OBSTACLE AVOIDANCE USING ULTRASONIC SENSOR

Submitted to Mother Teresa Women's University, Kodaikanal in partial fulfillment for the award of the degree of

BACHELOR OF SCIENCE IN COMPUTER SCIENCE

MOTHER TERASA WOMEN'S UNIVERSITY, KODAIKANAL

Submitted By

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SRI ADI CHUNCHANAGIRI WOMEN'S COLLEGE

(Accredited by NAAC with 'A' Grade)
(Run by Sri Adi Chunchanagiri Shikshana Trust @ Karnataka)
(Affiliated to Mother Teresa Women's University, Kodiakanal)
(Recognized Under Section 2(f) & 12(B) of UGC Act 1956)

CUMBUM - 625 516

APRIL-2023

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DEPARTMENT OF COMPUTER SCIENCE

BONAFIDE CERTIFICATE

Certified that, this is a bonafide record of the project work done by **Ms.S.MUTHUVAISHALI, (Reg.No:20126ER009)** of final year **B.Sc. Computer Science** during the academic year 2022-2023 in partial fulfillment of the requirements for the award of degree of Bachelor of Science in Computer Science.

INTERNAL GUIDE **HEAD OF THE DEPARTMENT**

Viva-Voce Examination is conducted on _____ at **SRI ADI CHUNCHANAGIRI WOMEN'S COLLEGE, CUMBUM – 625 516.**

INTERNAL EXAMINER **EXTERNAL EXAMINER**

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DEPARTMENT OF COMPUTER SCIENCE

CERTIFICATE

This is to certify that the project report entitled "OBSTACLE AVOIDANCE USING ULTRASONIC SENSOR" is a bonafide record of the major project work done by Ms.**S.MUTHUVAISHALI, (Reg. No. : 20126ER009) of SRI ADI CHUNCHANAGIRI WOMEN'S COLLEGE, CUMBUM – 625516,** as the partial fulfillment of the requirement for the award of **Bachelor of Science in Computer Science** under **MOTHER TERESA WOMEN'S UNIVERSITY, KODAIKANAL.**

HEAD OF THE DEPARTMENT **PRINCIPAL**

ACKNOWLEDGEMENT

First, we sincerely thank the **God Almighty** and our **Parents** without grace nothing might be possible for us.

We sincerely thank the honorable management of President **JAGADGURU POOJIYASRI SRI SRI SRI DR.NIRMALANADHANATHA MAHASWAMIJI** for having given us an opportunity to do this course.

I would like to express my sincere lovable **MY PARENTS** for their constant support and encouragement.

I wish to extend my sincere thanks to our honourable **Founder Secretary Cumbum** Thiru.**N.RAMAKRISHNAN, M.A. M.L.A.,** and honourable **Joint Secretary Mr.R.VASANTHAN, B.A., MBA., Mrs.VAISHNAVI VASANTHAN, M.A., College Coordinator,** and the **Advisory Committee Members** for having permitted me to complete my project successfully.

We sincerely thank our Principal **Dr.G.RENUGA M.Sc., Ph.D.,** for having given us the opportunity to do this project.

We sincerely thank **Mrs.M.BOBBY M.C.A., M.Phil., (Ph.D).,** Head and Assistant Professor, Department of Computer Science, for the motivation and in valuable suggestions given during our project work.

I feel honoured to thank my Guide **Mrs. T.JEYA, M.Sc., MPhil.,** Assistant professor, Department of Computer Science for her constant and positive guidance.

I find no words to thanks **OUR FACULTY MEMBERS** and **MY FRIENDS** who directly and indirectly helped during the project with their valuable suggestions to complete my project successfully. I place my deep sense of gratitude to all of them who encouraged completing this work.

S.MUTHUVAISHALI

INDEX

ABSTRACT

ABSTRACT:

The project is entitled as Obstacle Avoiding Robot using Ultrasonic sensor. Robotics is an interesting and fast-growing field. Being a branch of engineering, the applications of robotics are increasing with the advancement of technology.

The concept of Mobile Robot is fast evolving and the number of mobile robots and their complexities are increasing with different applications. There are many types of mobile robot navigation techniques like path planning, self – localization and map interpreting. An Obstacle Avoiding Robot is a type of autonomous mobile robot that avoids collision with unexpected obstacles.

Obstacle Avoiding Robot is an intelligent device that can automatically sense the obstacle in front of it and avoid them by turning itself in another direction. This design allows the robot to navigate in an unknown environment by avoiding collisions, which is a primary requirement for any autonomous mobile robot. The application of the Obstacle Avoiding robot is not limited and it is used in most of the military organizations now which helps carry out many risky jobs that cannot be done by any soldiers.

This project involves the design and implementation of an intelligent obstacle-avoiding robot car. The objective of this project is to implement a robot car, which while moving should have the ability to detect obstacles in its path and change direction where obstacles are present without any form of external influence. The new direction to be taken to avoid collision is the direction that has the most distance between the obstacle and the sensor and this is determined by the robot based on sensor inputs.

This implementation was done using an ultrasonic wave sensor, which measures distance by sending pulses. Also, the movement of the servo motor (for sensor movement) and the DC motors (for wheel movement) are controlled by the motor driver shield in order to enable the obstacle avoidance function. The commands are sent to the Arduino microcontroller chip which serves as the main control of the robot car, as it controls the sensor and car movement. The implemented robot car was able to successfully detect and avoid obstacles within the line of sight of the Ultrasonic sensor used.

