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Automatic Braking System with Bumper Actuation

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Abstract

For most people nowadays, driving is a common activity. Technology has undergone significant modifications, resulting in an increase in speed. However, high speed contributes to traffic accidents. When the driver is not attentive, ordinary braking is insufficient to prevent accidents. The braking system must be improved further in order to brake a vehicle when the driver is unable to do so, which may necessitate the use of an automatic braking system. The vehicle may brake without the driver's assistance using this autonomous braking technology. An automated braking system is an important aspect of car safety technology. It's a sophisticated system that's designed to avoid colliding with another vehicle or an obstacle of some sort. These systems use sensors like radar, video, infrared, and ultrasonic to scan for potential obstacles in front of the car and then use brake control to avoid a collision if the object is found.

Keywords

Sensor, transducer, operational amplifier and ADC, braking circuit

1. Introduction

Driving is a normal occupation for most people. Number of vehicles are growing day by day. Nowadays, technology has undergone major changes leading to an increase in speed. Speed plays an important role in travelling long distances. However, this speed also poses a serious problem with the causes of road accidents. Normal braking is not enough to avoid accidents if the driver is not attentive. Other improvements should be made to the brake system in order to brake the car where the driver cannot brake i.e., it may require an automatic braking system. This automatic braking system allows the car to brake without the driver's support.

The main purpose of the ultrasonic braking system is that vehicles should brake automatically when the sensors feel an obstacle. This is the technology of cars to avoid a collision from another vehicle or any sort of obstacle, as well as improper braking of the vehicle, caused by braking circuit. This system combines two ultrasonic sensors namely, ultrasonic wave emitter and ultrasonic wave receiver. Ultrasonic wave emitter is provided in the front part of an automatic braking system motor, which produces and emits ultrasonic waves in the area of a set distance in front of the car. The ultrasonic wave receiver also provided in the front part of the car; it receives an ultrasonic wave signal from the obstacle. The reflected wave (detection pulse) helps to measure distance between the car and the obstacle. DC gear motor connected to the wheels receive the power inputs from the Arduino board. Then there is a PIC microcontroller used to control servo motor based on driver and detection information this helps to automatically control vehicle brakes. So, this is a new system designed to solve a problem where drivers may not be able to brake at the required time, but the car can automatically stop and avoid collisions by detecting any obstacle in front it.

2. Literature Survey

Fundamentals of Sensors - In the broader sense, a sensor is something whose purpose is to see events or changes in its place, and then provide a corresponding output. A sensor is a type of transducer; sensors may offer different types of output, however usually use electrical or optical signals. For example, a thermocouple produces a known voltage (output) by reacting to its temperature (area). A mercury-in-glass thermometer, similarly, converts the average temperature into expansion and contraction of fluid, which can be read in a standard glass tube.

Sensors are used for everyday things like touch buttons that are sensitive to touch (touch sensor) and lights dimmed or illuminated by touching the base, otherwise countless apps that most people don't know about. With progress in small machines and small easy-to-use control platforms, the use of sensors is the best extend beyond the normal fields of temperature, pressure or flow rating, for example in MARG (Magnets, Angular Levels, and Strength) senses. In addition, analog sensors such as potentiometer and resistant-sensor, they are still widely used. Applications include manufacturing and equipment, aircraft and aerospace, automotive, medicine, and robots. It is also included in our daily lives.

Ultrasonic Sensor - Ultrasonic devices detects using high-frequency sound waves to find the object and its distance. Systems measure echo reflection of sound on objects or detect disturbance of sound beam as objects pass between transmitter and receiver. The ultrasonic sensor usually uses a transducer that generates electricity output in response to acquired ultrasonic power. Normal frequency range of human ears are estimated at 20 to 20,000 hertz. Ultrasonic sound waves are noisy waves, greater than the human sense and thus, have a frequency of about 20,000 hertz. Any frequency above 20,000 hertz may be considered ultrasonic. Many industrial processes, which include almost all sources of conflict, create some ultrasonic noise.

The ultrasonic transducer generates ultrasonic signals. These waves broadcast through the range of sensing area and the same transducer can be used for detection of reflected signals. Ultrasonic sensors usually have a piezoelectric ceramic transducer converting an exciting electric signal into an ultrasonic power explosion. Power explosion from an ultrasonic sensor, jumps on objects, and is returned to its sensor as echoed. Transducers are devices that convert electrical energy into mechanical force, or vice versa. The transducer handles the conversion of received echoes into electronic analog signals emanating from the transducer.

