A

PROJECT REPORT

on

"Arduino Obstacle Avoiding + Voice Control + Bluetooth Control Robot"

Submitted by

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Under the guidance of

Mrs. K.P. Wagh Ma'am

in partial fulfilment for the award of the degree of

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in

ELECTRONICS AND TELECOMMUNICATION ENGINEERING

SAVITRIBAI PHULE PUNE UNIVERSITY

DEPARTMENT OF

ELECTRONICS AND TELECOMMUNICATION ENGINEERING

JSPM NARHE TECHNICAL CAMPUS, PUNE - 411041

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Jayawant Shikshan Prasark Mandal's

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CERTIFICATE

This is to certify that a Project Report on

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is a bonafide work carried out by them during the academic year 2023-2024 in partial fulfilment of the requirement for the award of Degree of Bachelor of Engineering in Electronics and Telecommunication Engineering under Savitribai Phule Pune University, Pune.

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Place: Pune

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We would like to thank our parents for standing behind us all the time and we thank our friends for their advice, guidance and help.

ABSTRACT

This project was developed in a way that the robot controlled by voice commands. An android application with a microcontroller is used for required tasks. The connection between the android app and the vehicle is facilitated with Bluetooth technology. The robot is controlled by buttons on the application or by spoken commands of the user. The movement of the robot is facilitated by the two dc servo motors connected with microcontroller at the receiver side. The commands from the application are converted in to digital signals by the Bluetooth RF transmitter for an appropriate range (about 100 meters) to the robot. At the receiver end the data gets decoded by the receiver and is fed to the microcontroller which drives the DC motors for the necessary work. The aim of Voice Controlled Robotic Vehicle is to perform the required task by listening to the commands of the user. A prior preparatory session is needed for the smooth operation the robot by the user. For the same a code is used for giving instruction to the controller.

Keywords: Robot, Design, Fabrication, Sensor, Automation

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INTRODUCTION

The combination of major fields such as mechanical, electrical and electronics provides automation systems which are known as Robots. Robots are developed for a myriad of reasons, primarily to automate tasks that are repetitive, dangerous, or beyond human capabilities. In industries, they enhance efficiency, precision, and productivity, reducing labour costs and improving quality. Advancements in artificial intelligence and robotics continue to expand their applications, promising a future where they'll play increasingly integral roles in various aspects of our lives.

1) **Obstacle Detection**

Obstacle avoidance Robot is designed in order to navigate the robot in unknown environment by avoiding collisions. Obstacle avoiding robot senses obstacles in the path, avoid it and resumes its running. A more general and commonly employed method for obstacle avoidance is based on edge detection. Overall, obstacle avoidance robots play a crucial role in various fields by offering a safe, efficient, and sometimes life-saving solution for navigation and exploration tasks. To achieve the obstacle avoidance in the system we are using an Ultrasonic distance sensor which is connected to the L298D motor shield followed by Arduino UNO. This sensor is used to detect any object at some certain distance using sonar. This non-contact ultrasound sonar is used to measure the distance between the object and the sensor. It consists of two transmitters, a control circuit and a receiver for emitting and receiving pulse data respectively. A high ultrasonic sound is emitted by transmitters which will get reflected by any nearby object and the sensor will see toward to get any return echo. Once sensors detect obstacles, the robot's control system processes this information and generates commands to navigate around them.

2) **Speech Recognition:**

The ability of the machine to receive and interpret the human voice or to understand and carry out spoken commands can be concluded as speech recognition. Speech recognition in robots operates through a series of steps: First, the robot's microphone captures spoken words. Then, the audio undergoes preprocessing to enhance clarity and reduce noise. Finally, the recognized speech is output as text or commands. Advanced techniques, including deep learning, improve accuracy and adaptability to different speakers and environments, driving ongoing advancements in robot speech recognition. It works on the basis of algorithms codes that match the sound of the detected speech or voice with word sequences and interpret it as a command in Arduino IDE which is a coding platform for Arduino UNO. With the help of these we can command around our system as per the desired needs.

