(led1, OUTPUT);
pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
}

void loop() {
  long duration, distance;
digitalWrite(trigPin,HIGH);
delayMicroseconds(1000);
digitalWrite(trigPin, LOW);
  duration=pulseIn(echoPin, HIGH);

if((distance<=30))
  {
digitalWrite(led, HIGH);
digitalWrite(led1, HIGH);
}
   else if(distance>30)
 {
digitalWrite(led, LOW);
digitalWrite(led1, LOW );
   } }
```

B. *Calculation*

Braking Distance = $V^2 / 2\mu g$ (meter)

Where V= Velocity of the vehicle (m/s)

μ = Friction Coefficient = 0.8

g = Acceleration due to gravity = 9.81(m/s^2)

In this formula the condition of brakes and the road conditions are not considered for coefficient of friction μ. [2]

Table 1 Braking Distance

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

IV. WORKING

A. *Working of Electromagnetic Brake*

The principle of a conventional braking system is the conversion of kinetic energy into thermal energy.[1] When the brake is activated in the vehicle, a huge retarding force which is several times as powerful as the force required to put the car in motion is activated and emitt the associated kinetic energy as thermal energy.

It transmits torque mechanically but uses an electric actuation. A magnetic field is created when the brake receives a current and due to which the coil is turned into an electromagnet that creates magnetic lines of flux. This flux attracts the armature.[1] Usually, the armature and hub are mounted on a rotating shaft. The attraction force between coil and armature brings the rotating shaft to stop in a short amount of time.

When there is no current supply, then the armature can turn with the shaft smoothly. In most cases of electromagnetic brakes, the armature is held away from the braking surface with the help of spring.

B. *Working of EMBUS*

EMBUS consist of an ultrasonic transmitter and receiver on the front of the vehicle. The transmitter emits an ultrasonic wave regularly. [3] These waves are reflected by the obstacle and are received by the ultrasonic receiver. Then the microcontroller controls the speed of the vehicle on the base of the detection pulse information. The quick response time provide is used to shorten the braking distance by introducing advanced control of braking system operation.

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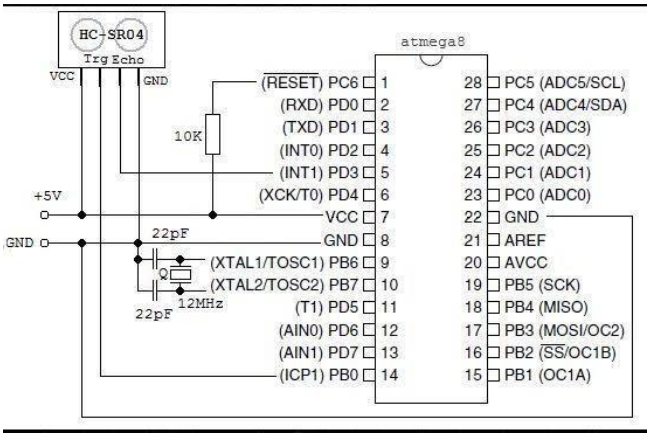

Fig.9 Circuit Pin Diagram

V. CONCLUSION

Our motive was to reduce the error from the braking system by introducing automation in braking system. In our prototype when the sensor senses the obstacle in front of the vehicle, it will send a signal to the control unit which will give the command for braking. Hence, we have reduced the rate of error by introducing automation in the braking system.

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