Ultrasonic Sensing and Control - Ultrasonic signals are similar to sound waves, but with high frequencies. Our ultrasonic transducers have compatible piezoelectric crystals that resonate at a frequency you want and converts electrical energy into acoustic energy and vice versa. The diagram shows how sound waves are transmitted in the form of a cone that is deviated in the reverse direction to the transducer. The output signal is generated for the operation of some kind of demonstration or control function. A short distance from the sensor is mandatory to provide a time delay for the "echoes" to be explicated. Variable which can affect the performance of ultrasonic sensors includes, target surface angle, apparent hardness or changes in temperature or humidity. The target can have any form of display form even round objects.

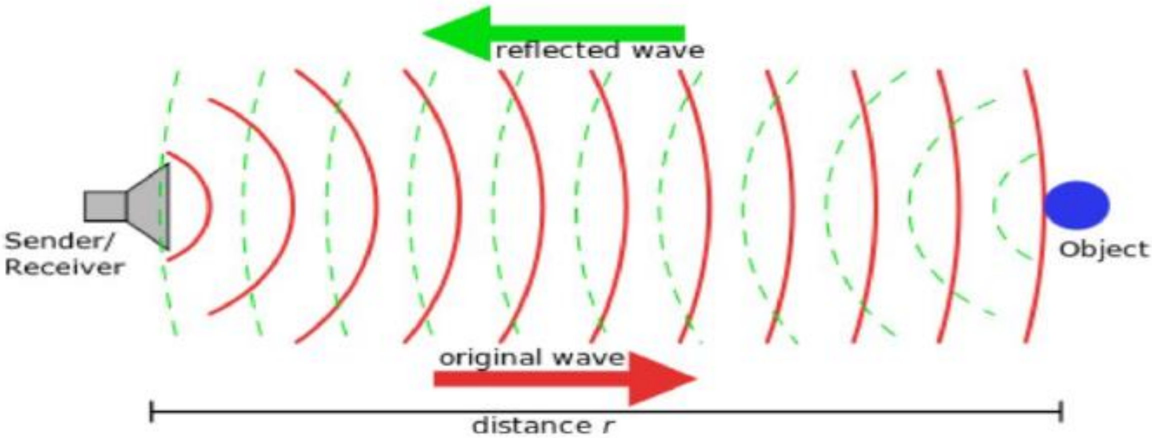

Figure 1. Basic ultrasonic operation

Measurement principle and effective use of Ultra Sonic Sensor - Ultrasonic sensor transmits ultrasonic waves from its sensor head frequently receives ultrasonic waves from an object. Basically, in our project Ultrasonic sensors of about 2cm to 1m. By measuring the time from transmission to sonic wave detection, the sensor obtains the location of obstacle. The ultrasonic transducer produces an ultrasonic signal. These signals broadcast through the sensing area and the same transducer can be used for the detection of reflected waves. In most systems, the medium for sensing is air. An ultrasonic sensor usually contains at least one ultrasonic transducer converting electrical energy into sound and reflected sound into electrical energy, a assembly including electrical connection, ultrasonic transducer, and an optional electronic signal processing unit is also confined in this assembly.

DC-gear motor - Geared DC motors are an expansion of the DC motor, which has already been explained in depth here. A geared DC motor is one that has a gear assembly attached to it. RPM stands for revolutions per minute, and it is used to measure the speed of a motor. The gear assembly aids in boosting torque while decreasing speed. A gear motor's speed can be decreased to any desired figure by using the right arrangement of gears. Gear reduction is a concept in which gears reduce the vehicle's speed while increasing its torque. This article will go through all of the tiny and big aspects that go into making a gear head and, as a result, how a geared DC motor works. DC Gear motors are also known as DC Geared Motors, Geared Dc Motors, and gear head or gearbox motors. It is made up of an electric DC motor and a gearbox or gear head that is used to reduce the DC motor's speed while increasing the torque. As a result, the gear motor can provide lower speed and more torque to the user.