PROBLEM STATEMENT:

1) The present automobiles are not suitable for handicapped and old age people.
2) This use of sensors will provide greater safety from sudden hits due to auto braking and slow down feature.
3) Prevention from hazardous and fatal situations.
4) Automatic braking and Bluetooth module controller will make the process handy and easy to detect and to provide judgments for the vehicle.

OBJECTIVES OF PROJECT:

1). Autonomous Navigation: Create a robot car capable of navigating autonomously through indoor environments while intelligently avoiding obstacles in its path.

2). Remote Control Capability: Implement a Bluetooth communication module to enable remote control of the robot car from a mobile device, providing users with flexibility and convenience in interacting with the robot.

3). Intuitive User Interface: Integrate voice control functionality to allow users to interact with the robot car using natural language commands, enhancing user experience and making the robot more accessible to a wide range of users.

4). Robust Obstacle Detection: Develop and implement robust obstacle detection algorithms using ultrasonic sensors to ensure reliable detection and avoidance of obstacles in real-time, thereby enhancing the safety and efficiency of the robot's navigation.

5). Educational and Experimental Platform: Serve as an educational tool and experimental platform for learning about robotics, sensor integration, wireless communication, and voice recognition technologies.

By achieving these objectives, the project aims to demonstrate the capabilities of robotic systems in autonomous navigation, remote control, and human-robot interaction while providing a platform for experimentation and learning in robotics and related fields.

LITERATURE SURVEY

The literature reviewed showcases the advancements and potential applications of multifunctional Arduino robot cars equipped with obstacle detection sensors, Bluetooth modules, and voice control interfaces. These technologies enable autonomous navigation, remote control, and intuitive human-robot interaction, paving the way for various real-world applications in robotics, education, and research. Overall, the reviewed studies provide valuable insights and methodologies for the design, implementation, and optimization of multifunctional Arduino robot cars. The essential focus of this research is speech recognition technology by converting speech into the text message. Controlling hardware utilizing speech was impractical before. This examination will help us in actualizing this innovation for the debilitated ones who can't drive the vehicle all alone. A Bluetooth module is utilized to set up a correspondence connection between the vehicle and human voice orders using the Android Application. The robot intelligently detects the obstacle that is in its path and navigates and moves around as given in the code. So, this system provides an alternate way to the existing system to replace a skilled labour with robotic machinery which can handle more complex tasks in less time increasing the accuracy with less cost with economic growth. With combination of Bluetooth module and motor driver shield we can control this by our android phone app.

METHODOLOGY

Speech Recognition is a technology which permits the procedure of a speech input to text and is speaker independent. This permits it to be used in numerous applications differing from digital assistants to controlling machinery. This paper put forward strategies which can be used in managing a robotic vehicle through connected speech input. The speech recognizer platform is going to be an Android smartphone which communicates with the car using Bluetooth Connectivity. This method permits for systematic recognition and effortless data transfer. Additionally, the car will also have the potential to detect obstacles and notify the user to use a different command. Obstacle avoidance robots are designed to navigate through environments autonomously while avoiding obstacles in their path. Our proposed technique will be functional for applications such as assistive robots for people with disabilities or in industrial applications such as work robots.