INTRODUCTION

1. INTRODUCTION:

1.1 COMPANY PROFILE:

Date: 1st April 2023

TO WHOMSOEVER IT MAY CONCERN

This is to certify that MS. MUTHUVAISHALI.S (Reg No-20126ER009) doing Final Year BSc (CS) at Sri Adi Chunchanagiri Women's College, Cumbum had undergone a project entitled

OBSTACLE AVOIDANCE USING UTRASONIC SENSOR

Using IOT in our organization for a duration of 3 months between 12th Dec, 2022 and 14th Mar, 2023. We are happy with her contribution towards the successful completion of the project which has been carried out in partial fulfilment of her degree.

We wish her good luck in all her future endeavours.

HABIBUNIISHA SENIOR EXECUTIVE
Tarcin Robotics LLP

TARCIN ROBOTICS LLP,
176,East,6th st,
K.K.nagar,
Madurai

1.2 SCOPE AND OBJECTIVE OF THE PROJECT:

SCOPE

- Work for an extended period of time without intervention from human or a need for power supply.
- Avoid situations that are harmful.
- The designed mobile robot will be able to avoid obstacle perfectly like programmed.
- If the current project is interfaced with a camera robot can be driven beyond line of sight & range become practically unlimited as networks have very large range.
- By adding temperature sensor, water tank and making some change in programming we can use this robot as firefighting robot.

OBJECTIVE

The objective of this project is to design and develop an obstacle avoidance system using an ultrasonic sensor that can detect obstacles in the path of a robot and take corrective action to avoid them.

SYSTEM ANALYSIS

2. SYSTEM ANALYSIS:

2.1 EXISTING SYSTEM:

Some of the existing systems to avoid obstacles is Moving obstacle avoidance of a mobile robot using a single camera. Some of the components involved are the mobile robot and the camera. This report consists of information on how this robot works. This system is designed to avoid collisions between a mobile robot and dynamic obstacles. The authors used the Block-based motion estimation method to avoid collisions of robots. This robot can detect approaching obstacles such as walking humans, but sometimes it did not detect the object due to the colour of the object and the reflected light.

2.2 PROPOSED SYSTEM:

Obstacle Avoiding Robot is an intelligent device that can automatically sense the obstacle in front of it and avoid them by turning itself in another direction. This design allows the robot to navigate in an unknown environment by avoiding collisions, which is a primary requirement for any autonomous mobile robot. The application of the Obstacle Avoiding robot is not limited and it is used in most of the military organizations now which helps carry out many risky jobs that cannot be done by any soldiers.

SYSTEM SPECIFICATION

3. SYSTEM SPECIFICATION:

3.1 HARDWARE SPECIFICATION:

1. Arduino Uno
2. Ultrasonic Sensor
3. L293D Motor Driver
4. DC Motor Wheels
5. Battery
6. Connecting Wires

3.2 SOFTWARE SPECIFICATION:

Arduino IDE

SYSTEM DESIGN

4. SYSTEM DESIGN:

4.1 ARCHITECTURE OF THE PROJECT:

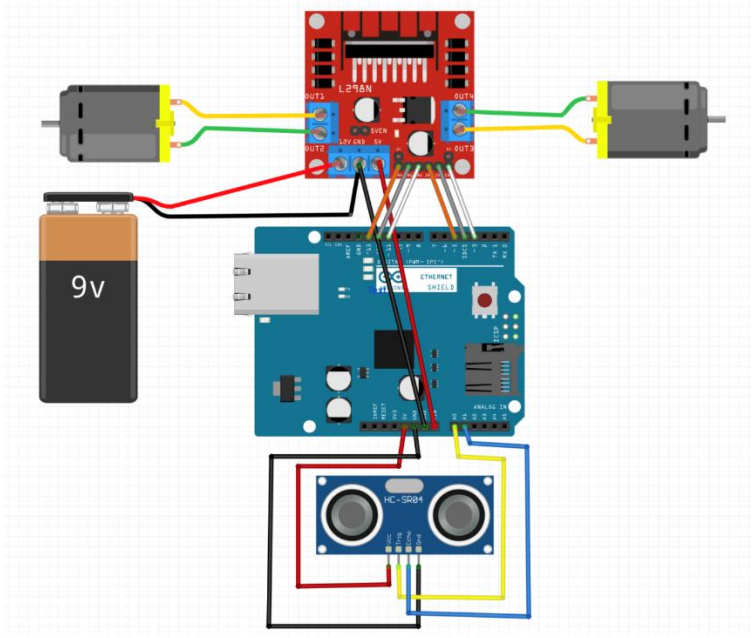


FIG – 4.1.1 CIRCUIT DIAGRAM

❖ The Arduino Platform

There are numerous hardware platforms in use based on which obstacle avoiding robots or in general mobile robots are built. We have selected the Arduino board as the microcontroller platform and its software counterpart to carry out the programming. Arduino is an open-source platform which is an integration of hardware (microcontroller) and software components. The microcontroller can read input in the form of light or sound through a sensor and convert it into an output (e.g., driving a motor) according to the instruction given by the Arduino programming (Arduino, 2015).

The Arduino microcontroller can only be functional with the help of a code. To write this code, Arduino Integrated Development Environment or Arduino Software (IDE) is used which is also open-source like the Arduino Uno board (Arduino, 2015). It is much popular software used by many for its simplicity and the ability to communicate with all Arduino boards. Arduino Software version 1.6.5 is used to write the code in C programming language which is then uploaded to the Arduino microcontroller through an USB cable. The software saves the code in a file with .ino extension. While there are many other microcontroller platforms available, Arduino gained much popularity which attributed to its distinctive features such as

- Economical
- It can run in various platforms like Windows, Linux and Macintosh
- Programming environment is easy to comprehend
- Both software and hardware are open source and can be customized to meet specific needs.

In this project, the Arduino board will take input from ultrasonic sensor, calculate the distance to the obstacle and control rotation of the servo motor as an output response.