Arduino Uno R3 - Arduino is a software firm, project, and user community that creates open-source hardware, software, and microcontroller-based kits for creating digital devices and interactive things that can sense and control real items. The project is based on microcontroller board designs from a variety of suppliers that use different microcontrollers. These systems provide a set of digital and analogue I/O pins that can be used to connect to various expansion boards (also known as shields) and other circuits. Serial connection interfaces, including USB on some variants, are included on the boards for loading applications from personal computers. The Arduino project provides an integrated development environment (IDE) for programming microcontrollers based on the Processing programming language, which additionally supports C and C++.

The original Arduino was released in 2005 with the goal of providing a low-cost, simple approach for both beginners and experts to construct devices that interact with their surroundings utilizing sensors and actuators. Simple robots, thermostats, and motion detectors are common examples of such gadgets aimed at beginning enthusiasts. Commercially available preassembled Arduino UNO R3 boards and DIY kits are available. The hardware design specifications are open source, allowing anybody to manufacture Arduino boards. Arduino is a programming language that allows you to create computers that can sense and control more of the physical environment than your typical desktop computer. It's an open-source physical computing platform that includes a development environment for building software for the board and a simple microcontroller board.

The Arduino Uno R3 is a microcontroller with 14 digital input/output pins (six of which are PWM outputs and six of which are analogue inputs). In actuality, the Arduino programming language is nothing more than a set of C/C++ functions that you can call from your code. The L293d Motor Drive Shield microcontroller shield is a circuit board that employs a series of pins to connect directly to parts of the microcontroller's pins. A shield is a simple means of connecting all of your external components. Shields can be used to control motors, relays, LEDs, and other devices

3. Principal Components of Automatic Braking System

- Sensor
- Transducer
- Ultrasonic-Sensor
- Operational-Amplifier and ADC
- Braking-Circuit
- DC-Gear Motor

Sensor - A sensor is an electrical device that converts a natural map into a quantitative measure. Each sensor is based on a specific transmission principle, the conversion of energy from one state to another. There are two key words related to any sensor -

- Targeted Angle - This term refers to the limitation of the 'moving response' of a given sensor. As the ultrasonic waves reflect the target object, the target angles indicate acceptable values for sensor provided.
- Beam Spread - This term refers to the high angular dispersion of ultrasonic waves as they leave the transducer.

Transducer - A transducer is a power converter that converts one type of power to another. Ultrasonic sensors are used to convert electricity power into ultrasonic power and vice versa. In this program, the piezoelectric transducers are used, generating ultrasonic vibration through piezoelectric materials such as certain types of crystals or ceramic polymers. Their performance is based on piezoelectric effect. This result refers to the voltage generated between the areas of a solid, (non-abrasive) in which mechanical pressure is applied. Conversely, when a voltage is applied to the solid in the exposed areas of piezoelectric effect, the solids are distorted mechanically.

Ultrasonic Sensor - Ultrasonic devices uses high frequency sound waves called ultrasonic waves to detect the presence of an object and its width. Normal ear frequency is approximately 20Hz to 20,000Hz. Ultrasonic sound waves have a frequency range greater the human ear, that is more than 20,000Hz. The ultrasonic sensor actually contains its own transducer used for the conversion of one type of energy into another, an ultrasonic switching house transducer and electrical connection. These sensors are of two types:

• **Ultrasonic Transmitter -** Before transmitting the ultrasonic wave, there is a part which is an ultrasonic wave generator used to produce ultrasonic waves. In that part, there are time guidelines for generating command signal providing periodically to ultrasonic waves. This signal will transmit to the ultrasonic waves a generator for the production of ultrasonic waves based on signal commands from the specified time instructions mean (converting electrical energy into sound waves). After the ultrasonic waves are produced, the ultrasonic transmitter transmits the ultrasonic waves along the road to find an obstacle. The obstacle gets detected if it is within the range of ultrasonic sensors used.

• **Ultrasonic Receiver -** If the ultrasonic wave detects a barrier, it will produce a wave that is reflected back to the receiver. This Ultrasonic receiver is used to receive ultrasonic waves further the ultrasonic transducer will convert the sound wave into electrical energy. Then it is amplified through an amplifier. The amplified signal is compared to the reference signal to determine if there is any obstacle in the road area. the reference signal and the magnified signal is controlled to maintain a constant rate within the reference signal range and the enhanced signal range

