ULTRASONIC SELF DRIVING CAR

Project report submitted in partial fulfilment of the requirements for the course-Digital Electronics and Computer Architecture (23IC001) of

Bachelor of Engineering

in

Computer Science and Engineering

Submitted by

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Group: - 23B, B.E.-2023 Batch

CHITKARA UNIVERSITY

Chitkara University Institute of Engineering and Technology

Department of Interdisciplinary Courses in Engineering (DICE)

CHITKARA UNIVERSITY PUNJAB

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Under the Supervision of

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DICE DEPARTMENT OF INTERDISCIPLINARY COURSES IN ENGINEERING

CHITKARA UNIVERSITY INSTITUTE OF ENGINEERING & TECHNOLOGY, PUNJAB

(Accredited by NAAC with Grade 'A+')

DEPARTMENT OF INTERDISCIPLINARY COURSES IN ENGINEERING

CERTIFICATE

This is to certify that the project titled "Ultrasonic Self Driving Car**.**" submitted to the **Chitkara University Institute of Engineering and Technology (CUIET)** by **Shreya Gagneja (2310992591), Diksha Vadehra (2310992592), Tathya Sachdeva (2310992592), Aneet Kaur (2310992593)** is a bonafide record of the work done by the students towards partial fulfilment of requirements for the course- Digital Electronics and Computer Architecture (23IC001) of **Bachelor of Engineering in Computer Science and Engineering.**

	Supervisor	**Project/Lab Faculty**	**Course/Project Coordinator**
Signature			
Name	**Dr. Anchal Thakur**	**Dr. Anchal Thakur**	**Dr. Gaurav Sharma**
Designation	**Assistant Professor**	**Assistant Professor**	**Associate Professor**
Department	**Engineering in Computer Science and Engineering.**	**Engineering in Computer Science and Engineering.**	**Department of Interdisciplinary Courses in Engineering**

Place: Chitkara University, Rajpura, Punjab

Date: 11-12-2023

Candidates' Declaration

We, **Shreya Gagneja (2310992591), Diksha Vadehra (2310992592), Tathya Sachdeva (2310992593), Aneet Kaur (2310992594), of Group G23-B,** B.E. -2023 batch of Chitkara University, Punjab hereby declare that the Digital Electronics and Computer Architecture (DECA) project entitled "Ultrasonic Self Driving Car" an original work and data provided in the study is authentic to the best of our knowledge. This project has not been submitted by us to any other institute for the award of any other course.

Contribution Details:

Sr. No.	Student Name	Roll No.	Contact Number	Contribution in Project	Signature
1.	SHREYA GAGNEJA	2310992591	9988001715	Coding, Hardware connections, Research	
2.	DIKSHA VADEHRA	2310992592	7009259273	Documentation, Research.	
3.	TATHYA SACHDEVA	2310992593	8684007858	Research, Hardware connections.	
4.	ANEET KAUR	2310992594	6280939164	Research, Hardware connections, Code	

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We wish a deep sense of gratitude and heartfelt thanks to the management for providing excellent lab facilities and tools.

ABSTRACT

Autonomous vehicles have been invented to increase the safety of transportation users. These vehicles can sense their environment and make decisions without any external aid to produce an optimal route to reach a destination. Even though the idea sounds futuristic and if implemented successfully, many current issues related to transportation will be solved, care needs to be taken before implementing the solution. This paper will look at the pros and cons of implementation of autonomous vehicles. The vehicles depend highly on the sensors present on the vehicles and any tampering or manipulation of the data generated and transmitted by these can have disastrous consequences, as human lives are at stake here.

A self-driving car (sometimes called an autonomous car or driverless car) is a vehicle that uses a combination of sensors, cameras, radar and artificial intelligence (AI) to travel between destinations without a human operator. To qualify as fully autonomous, a vehicle must be able to navigate without human intervention to a predetermined destination over roads that have not been adapted for its use.

Companies developing and/or testing autonomous cars include Audi, BMW, Ford, Google,

General Motors, Tesla, Volkswagen and Volvo. Google's test involved a fleet of self-driving cars -- including Toyota Prii and an Audi TT -- navigating over 140,000 miles of California streets and highways.

The neural networks identify patterns in the data, which are fed to the machine learning algorithms. That data includes images from cameras on self-driving cars from which the neural network learns to identify traffic lights, trees, curbs, pedestrians, street signs and other parts of any given driving environment.

Application Area(s) of the Project:

- obstacle detection
- assist with parking
- enhance low-speed manoeuvres
- support adaptive cruise control
- provide cross-traffic alerts
- offer redundancy in sensor systems.