❖ Hardware Components and Assembly

The flowchart shows the hardware used to build the robot and explains relationship (input and output) among them.

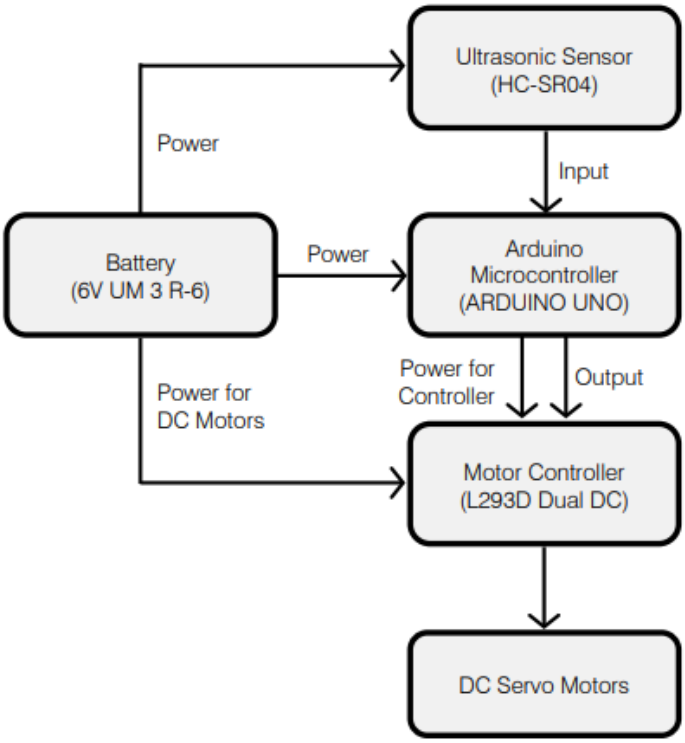


FIG – 4.1.2 ALGORITHM FOR OBSTACLE AVOIDING ROBOT

The hardware was assembled to form the obstacle avoiding robot with the help of a wheels and connecting cables

4.2 HARDWARE DESCRIPTION:

Arduino UNO

The Arduino UNO is a standard board of Arduino. Here UNO means 'one' in Italian. It was named as UNO to label the first release of Arduino Software. It was also the first USB board released by Arduino. It is considered as the powerful board used in various projects.Arduino.cc developed the Arduino UNO board.

Arduino UNO is based on an ATmega328P microcontroller. It is easy to use compared to other boards, such as the Arduino Mega board, etc. The board consists of digital and analog Input/Output pins (I/O), shields, and other circuits.

The Arduino UNO includes 6 analog pin inputs, 14 digital pins, a USB connector, a power jack, and an ICSP (In-Circuit Serial Programming) header. It is programmed based on IDE, which stands for Integrated Development Environment. It can run on both online and offline platforms.

The IDE is common to all available boards of Arduino.

The Arduino board:

FIG – 4.2.1 ARDUINO UNO BOARD

The components of Arduino UNO board:

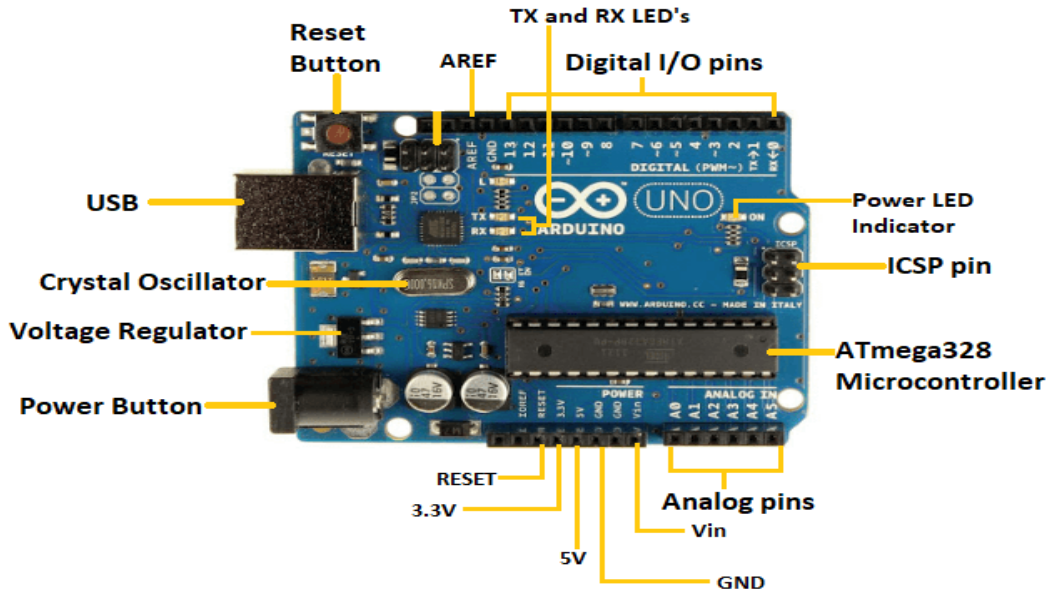


FIG – 4.2.2 COMPONENTS OF ARDUINO UNO BOARD

Each component of Arduino Board in detail:

- **ATmega328 Microcontroller**- It is a single chip Microcontroller of the ATmel family. The processor code inside it is of 8-bit. It combines **Memory (SRAM, EEPROM, and Flash), Analog to Digital Converter, SPI serial ports, I/O lines, registers, timer, external and internal interrupts, and oscillator.**
- **ICSP pin** - The In-Circuit Serial Programming pin allows the user to program using the firmware of the Arduino board.
- **Power LED Indicator**- The ON status of LED shows the power is activated. When the power is OFF, the LED will not light up.
- **Digital I/O pins**- The digital pins have the value HIGH or LOW. The pins numbered from D0 to D13 are digital pins.