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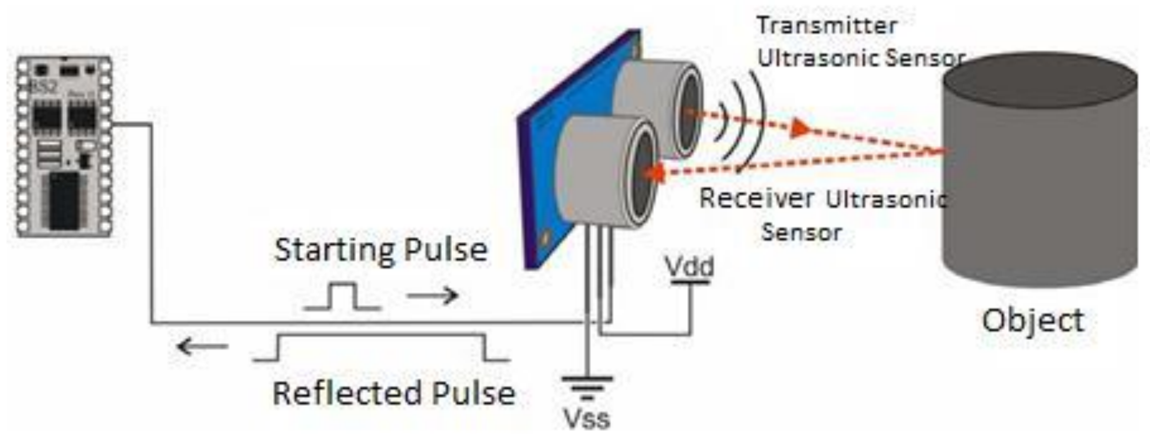

Figure 2. Working of an ultrasonic sensor

Operational Amplifier and ADC - An effective amplifier, commonly called op-amp, is the most advantageous voltage amplifier with different inputs and single output. The op-amp amplifies the difference in voltage between the two inputs called 'differential input' voltage '. The output voltage of the op-amp is regulated by supplying a portion of the output signal is back to the inverting input. This is known as a negative response. Due to the higher gain of the amplifier, the output voltage of any of the inputs supplied is controlled through only negative response. The amplified signal is a square pulse provided by ADC. ADC (Analog to Digital Converter) converts the input analog signal into a compatible digital signal. The digital signal is supplied to the microcontroller.

Braking Circuit - Processed i.e. amplified digital signal is sent to the braking cycle. PIC (Peripheral Interface Controller (or) Edge Visual Controller) – The used microcontroller is a PIC 16F84 8-bit microcontroller. PIC microcontrollers are made with microchip technology. PICs are used in this system because they are less costly and widely available. Numbers of instruction actions for various functions vary from 35 instructions on low-level PICs to about 70 instructions on advanced PICs. Edited using C language. The signal from the ADC is processed by the PIC microcontroller, too provide command as output, based on signal condition, and transmit it to the servomotor of the car. A signal obtained from ADC can be displayed on an LCD display (which provides audio and visual warning in the windshield in the driver's viewing area), and provides a distance between the front of the car and the obstacle. The default distance to start braking is already saved in microcontroller. If the estimated distance reaches this value, PIC automatically sends a signal to the servo motor which controls the braking by mechanical arrangements.

DC-Gear Motor - The DC gear motor is a simple electric gear motor, gearbox and magnetic field to create torque, which rotates the motor. Too much simple, DC gear motor requires two pulls of different polarity and electric coil, acting as an electric magnet. An electric shocking and attractive magnetic provides torque and causes the DC gearbox to turn. Gear box existing just after the DC motor and rotary shaft are connected to it, with the help of this set of DC gear motor, car wheels can be turned in an automatic braking system.