CIRCUIT DIAGRAM OF THE ROBOT CAR:

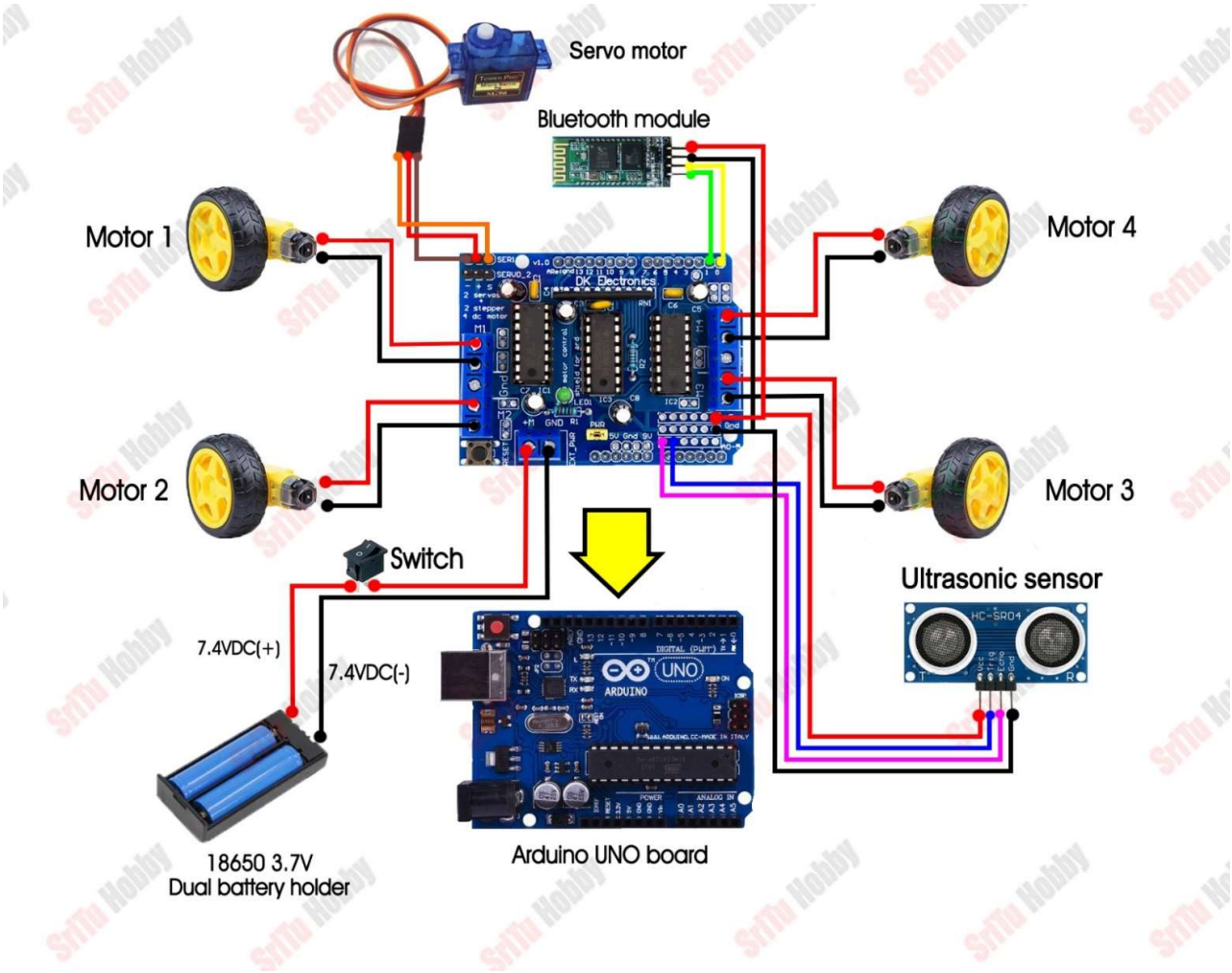

FIG. 01 CIRCUIT DIAGRAM

Flowchart Of the Working Model:

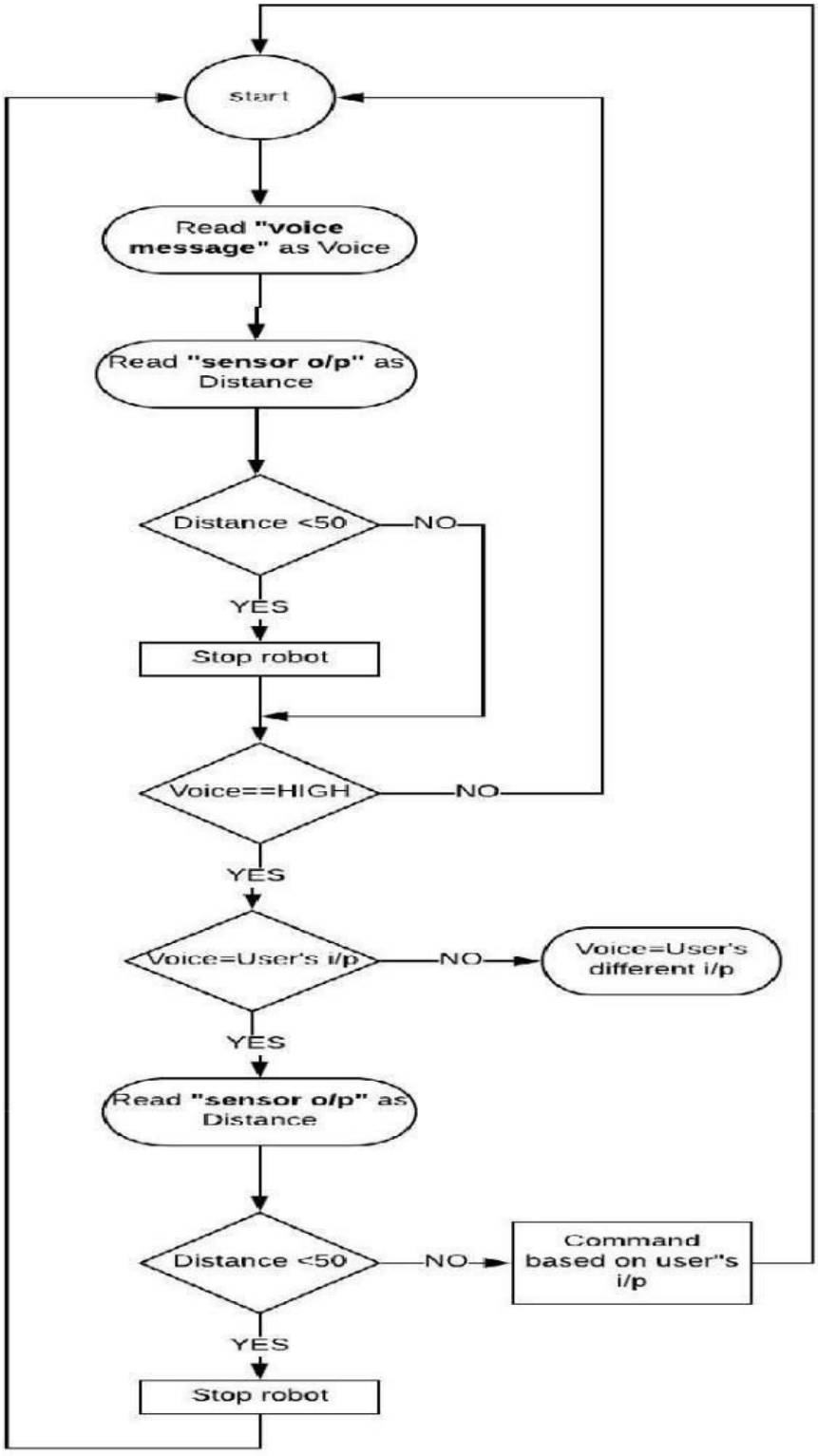

FIG. 02 FLOWCHART

SOFTWARE IMPLEMENTATION

1) Arduino IDE:

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them. 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++. 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 will appear as:

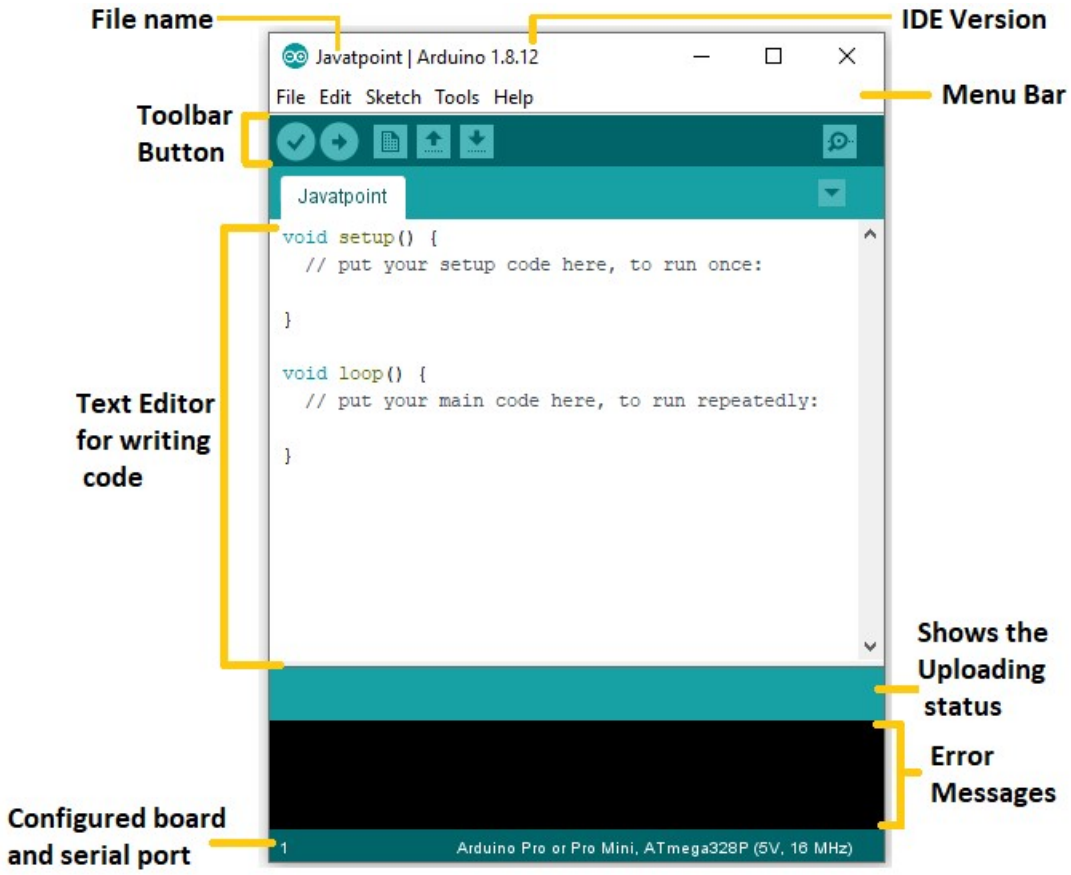

FIG. 03 HOMEPAGE OF ARDUINO IDE

Arduino Integrated Development Environment - or Arduino Software (IDE) - consists of a text editor, code message, text console, toolbar with standard function keys, and a series of menus. Programs written using Arduino Software Integrated Development Environment platform are called sketches (codes). These sketches are written in a text editor and are saved. The message area provides feedback while saving and sending and also displays errors. The console displays the text output, including complete error coding and other information text. It is designed to introduce programming techniques to artists and other young people who are unfamiliar with software development. It includes a code editor with features such as syntax highlighting and automatic steering and provides an easy one-click way to integrate and load programs on the Arduino board.