- **TX and RX LED's-** The successful flow of data is represented by the lighting of these LED's.
- **AREF-** The Analog Reference (AREF) pin is used to feed a reference voltage to the Arduino UNO board from the external power supply.
- **Reset button**- It is used to add a Reset button to the connection.
- **USB**- It allows the board to connect to the computer. It is essential for the programming of the Arduino UNO board.
- **Crystal Oscillator**- The Crystal oscillator has a frequency of 16MHz, which makes the Arduino UNO a powerful board.
- **Voltage Regulator**- The voltage regulator converts the input voltage to 5V.
- **GND**- Ground pins. The ground pin acts as a pin with zero voltage.
- **Vin**- It is the input voltage.
- **Analog Pins**- The pins numbered from A0 to A5 are analog pins. The function of Analog pins is to read the analog sensor used in the connection. It can also act as GPIO (General Purpose Input Output) pins.

Ultrasonic distance sensor

The Ultrasonic sensor or HC-SRO4 is used to measure the distance of the object using SONAR. It emits the Ultrasound at a frequency of **40KHZ or 40000 Hz**. The frequency travels through the air and strikes the object on its path. The rays bounce back from the object and reach back to the module. The four terminals of HC-SRO4 are VCC, TRIG, ECHO, and GND. The voltage supply or VCC is +5V. We can connect the ECHO and TRIG terminal to any of the digital I/O pin on the specific Arduino board.

The Ultrasonic sensors work best for medium ranges.

The resolution is **0.3cm**.

The medium ranges of the sensor are **10cm** to **3m**. It works best at this duration.

The maximum range the sensor may detect is **4.5m**.

How does Ultrasonic sensor work?

- It sends ultra-high frequency samples.

FIG – 4.2.3

- When samples strike the object, it bounces back from the object.

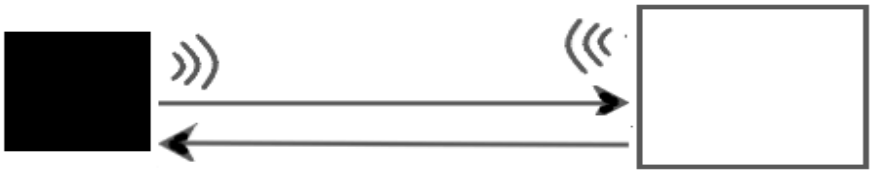


FIG – 4.2.4

- The distance sensor reports the time it takes between the sending and receiving of the samples.

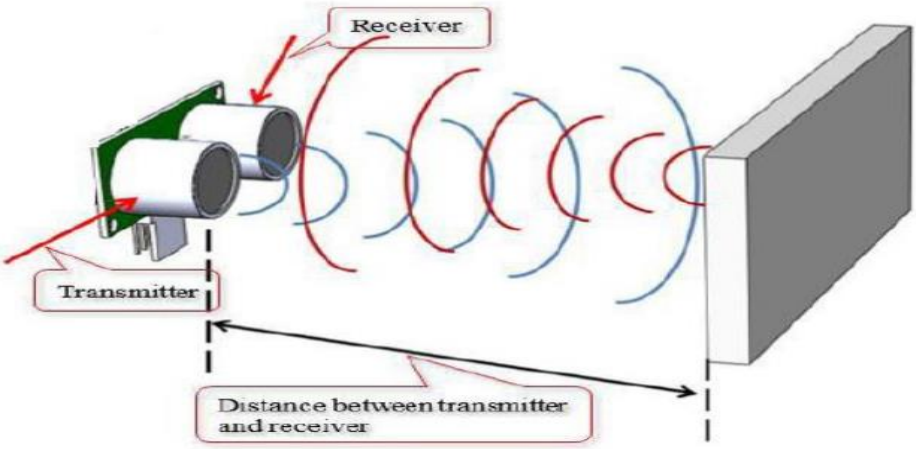


FIG – 4.2.5 WORKING OF ULTRASONIC SENSOR

Structure of Ultrasonic Sensor

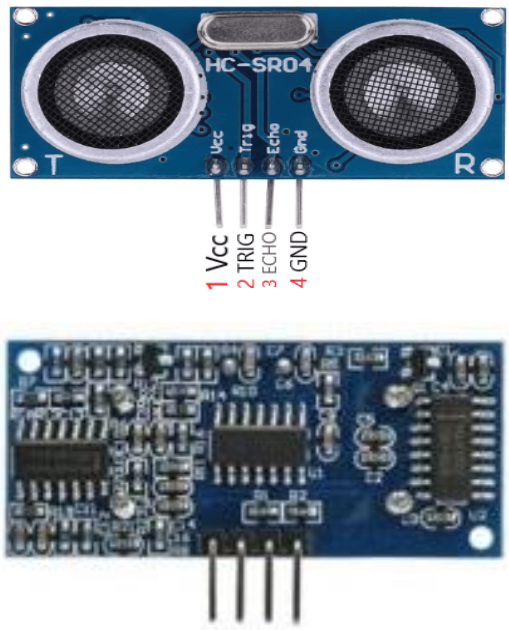


FIG – 4.2.5 STRUCTURE OF ULTRASONIC SENSOR

Ultrasonic Sensor – Features

- Power Supply: +5V DC
- Quiescent Current: <2mA
- Working Current: 15mA
- Effectual Angle: <15°
- Ranging Distance: 2cm-400 cm 1"-13ft
- Resolution: 0.3 c cm
- Measuring Angle: 30 degrees
- Trigger Input Pulse width: 10uS
- Dimension: 45mm x 20mm x 15mm

L293D Motor Driver

L293D is defined as the motor driver IC that permits the DC motor to drive in any direction. It can also simultaneously control two DC motors. It is a 16-pin Integrated Circuit (IC). It receives signals from the microprocessor present on the Arduino board and transmits this signal to the motor. It has two VCC or voltage pins, where one pin draws current for its working and another is used to provide voltage to the DC motor.