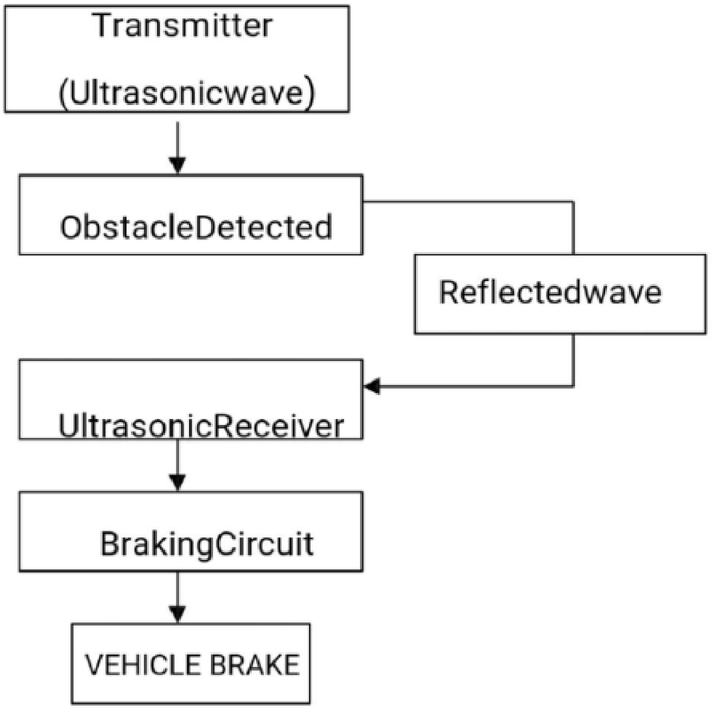

Figure 3. Block-Diagram of the Automatic-Braking system

4. Sensing and Controlling Unit

The Sensing and Controlling unit detect an object or obstruction in front of the automobile, measures the distance and approaching velocity, and then transmits the required signals to the servo motor and, as a result, to the Automatic Braking Unit. The system's components include an Arduino microprocessor, a servo motor, an ultrasonic transducer, and a power source. The Arduino is programmed using Arduino 1.6, a language advocated by the same-named corporation that functions as a free source coding platform similar to Android.

- **Components of Sensing and Controlling Unit (SCU)**

Arduino Uno R3 - The ATmega328P-based Uno is a microcontroller board. It contains 14 digital input/output pins, 6 analogue inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, and a reset button. It comes with everything you need to get started with the microcontroller; simply connect it to a computer by USB or power it with an AC-to-DC adapter or battery. You can experiment with your UNO without fear of making a mistake; in the worst-case situation, you can replace the chip for a few dollars and start over. The number "one" was chosen to commemorate the release of Arduino Software (IDE) 1.0. The Uno board and Arduino Software (IDE) version 1.0 were the reference versions of Arduino, which have since been replaced by newer releases. The Arduino Uno board is the first of a series of USB Arduino boards and serves as the platform's reference model.

The Arduino's structure is also a disadvantage. During the construction of a project, you must keep it as small as feasible. However, because to the large structures of Arduino, we must use large PCBs. If you're dealing with a small microcontroller like the ATmega8, you may simply reduce the size of your PCB.

Figure 4. Arduino-Uno layout

Table 1. Technical specifications of Arduino-Uno

Brand name	Arduino
Height	25 Millimetres
Width	5.5 Centimetres
Weight	91 Grams
Dimensions	8 x 5.5 x 2.5 Centimetres
RAM Size	8 kb
Voltage	5 Volts
Digital Pins	14

The Arduino Uno can be fueled either by USB or an external power supply. The power source is automatically selected.

An AC-to-DC adapter (wall-wart) or a battery can provide external (non-USB) power. A 2.1mm centre-positive plug can be plugged into the board's power jack to connect the adapter.

Battery leads can be placed into the POWER connector's GND and VIN pin headers.

The board can be powered from a 6 to 20-volt external supply. If less than 7V is given, the 5V pin may supply fewer than five volts, making the board unstable. The voltage regulator may overheat and destroy the board if more than 12V is used. 7 to 12 volts is the preferred range.

The following are the power pins:

- VIN: When the Arduino board is powered by an external power source (rather than 5 volts from a USB connection or other regulated power source), this is the input voltage. This pin can be used to supply voltage or to access voltage if it is supplied via the power jack.
- 5V: The microprocessor and other components on the board are powered by a controlled 5V power source. This can be supplied via USB or another regulated 5V supply, or it can originate from VIN via an on-board regulator.
- 3V3: The on-board regulator generates a 3.3-volt supply. The maximum current draw is 50 milli-amperes.
- GND: GND stands for ground pins.