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CHAPTER 1
INTRODUCTION

Ultrasonic sensors are used in self-driving cars to detect objects and measure distances, making them invaluable components of the autonomous vehicle’s sensor suite. They are cost-effective and aren’t negatively affected by environmental factors. However, they have low resolution and a very close range. Ultrasonic sensors are used for close-range object detection, emergency brake assistance, and to check blind spots. They work normally in bad weather (rain, snow, dust) unlike LiDAR. Some newer versions have resolutions and object recognition capabilities comparable to LiDAR.

Self-driving cars can achieve:

1. Mobility for everyone
2. Avoid accidents that occur due to systematic human errors
3. A lot of people learn to drive, but they all start from scratch, nobody is born with a special power wherein they know how to drive. With an be better than the previous one, each car would improve on what it drove like yesterday. Yes, I know it sounds naively ambitious, but it is a benefit you cannot ignore if you’re looking at advancing in this field.

What is an ultrasonic sensor?

Sonar stands for Sound Navigation and Ranging. It has been used in vehicles to support drivers with their driving tasks like parking and nearby obstacle detection. An ultrasonic sensor is a device that emits high-frequency sound waves and measures the time it takes for the waves to bounce back after hitting an object. This information is used to calculate the distance between the sensor and the object, enabling non-contact distance measurement in applications like robotics and automation.

Physics of an ultrasonic sensor:

The ultrasonic sensors send out short ultrasonic impulses which are reflected by obstacles. The echo signals are then received and processed. Within the plastic case of an ultrasonic sensor is the main components, the ultrasonic transducer. It consists of an aluminium pot with diaphragm containing a piezoceramic element). The sensor receives a digital transmit signal from the ECU. This causes the aluminium diaphragm to oscillate with square waves for about 300µsec with resonant frequency of about 48 kHz which results in emission of ultrasonic pulses. The diaphragm then relaxes for about 900µsec (during which no reception is possible) receives the reflected sound from an obstacle and vibrates. These vibrations are outputted by the piezoceramic element as analog signals, it’s then amplified and converted to a digital signal.

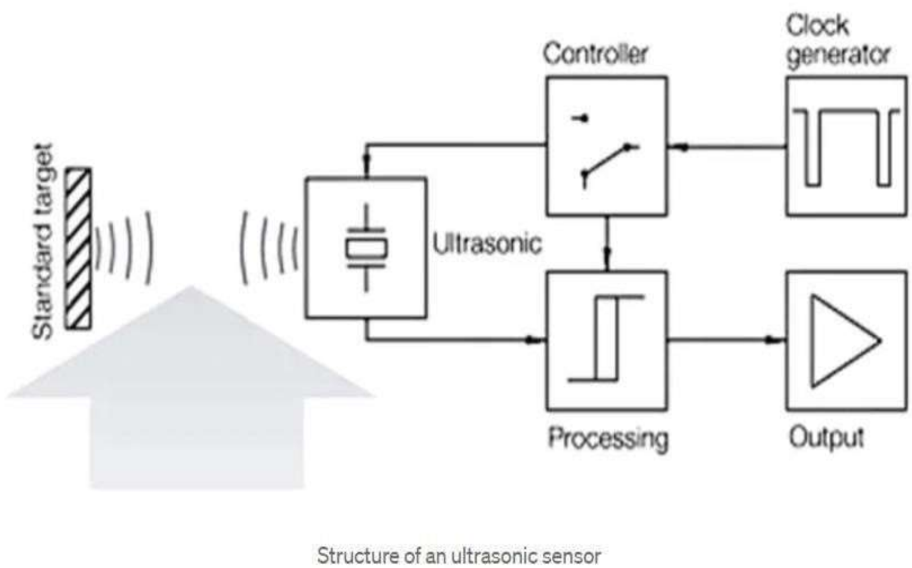

Figure 1: Structure of an ultrasonic sensor

This is basically a Self-Driving Car powered by Arduino R-3 Development Board and a L293D Motor Shield. It uses the data given by the HC-SR04 Ultrasonic Sensor which is connected to analog pins of the Arduino board.

Ultrasonic sensors emit ultrasonic waves, which bounce off objects and return to the sensor. By measuring the time, it takes for the waves to return, the sensor can calculate the distance to the object. This information is crucial for identifying and avoiding obstacles, such as other vehicles, pedestrians, or stationary objects, ensuring the car can navigate safely in various environments.