HARDWARE IMPLEMENTATION

1) ARDUINO UNO:

The Arduino Uno is an open-source microcontroller board and developed by Arduino.cc. The board is given sets of digital and analog I/O pins which may be interfaced to varied expansion shield and other circuit's boards. The board has 14 digital input/output pins during which six capable of PWM output and programmable with the Arduino IDE (Integrated Development Environment), via USB type B cable. This microcontroller is often powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. The motor driver board is mounted on the Arduino UNO. Then, the program is uploaded to Arduino UNO via data cable needed. Arduino UNO is basically cheap, easy to use and acquire less space so as that each one the components are often placed on the chassis of car.

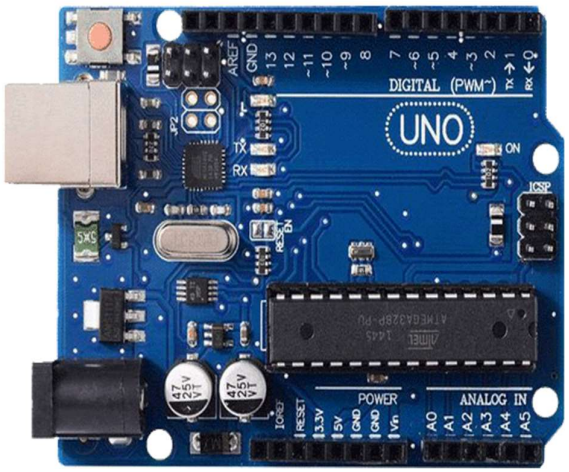

FIG.04 ARDUINO UNO

2) L293D MOTOR DRIVER:

The Motor driver is a module that permits you to use Arduino to regulate the working speed and direction of the motor. The Motor driver is often powered by Arduino directly or by an external 6V~15V power supply via the Terminal input.

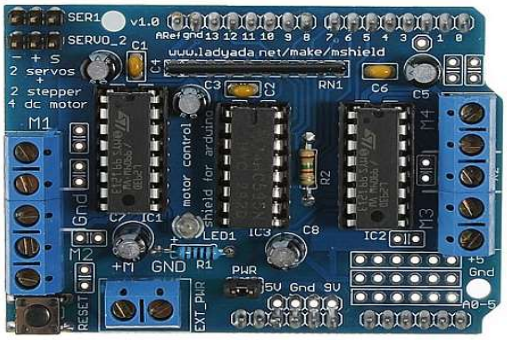

FIG.05 L293D MOTOR DRIVER

The DC motor drives in both forward and reverse direction with the assistance of L293D. Two H-bridges are located in L293D circuit. In L293D, pin 2, 7 are input pins which is found within the left side of the L293D and pin 15, 10 also are input pins which are located in the right side of L293D.

It designed to drive inductive loads like relays, solenoids, DC motors and stepping motors. It allows you to drive two DC motors alongside your Arduino board, controlling the speed and direction of each one independently. You can also measure the motor current absorption of every motor, among other features.

3) ULTRASONIC SENSORS:

The purpose of this part is to save the driver and vehicle from different type of hurdles. To achieve this, ultrasonic sensor is employed within the front side of the vehicle. Ultrasonic sensor which emits ultrasonic waves having a frequency over 20KHZ which is beyond the human hearing. Ultrasonic sensor has transmitter and receiver part. Distance from which the location of the obstacle is additionally detected. The piezoelectric material convert's electrical energy into sound waves (mechanical energy). The piezoelectric material will generate Ultrasonic waves for detecting the obstacle.

FIG. 06 ULTRASONIC SENSOR

4) BLUETOOTH MODULE:

The Bluetooth technology manages the communication of the wireless part. The Bluetooth modules can transmit and receives the info wirelessly by using two devices. The Bluetooth module can receive and transmits the data from a more than two system with the help of the host controller. Bluetooth module makes connection with the microcontroller using serial communication method. HC-05 Bluetooth module operates on the premise of master and slave mode because it is Employed for either transmitting or receiving the info. It is a short-range device of around 10 meters which provides both sound and data transmission. The Bluetooth transmits and receives at a waveband of 2.4 GHz.