Each of the Uno's 14 digital pins can function as an input or output. They are powered by 5 volts. Each pin includes a 20-50 k-Ohm internal pull-up resistor (disconnected by default) and may deliver or receive a maximum of 40 mA. Furthermore, several pins have specific functions:

- Serial: 0 (RX) and 1 (TX) serial numbers (TX). TTL serial data is received (RX) and transmitted (TX) using this device. These pins are connected to the ATmega8U2 USB-to-TTL Serial chip's corresponding pins.
- External Interrupts: 2 and 3 are external interrupts. On a low value, a rising or falling edge, or a change in value, these pins can be programmed to generate an interrupt. For more information, see the attachInterrupt() function.
- PWM: 3, 5, 6, 9, 10, and 11. The analogWrite() method generates an 8-bit PWM signal.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SPI) (SCK). These pins support SPI communication, which is currently not supported by the Arduino language despite being given by the underlying hardware.
- LED: 13. A built-in LED is connected to digital pin 13 by a wire. The LED is on when the pin is HIGH, and it is off when the pin is LOW

Ultrasonic Transducer - Transducers that convert ultrasound waves to electrical signals or vice versa are known as ultrasonic transducers. Ultrasound transceivers are those that can both transmit and receive ultrasonic signals; many ultrasound sensors, in addition to being sensors, can also sense and transmit. These devices work on the same principle as transducers in radar and sonar systems, which evaluate target qualities by interpreting echoes from radio or sound waves, respectively. Active ultra-sonic sensors create high-frequency sound waves and analyze the echo that is returned by the sensor, determining the dis-tance to an item by measuring the time gap between transmitting the signal and getting the echo. Passive ultrasonic sensors are essentially microphones that detect ultrasonic sounds in specific conditions, convert it to an electrical signal, and send it to a computer.

In a variety of scientific applications, ultrasonic probes and ultrasonic baths are utilized to impart sound energy to agitate particles. An ultrasonic transducer is a device that converts alternating current (AC) into ultrasound as well as sound into AC. The phrase typically refers to piezoelectric or capacitive transducers in ultrasonic. When a voltage is supplied, piezoelectric crystals change size and shape; AC voltage causes them to vibrate at the same frequency and produce ultrasonic sound.

Electrostatic fields are created between a conductive diaphragm and a backing plate in capacitive transducers.

The active transducer area and shape, the ultrasonic wavelength, and the sound velocity of the propagation medium all influence the beam pattern of a transducer. The diagrams depict the sound domains of an unfocused and focusing ultrasonic transducer in water at various energy levels.

Piezoelectric materials can be used as ultrasonic detectors because they generate a voltage when force is applied to them. Some systems have separate transmitters and receivers, while others have a single piezoelectric transceiver that performs both roles. Non-piezoelectric concepts such as magneto-striction can also be used in ultrasound transmitters. When subjected to a magnetic field, materials having this feature change size slightly, making them useful transducers.

A narrow diaphragm responds to ultrasonic waves in a capacitor ("condenser") microphone. Sound signals are converted to electric currents by changes in the electric field between the diaphragm and a closely spaced backing plate. Ultrasonic sensors are commonly employed as parking sensors in automobiles to assist drivers in reversing into parking spaces. They're also being tested for other vehicle applications, such as ultrasonic people identification and supporting autonomous UAV navigation. The HC – SR04 ultrasonic ranging module has a measurement range of 2cm to 400cm and a ranging precision of 3mm. Ultrasonic transmitters, receivers, and a control circuit are included in the module.

Fundamental working principle:

- The Module sends eight 40 kHz and detects whether there is a pulse signal back using IO trigger for at least 10us high level signal.
- If the signal returns at a high level, the time of high output IO duration is the period between sending ultrasonic and receiving it. (high level time * sound velocity (340M/S) / 2) = test distance

Fig 5. Ultrasonic Transducer

Table 2. Technical specifications of the Ultrasonic transducer

Working Voltage	DC 5V
Working Current	15mA
Working Frequency	40Hz
Max Range	4m
Min Range	2cm
Measuring Angle	15 degree
Trigger Input Signal	10uS TTL pulse
Echo Output Signal	Input TTL lever signal and the range in proportion
Dimension	45 X 20 X 15mm

DC-Gear Motor - DC geared motors are simply DC shunt motors that have been optimized for low inertia, symmetrical rotation, and smooth low-speed performance. A geared motor has a closed feedback loop, which means the position of the motor is conveyed back to the motor's control circuit. A geared motor is made up of four parts: a DC motor, a position-sensing device (potentiometer), a gear reducing portion, and a control unit. All of these parts work together to allow the motor to take control signals that reflect the desired output of the motor shaft and to power the DC motor until the shaft is turned to the proper position.