Ultrasonic sensors in self-driving cars usually have a wide horizontal sensing range (min. 15cm to max. 2–6m depending on sensor type) and a narrow vertical sensing range to avoid the earth reflections. Detection range: max. 5.5 m, min. 15 cm; object presence 3 cm. There are different types of radars based on the range and beam angle. Ultrasonic sensors in self-driving cars usually have a wide horizontal sensing range (min. 15cm to max. 2–6m depending on sensor type) and a narrow vertical sensing range to avoid the earth reflections.

How does the car see the road?

Ultrasonic sensors: play a pivotal role in enhancing the safety and efficiency of self-driving cars. These sensors utilize high-frequency sound waves to detect objects and measure distances, making them invaluable components of the autonomous vehicle’s sensor suite. Here’s how ultrasonic sensors contribute to safe and efficient navigation in self-driving cars.

Obstacle Detection: Ultrasonic sensors emit ultrasonic waves, which bounce off objects and return to the sensor. By measuring the time, it takes for the waves to return, the sensor can calculate the distance to the object. This information is crucial for identifying and avoiding obstacles, such as other vehicles, pedestrians, or stationary objects, ensuring the car can navigate safely in various environments.

Parking Assistance: Ultrasonic sensors are commonly used for parking assistance systems. They provide real-time feedback to the vehicle’s control system, help in the car park accurately and avoid collisions with nearby objects. This simplifies parking, reduces the risk of accidents, and minimizes damage to the vehicle.

CHAPTER 2

RELATED WORK

The terms self-driving and autonomous are used fairly interchangeably, and they essentially are. Autonomous is more general, whereas self-driving only relates to vehicles. In the case of cars though, those technicalities don't matter.

Self-driving cars rely on hardware and software to drive down the road without user input. The hardware collects the data; the software organizes and compiles it. On the software side, the input data will normally be processed through machine learning algorithms or complex lines of code that have been trained in real-world scenarios. It's this machine learning technology that is at the centre of self-driving technology.

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Self-driving cars also use ultrasonic sensors for close-range object detection. Ultrasonic sensors are cost effective and aren't negatively affected by environmental factors. On the other hand, they have low resolution and a very close range. We normally use ultrasonic sensors for emergency brake assistance and to check blind spots.

How do ultrasonic sensors work?

- The ultrasonic sensors send out short ultrasonic impulses which are reflected by obstacles. The echo signals are then received and processed. Within the plastic case of an ultrasonic sensor is the main components, the ultrasonic transducer. It consists of an aluminium pot with diaphragm containing a piezoceramic element).

How do car sensors work?

- Automakers have been known to utilize different sensors for different functions too. Cameras that can read signs and traffic lights, and ultrasonic sensors along the wheels to detect curbs and other ground-based obstacles. The information pulled in from those sensors is then processed and analyzed by the car's computer.

What is sensor fusion & how can it improve self-driving cars?

- Autonomous vehicle developers use novel data-processing techniques like sensor fusion to process information from multiple data sensors simultaneously in real-time. Sensor fusion can improve the ways self-driving cars interpret and respond to environmental variables and can therefore make cars safer.

Figure 2: Functioning of sensor fusion

CHAPTER 3

HARDWARE COMPONENTS

Figure 3: Hardware Components

1. Arduino:

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

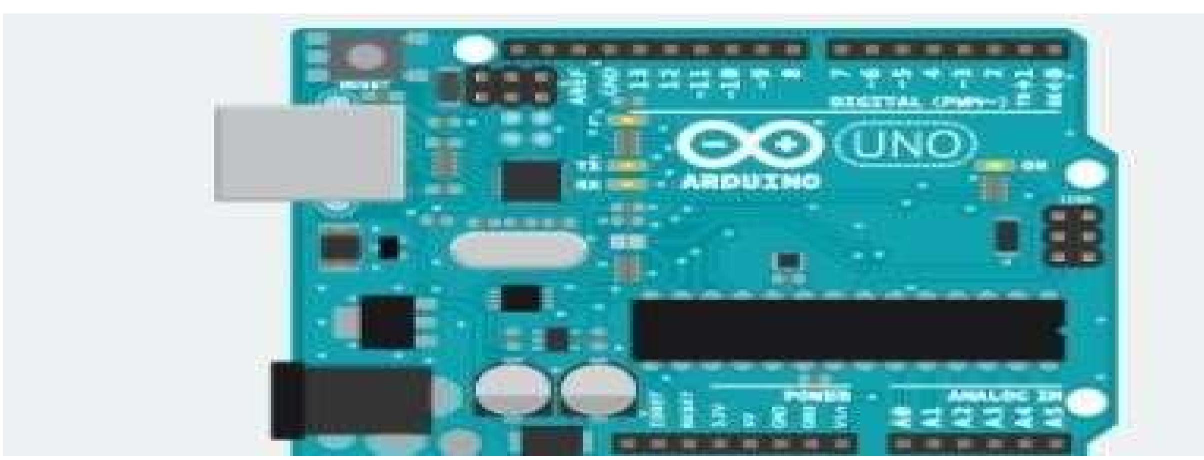

Figure 4: Arduino

2. Motors:

Motors will introduce you to the design of sensors and motors, and to methods that integrate them into embedded systems used in consumer and industrial products. You will gain hands-on experience with the technologies by building systems that take sensor or motor inputs, and then filter and evaluate the resulting data.