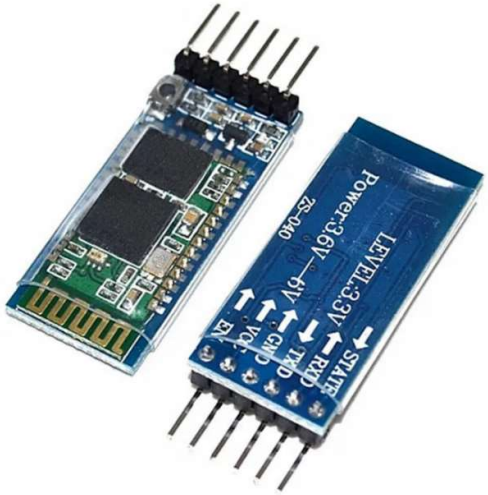

FIG.07 BLUETOOTH MODULE

5) SERVO MOTOR:

A servomotor is a gyrating actuator that permits for accurate control of angular or linear position, velocity and acceleration. It consists of an appropriate motor coupled to a sensor for position feedback. We use servo motor for movement of ultrasonic sensor. It allows the sensor detect obstacles in left and right also.

FIG. 08 SERVO MOTOR

6) GEAR MOTOR:

The TT Micro DC geared motor with encoder. It is a motor with a 120:1 gearbox and an integrated quantization encoder that provides a resolution of 16 pulse single per round giving a maximum output of 1920 within one round. With an Arduino Uno microcontroller and motor driver, applications for this include a closed-loop PID control or PWM motor speed control. We have used 1 motor per wheel for out project.

FIG.09 GEAR MOTOR AND WHEELS

7) LI-ION BATTERY:

The 18650 cell has voltage of 3.7v and has between 1800mAh and 3500mAh (milliamp-hours). 18650s may have a voltage range between 2.5 volts and 4.2 volts, or a charging voltage of 4.2 volts, but the nominal voltage of a typical 18650 is 3.7 volts

FIG.10 LI-ION BATTERY

SYSTEM IMPLEMENTATION

The Primary goal of this project has been to develop a functional prototype of an autonomous Robot Car that demonstrates basic capabilities such as obstacle avoidance, remote control via Bluetooth, and response to voice commands while serve as an educational tool for learning about robotics, electronics, programming, and sensor integration.
Exploration and experimentation have been a core intention to explore the capabilities of Arduino-based robotics platforms and experiment with different sensors, communication modules, and control strategies. encourage participants to innovate and come up with unique solutions or applications for the robot car.

SOFTWARE ARCHITECTURE OVERVIEW:

1. Sensor Data Processing:
 - The ultrasonic sensor (HC-SR04) is used to measure distances. The `ultrasonic()` function triggers the sensor and calculates the distance based on the returned pulse width.
 - The `Obstacle()` function processes the distance readings and decides the robot's movement based on obstacle detection.
2. Motor Control:
 - Motor control commands are generated by functions like `forward()`, `backward()`, `left()`, `right()`, and `Stop()`.
 - These functions utilize the `AFMotor` library to control the DC motors connected to the Arduino motor driver shield.
3. Bluetooth Communication:
 - The `Bluetoothcontrol()` function reads commands from a Bluetooth serial connection and translates them into motor control commands.
 - It listens for specific characters ('F' for forward, 'B' for backward, etc.) and calls corresponding motor control functions.
4. Voice Command Recognition:
 - The `voicecontrol()` function listens for commands received via serial communication.
 - It interprets specific characters ('^' for forward, '-' for backward, '<' for left, '>' for right, '*' for stop) and executes corresponding actions.