The shaft of geared motors can only revolve roughly 200 degrees in both directions, which is less than that of normal DC motors. In a geared motor, the position sensing device determines the rotation of the shaft and consequently the direction in which the motor must turn to reach the required position. The sliding mode control is insensitive to external disturbances and resistant to plant uncertainty. It's a frequent technique for improving the dynamic performance of controlled systems. Even yet, the chattering phenomenon caused by the switching devices' limiting speed might have a major impact on the system's behavior.

Furthermore, understanding of the mathematical model of the system with defined uncertainties is required for sliding control. Combining the appealing qualities of fuzzy control with SMC can reduce chattering without sacrificing robust performance.

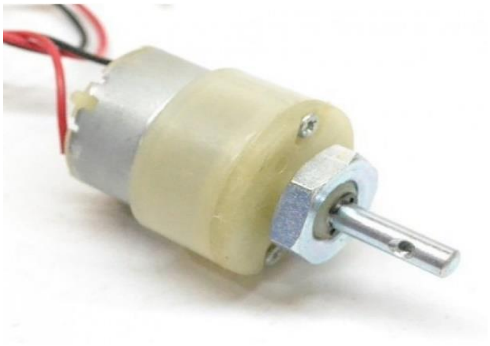

Figure 6. DC gear motor

Table 3. Specifications of DC-gear motor

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

5. Working Model

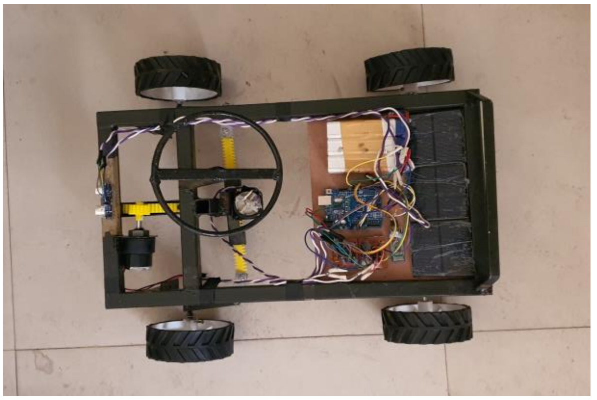

Figure 7. Working model (Top view)

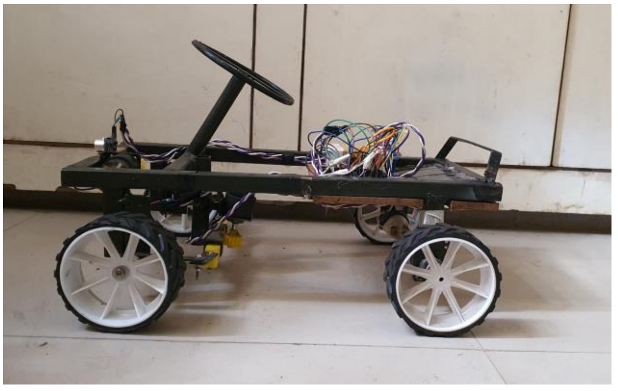

Figure 8. Working model (Side view)

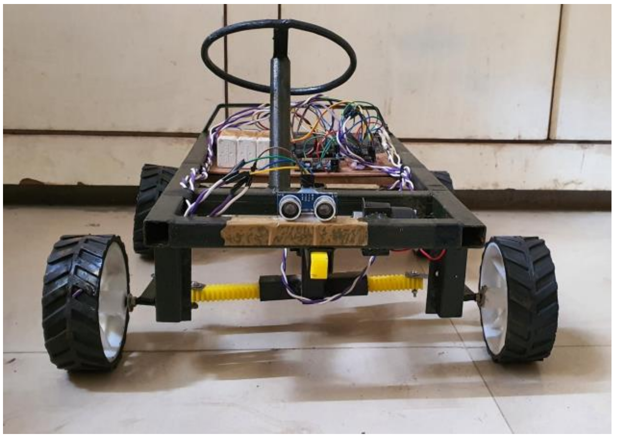

Figure 9. Working model (Front view)

Arduino 1.6 software - Writing code and uploading it to the board is simple with the open-source Arduino Software (IDE). It is compatible with Windows, Mac OS X, and Linux. The environment is written in Java and is based on open-source applications such as Processing