Figure 5: Motors

3. Motor Shield:

L293D motor driver shield is a great option to drive several motors using Arduino and used in projects such as four wheeled robots, CNC machines, and printers. The L293D motor driver shield is a popular choice because of its dual H-bridge configuration, compatibility with Arduino, current and voltage handling capabilities, built-in protections, versatility in supporting different motor types, ease of wiring, cost-effectiveness, and its wide application range in various projects.

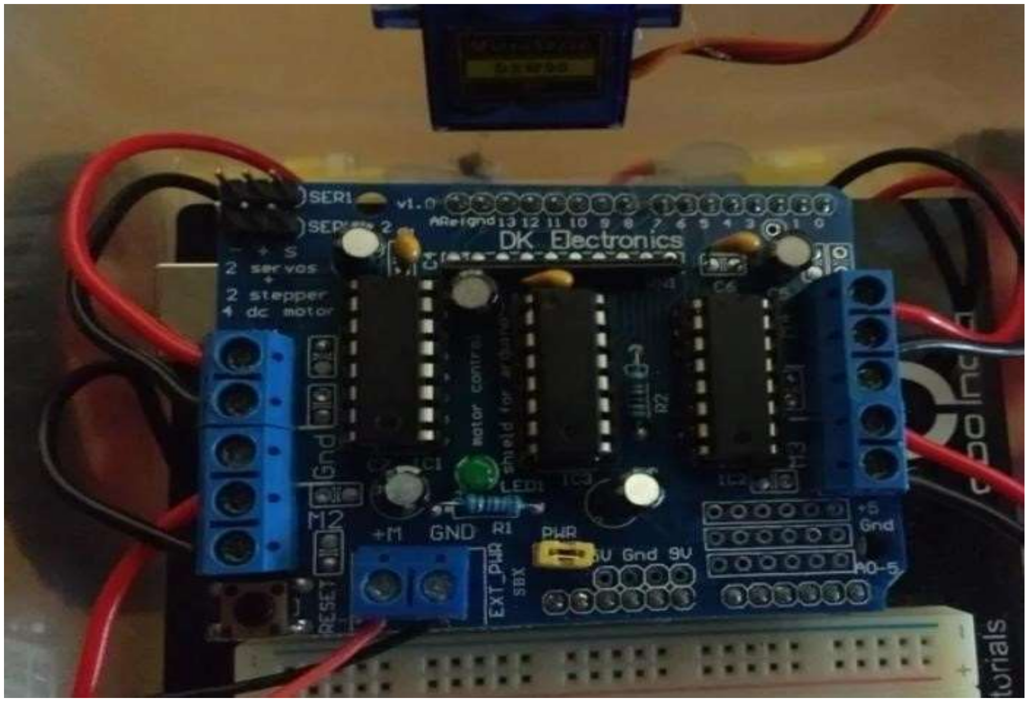

Figure 6: Motor Shield

4. Servo:

A servo motor is defined as an electric motor that allows for precise control of angular or linear position, speed, and torque. It consists of a suitable motor coupled to a sensor for position feedback and a controller that regulates the motor's movement according to a desired setpoint.