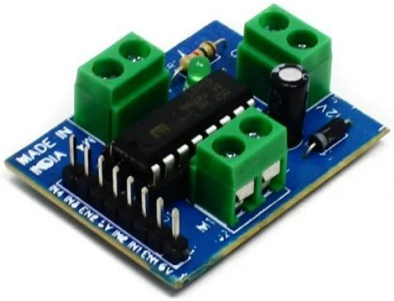


FIG – 4.2.6 L293D Motor Driver

L293D Pinout

The pinout of L293D:

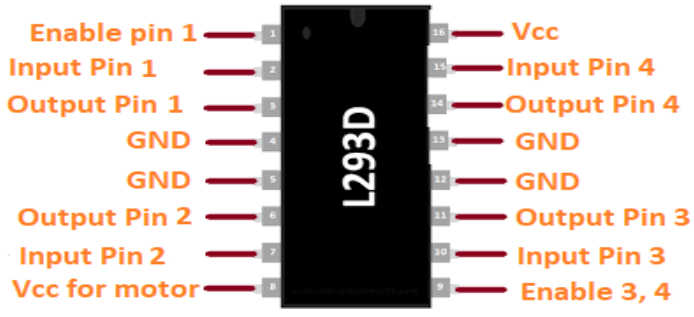


FIG – 4.2.7 PIN DIAGRAM OF L293D

DC motor wheels

The DC motor is considered as the simplest motor, which has various applications ranging from households to industries. Examples include an **electric window in cars, electric vehicles, elevators, etc.**

The principle of the DC motors is based on Electromagnetic Induction. It means that *the rotation of the motor depends on the force generated by the magnetic fields*. It converts electrical energy into mechanical energy. Such motors can be powered from the direct current.

DC motor wheels are a type of wheel that is driven by a DC motor. DC motor wheels are used in many applications, such as robotics, automotive, and aerospace. They are available in a variety of sizes, materials, and torque ratings to meet the needs of different applications. DC motor wheels can be powered by a variety of power sources, including batteries, solar cells, and even direct current from a wall outlet. They provide a simple, efficient, and cost-effective way to move objects and devices. DC motor wheels are commonly used in obstacle avoidance cars. These cars use two DC motor wheels to guide the vehicle around obstacles. The two motors are connected to the car's control system and can be programmed to detect objects and steer the car away from them. This type of wheel is also used in autonomous vehicles, allowing the car to navigate around obstacles without the driver's input.

FIG .4.2.8 - DC MOTOR WHEEL

Battery

The obstacle avoidance car requires the use of a battery for power. Two 3.7V lithium-Ion batteries are used in this car. The battery provides the power to the motor that drives the car, as well as to the sensors that detect obstacles in the car's path. It also powers the components of the car's control system, such as the microcontroller as well as components. The battery must be chosen to provide the necessary power while meeting the necessary requirements of the car's performance, such as weight, size, and battery life.

FIG.4.2.9 - 3.7V LITHIUM-ION BATTERIES.

4.3 SOFTWARE DESCRIPTION:

Arduino IDE

The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as **Windows, Mac OS X, and Linux**. It supports the programming languages C and C++. Here, IDE stands for **Integrated Development Environment**.

The program or code written in the Arduino IDE is often called as sketching. We need to connect the Genuino and Arduino board with the IDE to upload the sketch written in the Arduino IDE software. The sketch is saved with the extension '.ino.'

The Arduino IDE:

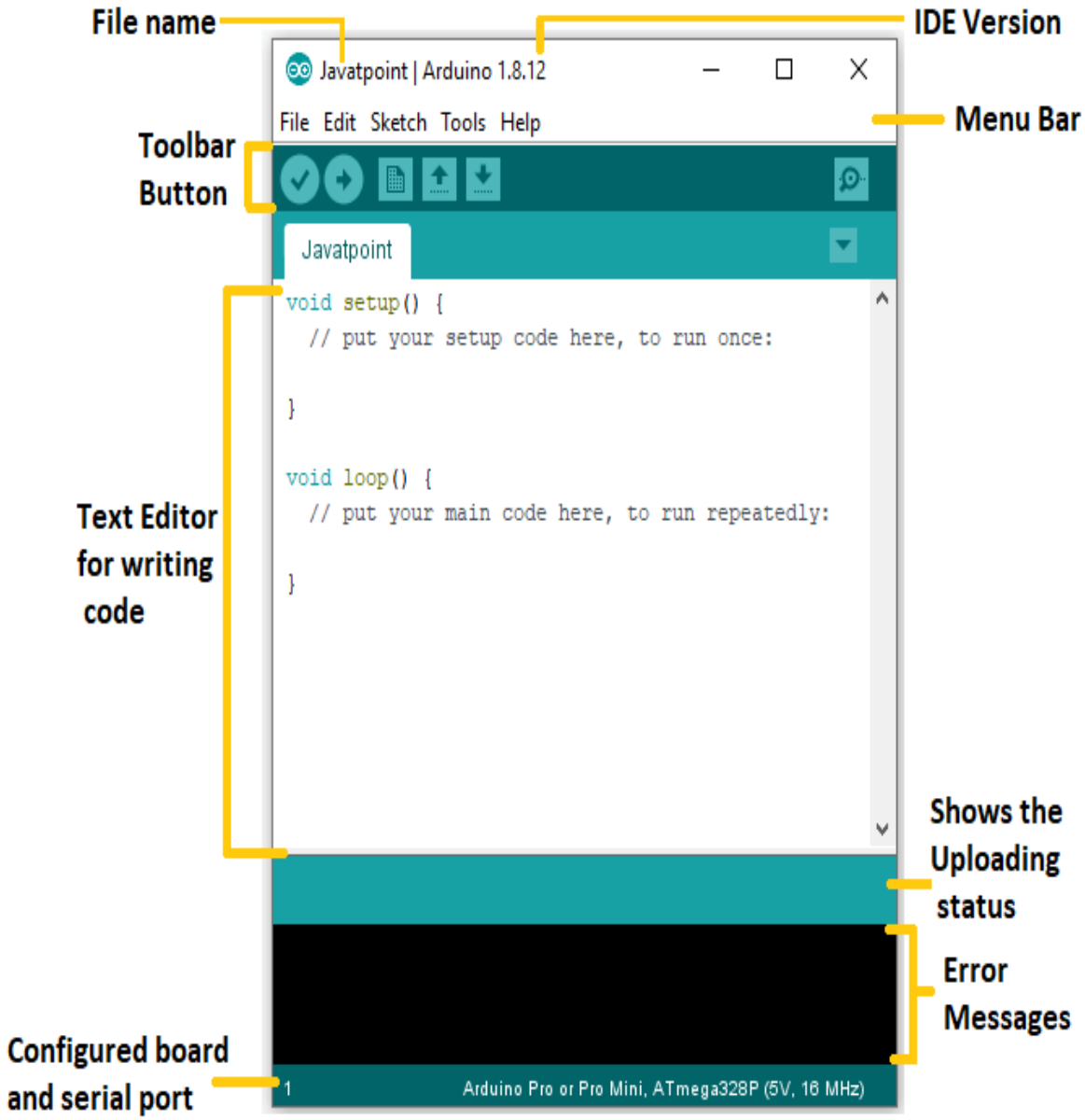


FIG – 4.3.1 ARDUINO IDE

Each section of Arduino IDE in detail.

Toolbar Button

The icons displayed on the toolbar are **New, Open, Save, Upload,** and **Verify**.

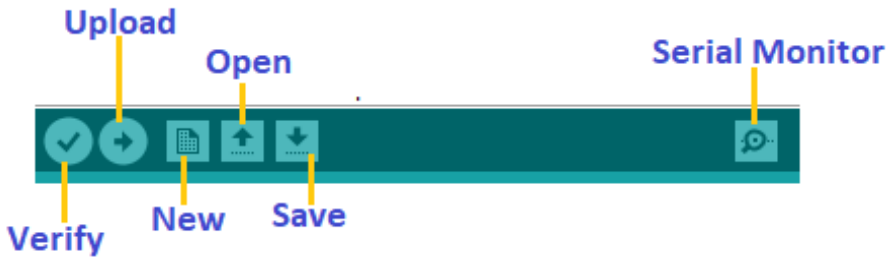


FIG – 4.3.2 ICONS ON TOOLBAR

Upload

The Upload button compiles and runs our code written on the screen. It further uploads the code to the connected board. Before uploading the sketch, we need to make sure that the correct board and ports are selected. We also need a USB connection to connect the board and the computer. Once all the above measures are done, click on the Upload button present on the toolbar.

The latest Arduino boards can be reset automatically before beginning with Upload. In the older boards, we needed to press the Reset button present on it. As soon as the uploading is done successfully, we can notice the blink of the Tx and Rx LED.

If the uploading fails, it will display the message in the error window.

We do not require any additional hardware to upload our sketch using the Arduino Bootloader. A **Bootloader** is defined as a small program, which is loaded in the microcontroller present on the board. The LED will blink on PIN 13.

Open

The Open button is used to open the already created file. The selected file will be opened in the current window.

Save

The save button is used to save the current sketch or code.

New

It is used to create a new sketch or opens a new window.

Verify

The Verify button is used to check the compilation error of the sketch or the written code.

Serial Monitor

The serial monitor button is present on the right corner of the toolbar. It opens the serial monitor.

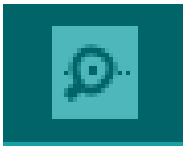


FIG – 4.3.3 SERIAL MONITOR BUTTON

When we connect the serial monitor, the board will reset on the operating system Windows, Linux, and Mac OS X. If we want to process the control characters in our sketch, we need to use an External terminal program. The terminal program should be connected to the COM port, which will be assigned when we connect the board to the computer.

PROJECT DESCRIPTION

5. PROJECT DESCRIPTION:

5.1 OVERVIEW OF PROJECT:

The Obstacle Avoidance System is a device that detects objects in the path of a vehicle or robot and takes corrective action to avoid them. In this project, we will be using an ultrasonic sensor to detect the obstacles and microcontroller to control the movement of the robot. The ultrasonic sensor sends out a sound wave and waits for it to bounce back from the obstacle. Based on the time taken for the wave to bounce back, the distance of the object can be calculated. The microcontroller then processes this data and takes corrective action to avoid the obstacle.

5.2 MODULES DESCRIPTION:

There are 5 modules in obstacle avoidance using ultrasonic sensors:

Ultrasonic Sensor Module: This is the main sensor module that is responsible for detecting obstacles in the car's path. It uses ultrasonic waves to detect the distance of an object in front of the car.

Microcontroller Module: This module controls the sensor module and processes the data received from it. It is responsible for calculating the distance of the obstacle from the car, and if the obstacle is too close, it triggers the car to stop or turn.