Any Arduino board can be used with this software.
The following is the developed programme for our project's success:

```
#include <Servo.h> // Includes servo library.
#include <Ultrasonic.h> // Includes SR-04 Sensor Library.
Ultrasonic ultrasonic(A0,A1); // (Trig PIN,Echo PIN)
Servo servo_1; // Creating Servo object.

// declaring Motor Shield
int dataPin = 8;
int latchPin = 12;
int clockPin = 4;
int en = 7;

// Variable to store distance
int left_d = 0;
int right_d = 0;
int front_d = 0;
int max_d = 50; // Max distance to obstacle
void setup()
{

// setting up shield.
pinMode(dataPin, OUTPUT);
pinMode(latchPin, OUTPUT);
pinMode(clockPin, OUTPUT);
pinMode(en, OUTPUT);
digitalWrite(en, LOW);

servo_1.attach(10); // Attaching servo to Pin No.10
servo_1.write(90); // Initial position
delay(350);
}

void loop()
{
front_d = ultrasonic.Ranging(CM); // measuring fornt distance
if (front_d < max_d)
{
halt();
get_d();
if(right_d > max_d)

{
delay(400);
forward();
}

else if ( left_d > max_d)
{
delay(400);
forward();
}

else {
backward();
delay (500);
halt();
```

```
}
}
else{
forward();
}
}

void forward(void){ // function for forward movement.
digitalWrite(latchPin, LOW);
shiftOut(dataPin, clockPin, LSBFIRST, 3);
digitalWrite(latchPin, HIGH);
}
void backward(void){ // function for backward movement.
digitalWrite(latchPin, LOW);
shiftOut(dataPin, clockPin, LSBFIRST, 164);
digitalWrite(latchPin, HIGH);
}

void halt(void){ // function for stopping robot.
digitalWrite(latchPin, LOW);
shiftOut(dataPin, clockPin, LSBFIRST, 32);
digitalWrite(latchPin, HIGH);
}

void get_d(void) // Fuction to get distances.
{
servo_1.write(180); // Right Position
delay(3000);
right_d = ultrasonic.Ranging(CM);
servo_1.write(0); // Front Positon
delay(500);
front_d = ultrasonic.Ranging(CM);
servo_1.write(0); // Left position of servo
delay(500);
left_d = ultrasonic.Ranging(CM);
servo_1.write(0); // back to front
delay(250);
}
```

6. Result

As a result of this automatic braking system, each component functions properly, and the entire system is completed effectively. When an obstacle is recognized, the vehicle system is braked and the safety distance of 50cm is determined. The ultrasonic sensor in this prototype has a range of around 2cm to 1m and performs successfully within the permitted limits.

Final Overview of Project - The functionality of the prototype has been tested by connecting it to batteries and controlling the braking mechanism with a DC gear motor. This technology is environmentally sustainable, and this work aims to prevent accidents while driving. We put several objects in front of the system as hurdles to see how it worked. When the impediment is placed at various distances from the car, the system responds by stopping it about 50cm away from the obstacle and simultaneously the bumper gets actuated for more safety. It provided extremely accurate measurements based on the range of values interpreted.

7. Conclusion

I have successfully completed the assembling of an automatic braking system model prototype, and this project describes the implementation of an Automatic Braking System for forward collision avoidance, which is intended for use in vehicles where the drivers are unable to brake manually but the vehicle can be stopped automatically due to the detection of obstacles. Moreover, the bumper gets actuated simultaneously at the time of braking as well for more safety. It decreases the number of accidents and saves the lives of countless people. I gained practical knowledge about how automatic braking systems work, and I hope to develop the system into an even more advanced speed control system for automobile safety with future study and research, while realising that this will undoubtedly require a lot of work and learning, such as programming and operating microcontrollers and understanding the automobile structure. As a result, I believe that including an Automatic Braking System will increase safety while also giving the system a larger market space and a competitive advantage.

8. Future Work

The "Automatic Braking System" is the future scope for designing and developing a brake control system for our vehicles. When the distance between the vehicle and the obstruction is within the sensing range zone, the Automatic Braking System with ultrasonic sensor will inform the driver and apply the brakes. This is a feature in this prototype design that might be applied to all automobiles. This method will provide a greater assurance for vehicle safety and minimise losses by making it safer. As a result, car safety systems will be improved and may face increased market demand. It can also be utilised for huge heavy vehicles such as buses, trucks, cranes, and tractors. According to the vehicle situation, we can certainly obtain information about the obstacle detection sense zone. It is extremely beneficial to both the public sector and users. Accidents are also avoided in large or metropolitan cities. As a result, we believe that automatic vehicle braking at a moderate cost is a better idea.

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