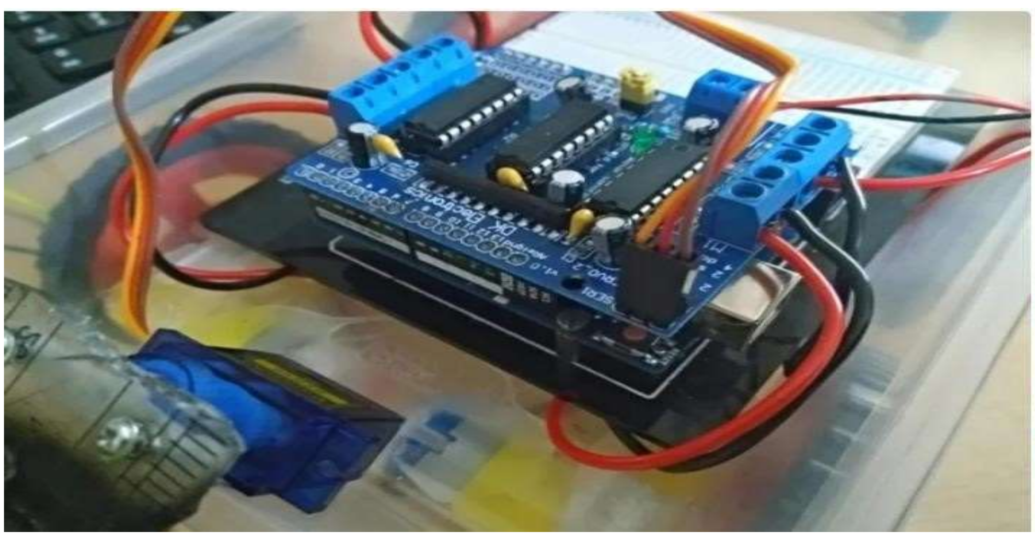

Figure 7: Servo

5. Ultrasonic sensor:

Ultrasonic sensors are in available for the past many decades and these devices continue to hold huge space in the sensing market because of their specifications, affordability, and flexibility. As the automation industry has been progressing, the employment of ultrasonic.

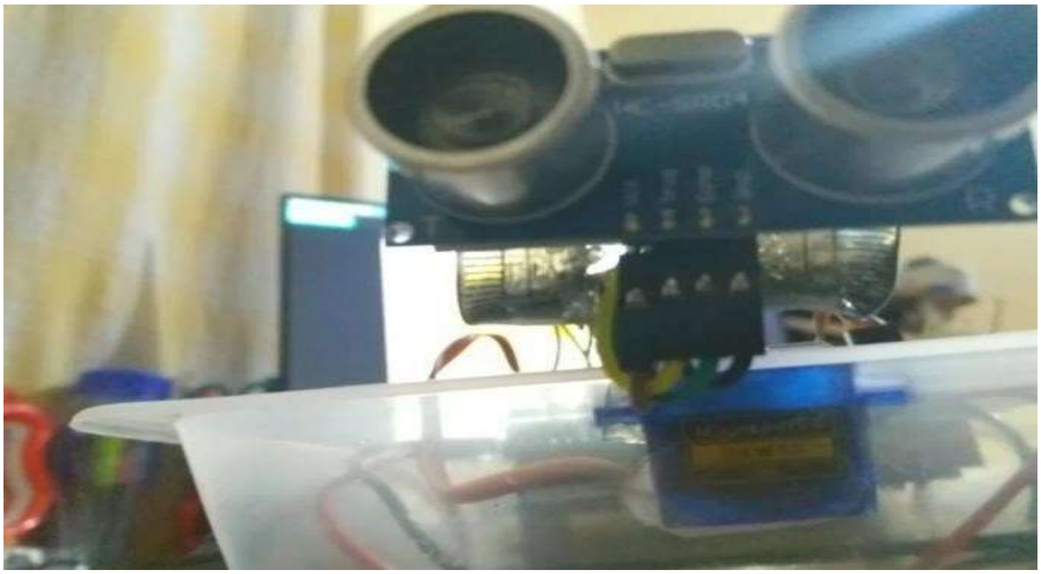

Figure 8: Ultrasonic sensor

6. Batteries:

A **battery** is a source of electric power consisting of one or more electrochemical cells with external connections for powering electrical device.

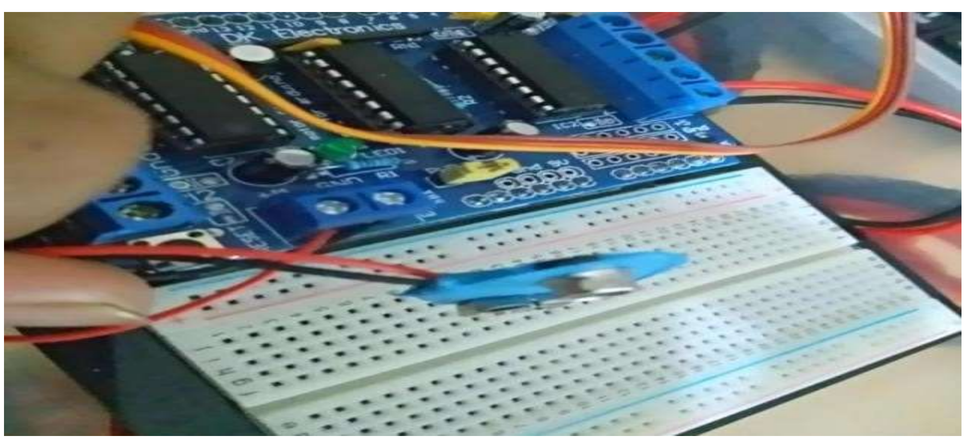

Figure 9: Batteries

CHAPTER 4

PROJECT DETAILS

Ultrasonic self-driving car play a pivotal role in enhancing the safety and efficiency of self-driving cars. These sensors utilize high frequency sound waves to detect objects and measure distances, making them invaluable components of the autonomous vehicle's sensor suite. Here's how ultrasonic sensors contribute to safe and efficient navigation in self-driving cars:

Obstacle Detection: Ultrasonic sensors emit ultrasonic waves, which bounce off objects and return to the sensor. By measuring the time it takes for the waves to return, the sensor can calculate the distance to the object. This information is crucial for identifying and avoiding obstacles, such as other vehicles, pedestrians, or stationary objects, ensuring the car can navigate safely in various environments.

Parking Assistance: Ultrasonic sensors are commonly used for parking assistance systems. They provide real-time feedback to the vehicle's control system, helping the car park accurately and avoid collisions with nearby objects. This simplifies parking, reduces the risk of accidents, and minimizes damage to the vehicle.

Low-Speed Manoeuvres: Ultrasonic sensors excel at detecting objects at close range. They are particularly useful for low speed manoeuvres, such as navigating through tight spaces, performing three-point turns, or avoiding obstacles while driving slowly in congested areas. This capability enhances the vehicle's adaptability in complex urban environments.

Adaptive Cruise Control: Ultrasonic sensors also contribute to adaptive cruise control systems. By constantly monitoring the distance to the vehicle ahead, the car can adjust its speed and maintain a safe following distance. This feature enhances both safety and fuel efficiency on highways, as it reduces unnecessary acceleration and braking.

Cross-Traffic Alert: Ultrasonic sensors are employed in crosstraffic alert systems, which warn drivers of approaching vehicles when they are backing out of parking spaces or driveways. This functionality reduces the likelihood of collisions with vehicles coming from the sides and enhances overall safety.

Redundancy: In self-driving cars, redundancy is crucial for safety. Ultrasonic sensors complement other sensor technologies like LiDAR and radar, providing an additional layer of object detection. This redundancy helps ensure that the vehicle can navigate safely, even in adverse weather conditions or situations where one sensor type may be less required.

CHAPTER 5
RESULT

Self-driving vehicles will also play a central role in the future to advance ride-sharing concepts. The future vision looks like this: One books an autonomous shuttle, it moves through the traffic without a human driver, one boards and is driven to the desired destination. Above all, one benefit is that one does not have to worry about parking the fully autonomous vehicle, as optimal capacity utilization — with as little standstill as possible — means the driverless car can do it for itself. A more efficient disposition significantly reduces the need for parking spaces — urban areas that can then be used in a variety of other ways.