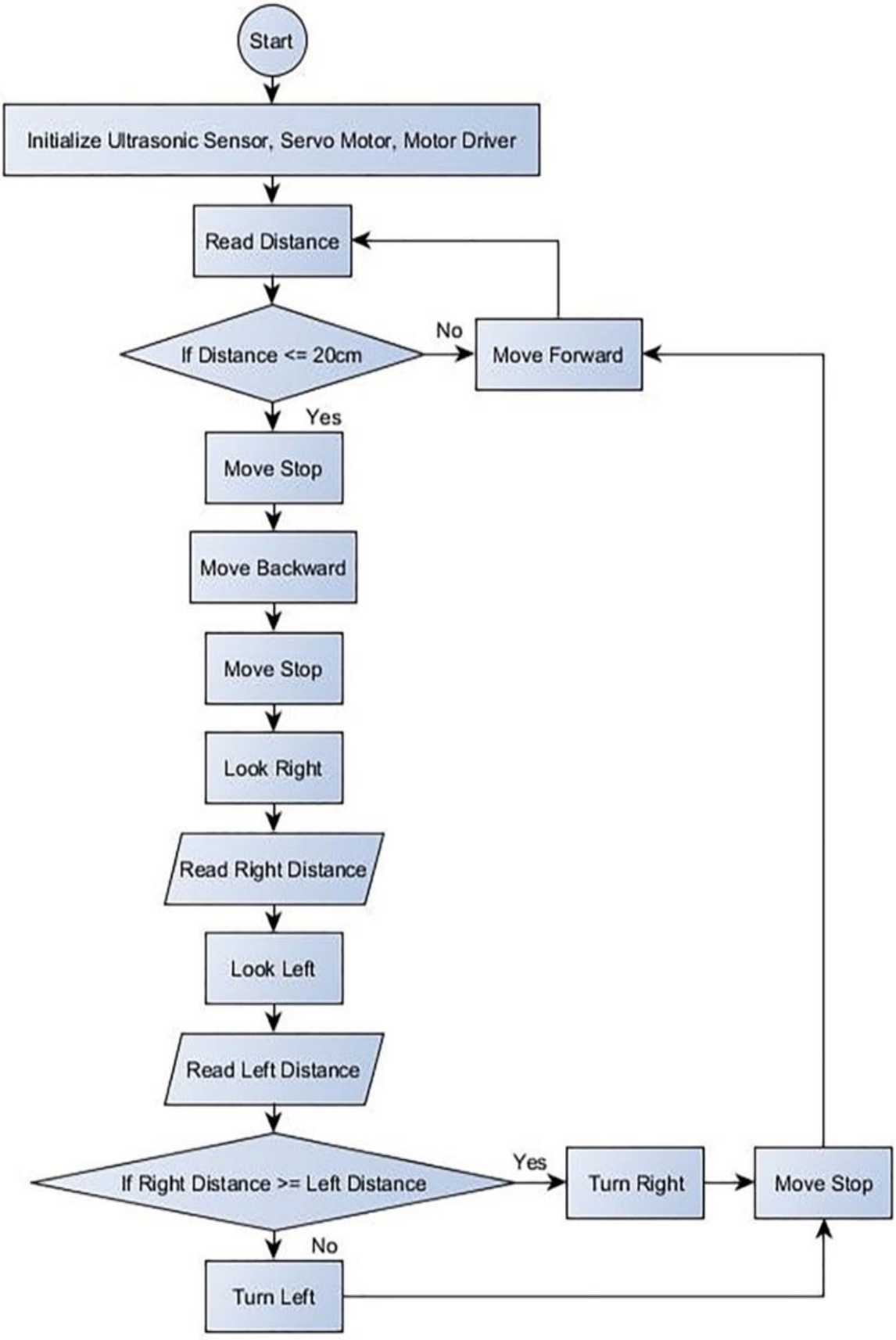
Motor Control Module: This module controls the motors of the car. If the microcontroller module detects an obstacle too close to the car, it sends a signal to this module to stop the car or change its direction.

Power Module: This module provides power to all the other modules in the system. It ensures that the system is powered properly, and all modules are functioning correctly.

User Interface Module: This module provides an interface for the user to interact with the system. It can be a simple LCD screen, LED lights, or a buzzer that indicates when an obstacle is detected.

By breaking down the obstacle avoidance system into these modular components, it becomes easier to design, test, and modify the system. Additionally, it allows for easier maintenance and troubleshooting of the system.

5.3 FLOWCHART:



APPENDIX

6. APPENDIX:

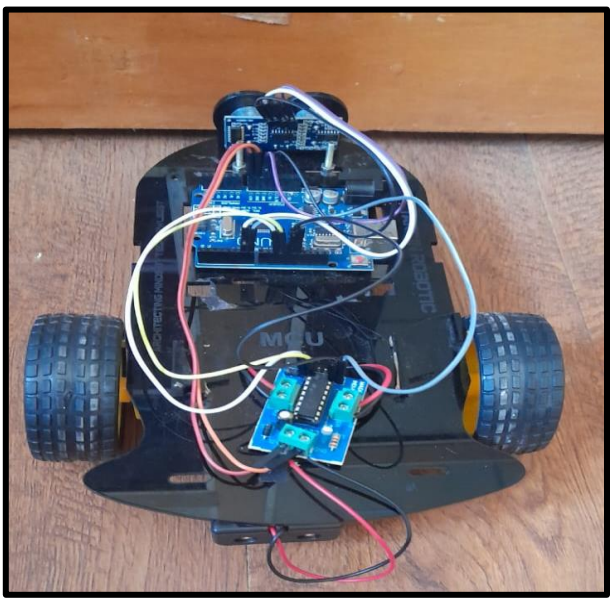
6.1 SOURCE CODE:

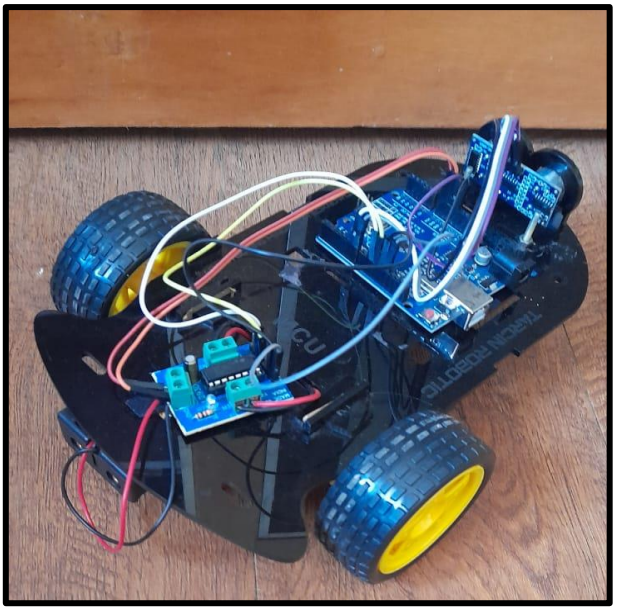
```
define trigPin = 6; // Trig Pin Of HC-SR04
#define echoPin = 7; // Echo Pin Of HC-SR04
#define MLa 8 //left motor 1st pin
#define MLb 9 //left motor 2nd pin
#define MRa 10 //right motor 1st pin
#define MRb 11 //right motor 2nd pin
long duration, distance;
void setup()
{
Serial.begin(9600);
pinMode(MLa, OUTPUT); // Set Motor Pins As O/P
pinMode(MLb, OUTPUT);
pinMode(MRa, OUTPUT);
pinMode(MRb, OUTPUT);
pinMode(trigPin, OUTPUT); // Set Trig Pin As O/P To Transmit Waves
pinMode(echoPin, INPUT); //Set Echo Pin As I/P To Receive Reflected Waves
}
void loop()
{
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH); // Transmit Waves For 10us
delayMicroseconds(10);
duration = pulseIn(echoPin, HIGH); // Receive Reflected Waves
distance = duration / 58.2; // Get Distance
Serial.println(distance);
delay(10);
if (distance > 15) // Condition For Absence Of Obstacle
{
digitalWrite(MRb, HIGH); // Move Forward
digitalWrite(MRa, LOW);
digitalWrite(MLb, HIGH);
digitalWrite(MLa, LOW);
}
if (distance < 10) // Condition For Presence Of Obstacle
{
digitalWrite(MRb, LOW); //Stop
digitalWrite(MRa, LOW);
digitalWrite(MLb, LOW);
digitalWrite(MLa, LOW);
delay(500);
digitalWrite(MRb, LOW); // Move Backward
```

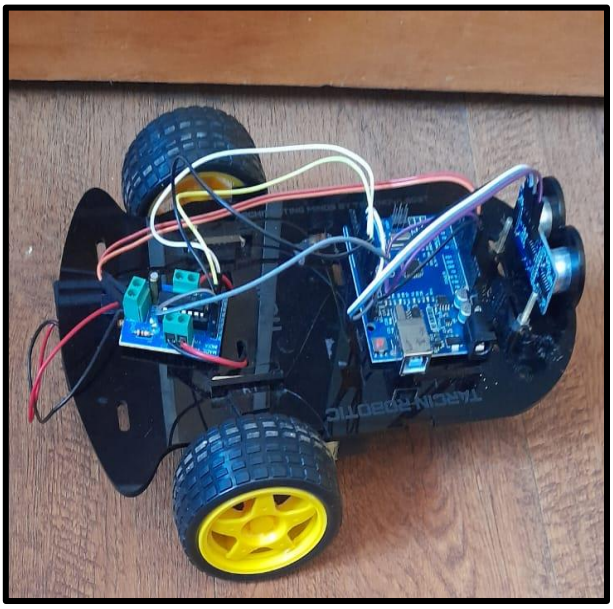
```
digitalWrite(MRa, HIGH);
digitalWrite(MLb, LOW);
digitalWrite(MLa, HIGH);
delay(500);
digitalWrite(MRb, LOW); //Stop
digitalWrite(MRa, LOW);
digitalWrite(MLb, LOW);
digitalWrite(MLa, LOW);
delay(100);

digitalWrite(MRb, HIGH); // Move Left
digitalWrite(MRa, LOW);
digitalWrite(MLa, LOW);
digitalWrite(MLb, LOW);
delay(500);
}
}
```

OUTPUT

7. OUTPUT:







CONCLUSION

8. CONCLUSION:

This project provides an obstacle avoiding car to detect presence of obstruction in a particular path then avoids it. This robot is built on the environment of Arduino to process the information that enables it to exchange information with the robotic vehicle to send parameters for guiding the robot. For object detection, three sensors are used that provide a wider view. The car is completely automatic and later uploading program it doesn't need any human intervention to control its motion. When place in any unfamiliar ecosystem, it will move forward avoiding all obstacle in its path.

FUTURE ENHANCEMENT

9. FUTURE ENHANCEMENT:

This model was a very basic one, saving both time and money, and clearly demonstrates the idea we had. For better and more accurate results, preferable three ultrasonic sensors can be used for a wider field of view, to cover a greater region. Alternatively, an ultrasonic sensor on a rotating servo motor can also be used to sweep through a larger coverage area.

Also, otherwise it can be fitted with camera modules and AI can be implemented so that it can be used in real life applications, like on roads, judging other vehicles speed, pot holes, speed breakers, traffic light signals and even change lanes, which is same as the technology used in currently some of the most advanced autonomous driving cars made by tech giants.

Further for military uses, it can be fixed with a GSM Module or a Radio Module and be provided with a manual control, for even better maneuvers. We can conclude that this project of ours has a vast scope in future applications.

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