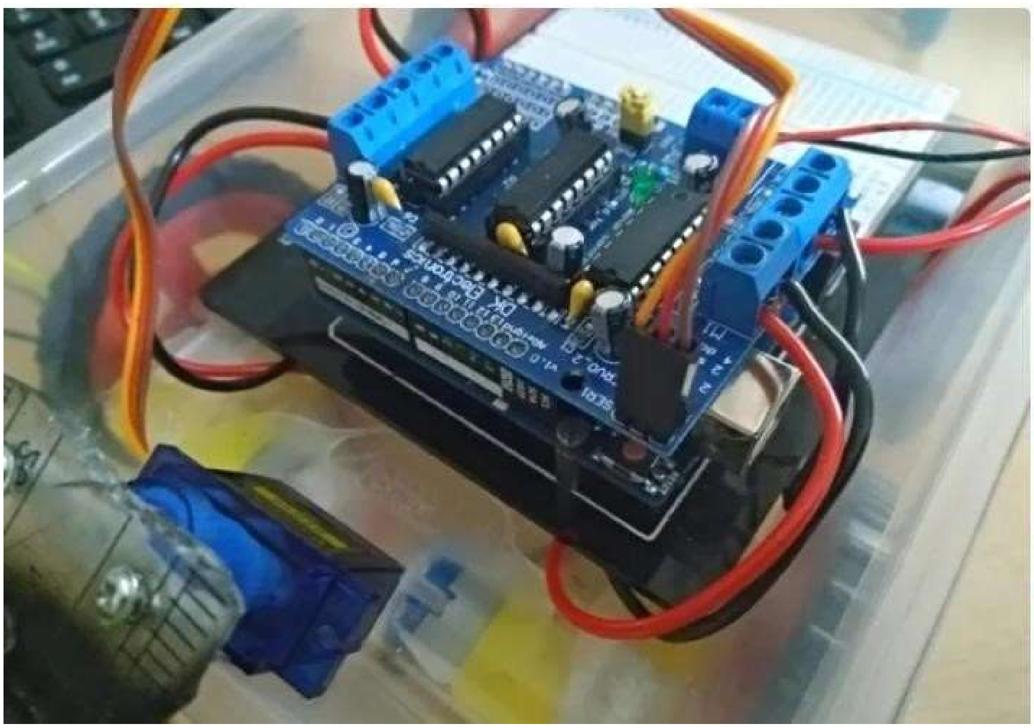

Figure 10: Image of the circuit

Working Picture of project:

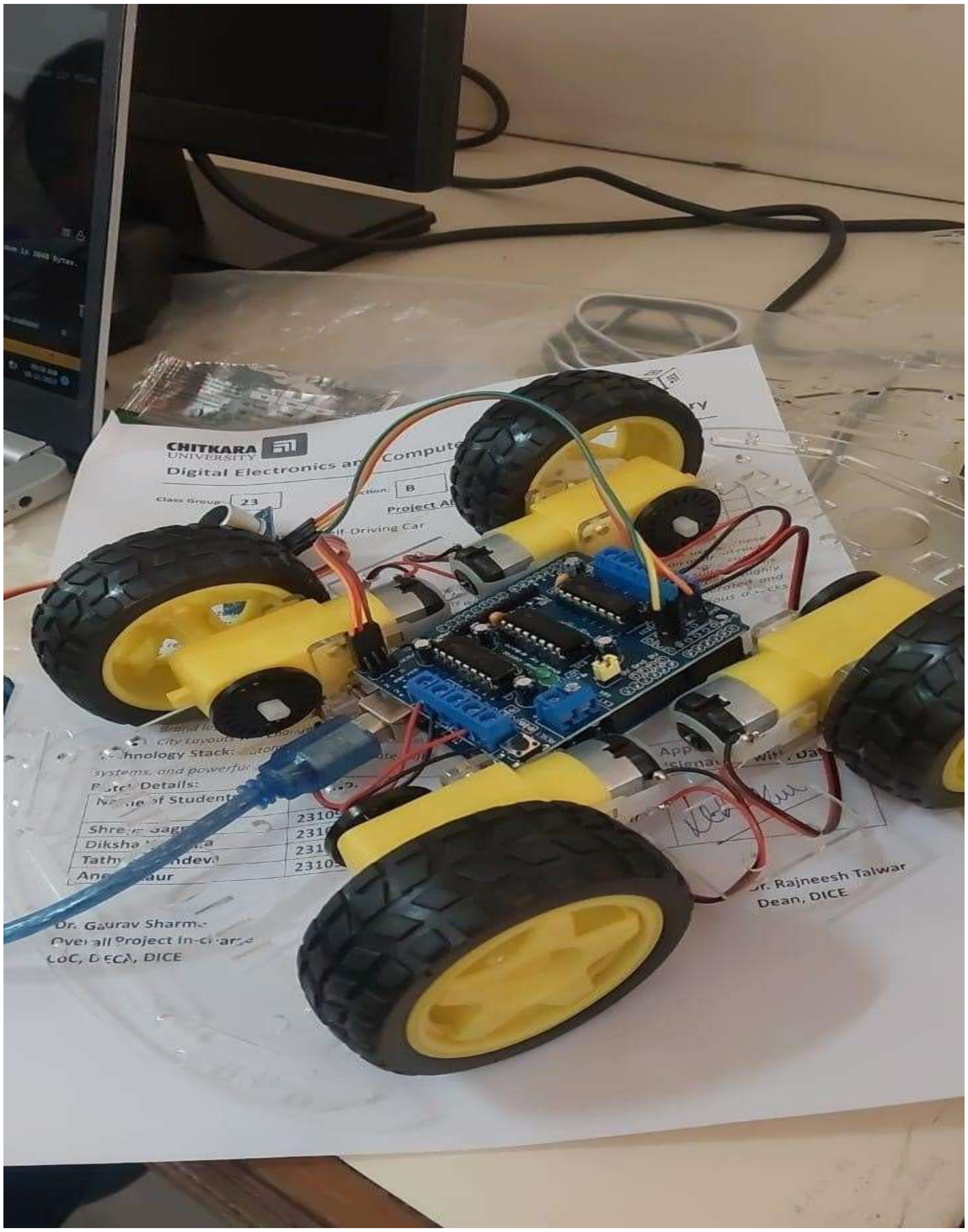

Figure 11: Working picture of the project

REFERENCES:

https://ijarsct.co.in/paper2507.pdf **https://www.youtube.com**

https://arduinogetstarted.com/tutorials/arduino-self-driving-car

www.google.com

APPENDIX A

Source Code of the Project:

```
//ARDUINO OBSTACLE AVOIDING CAR//
// Before uploading the code you have to install the necessary library//
//AFMotor Library https://learn.adafruit.com/adafruit-motor-shield/library-install //
//NewPing Library https://github.com/livetronic/Arduino-NewPing//
//Servo Library https://github.com/arduino-libraries/Servo.git //
// To Install the libraries go to sketch >> Include Library >> Add .ZIP File >> Select the Downloaded ZIP files From
the Above links //


#include <AFMotor.h>
#include <NewPing.h>
#include <Servo.h>

#define TRIG_PIN A0
#define ECHO_PIN A1
#define MAX_DISTANCE 200
#define MAX_SPEED 190 // sets speed of DC  motors
#define MAX_SPEED_OFFSET 20

NewPing sonar(TRIG_PIN, ECHO_PIN, MAX_DISTANCE);

AF_DCMotor motor1(1, MOTOR12_1KHZ);
AF_DCMotor motor2(2, MOTOR12_1KHZ);
AF_DCMotor motor3(3, MOTOR34_1KHZ);
AF_DCMotor motor4(4, MOTOR34_1KHZ);
Servo myservo;

boolean goesForward=false;
int distance = 100;
int speedSet = 0;

void setup() {

  myservo.attach(10);
myservo.write(115);
delay(2000);   distance
= readPing();
delay(100);   distance
= readPing();
delay(100);   distance
= readPing();
delay(100);   distance
= readPing();
delay(100);
}
```

```
void loop() {  int
distanceR = 0;  int
distanceL =  0;
delay(40);

 if(distance<=15)
 {   moveStop();
delay(100);
moveBackward();
delay(300);   moveStop();
delay(200);   distanceR =
lookRight();   delay(200);
distanceL = lookLeft();
  delay(200);

  if(distanceR>=distanceL)
  {
turnRight();
moveStop();
}else   {
turnLeft();
    moveStop();
  }
 }else
 {
  moveForward();
 }  distance =
readPing();
}

int lookRight() {
myservo.write(50);
delay(500);     int distance
= readPing();     delay(100);
myservo.write(115);
return distance;
}

int lookLeft() {
myservo.write(170);
delay(500);     int distance
= readPing();     delay(100);
myservo.write(115);
return distance;
delay(100);
}

int readPing() {
delay(70);
  int cm = sonar.ping_cm();
if(cm==0)
  {
    cm = 250;
```

```
  }
  return cm;
}

void moveStop() {
motor1.run(RELEASE);
motor2.run(RELEASE);
motor3.run(RELEASE);
motor4.run(RELEASE);
  }

void moveForward() {

 if(!goesForward)
  {
    goesForward=true;
motor1.run(FORWARD);
motor2.run(FORWARD);
motor3.run(FORWARD);
motor4.run(FORWARD);
   for (speedSet = 0; speedSet < MAX_SPEED; speedSet +=2) // slowly bring the speed up to avoid loading down
the batteries too quickly
   {
    motor1.setSpeed(speedSet);
motor2.setSpeed(speedSet);
motor3.setSpeed(speedSet);
motor4.setSpeed(speedSet);
    delay(5);
   }
  }
}

void moveBackward() {
goesForward=false;
motor1.run(BACKWARD);
motor2.run(BACKWARD);
motor3.run(BACKWARD);
motor4.run(BACKWARD);
  for (speedSet = 0; speedSet < MAX_SPEED; speedSet +=2) // slowly bring the speed up to avoid loading down
the batteries too quickly
  {
    motor1.setSpeed(speedSet);
motor2.setSpeed(speedSet);
motor3.setSpeed(speedSet);
motor4.setSpeed(speedSet);
delay(5);   }
}

void turnRight() {
motor1.run(FORWARD);
motor2.run(FORWARD);
motor3.run(BACKWARD);
motor4.run(BACKWARD);
delay(500);
```

```
motor1.run(FORWARD);
motor2.run(FORWARD);
motor3.run(FORWARD);
  motor4.run(FORWARD);
}

void turnLeft() {
motor1.run(BACKWARD);
motor2.run(BACKWARD);
motor3.run(FORWARD);
motor4.run(FORWARD);
delay(500);
motor1.run(FORWARD);
motor2.run(FORWARD);
motor3.run(FORWARD);
motor4.run(FORWARD);
}
```