Structure of the Arduino Code:

1)Setup Function (`setup()`):
 - Initializes serial communication, pin modes for ultrasonic sensor (Echo and Trig pins), and servo motor.
 - Sets the initial speed for all DC motors.
2) Main Loop Function (`loop()`):
 - Contains commented-out function calls for obstacle avoidance (`Obstacle()`), Bluetooth control (`Bluetoothcontrol()`), and voice control (`voicecontrol()`).
3)Bluetooth Control Function (`Bluetoothcontrol()`):
 - Reads incoming Bluetooth commands and executes corresponding motor control actions.
4)Obstacle Avoidance Function (`Obstacle()`):
 - Uses ultrasonic sensor readings to detect obstacles.
 - Executes appropriate maneuvers to avoid obstacles based on sensor data.
5)Voice Control Function (`voicecontrol()`):
 - Reads incoming voice commands via serial communication and executes corresponding motor control actions.

6)Motor Control Functions (`forward()`, `backward()`, `left()`, `right()`, `Stop()`):
- Utilize the `AFMotor` library to control DC motors connected to the motor driver shield.

7)Ultrasonic Sensor Reading Function (`ultrasonic()`):
- Triggers the ultrasonic sensor to measure distances and calculates the distance based on the returned pulse width.

8)Servo Control Functions (`leftsee()`, `rightsee()`):
- Adjusts the position of the servo motor to enable side-scanning for obstacle detection.

BLUETOOTH REMOTE CONTROL: A MOBILE APPLICATION

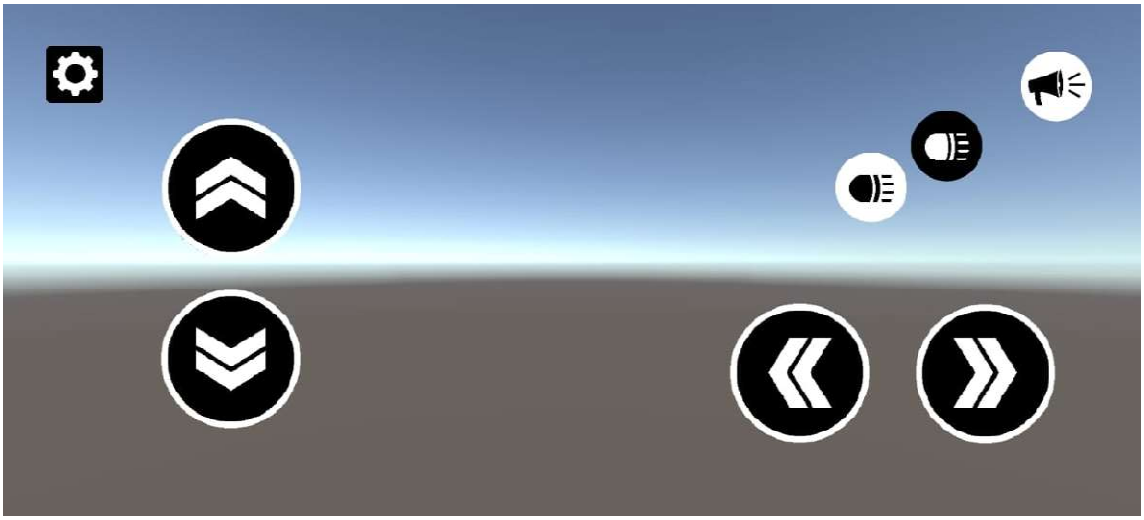

FIG. 11 BLUETOOTH REMOTE CONTROL: A MOBILE APPLICATION

The Bluetooth module receives control signals from the smartphone app and forwards them to the Arduino. Motor Drivers: Control the speed and direction of the motors that drive the wheels. They receive signals from the Arduino and convert them into power levels for the motors.

ARDUINO BLUEETOOTH CONTROL: MOBILE APPLICATION

Arduino Bluetooth Control is an application that allows you to control your arduino board (and similar boards) via Bluetooth, and so to create awesome and fully customized projects, with the new features. The settings section allows you to adapt the application to your needs, through a very simple and intuitive interface. The application also smartly remembers your bluetooth module and tries to connect automatically to the latest one you have used, so you won't have to select it every time you use it.

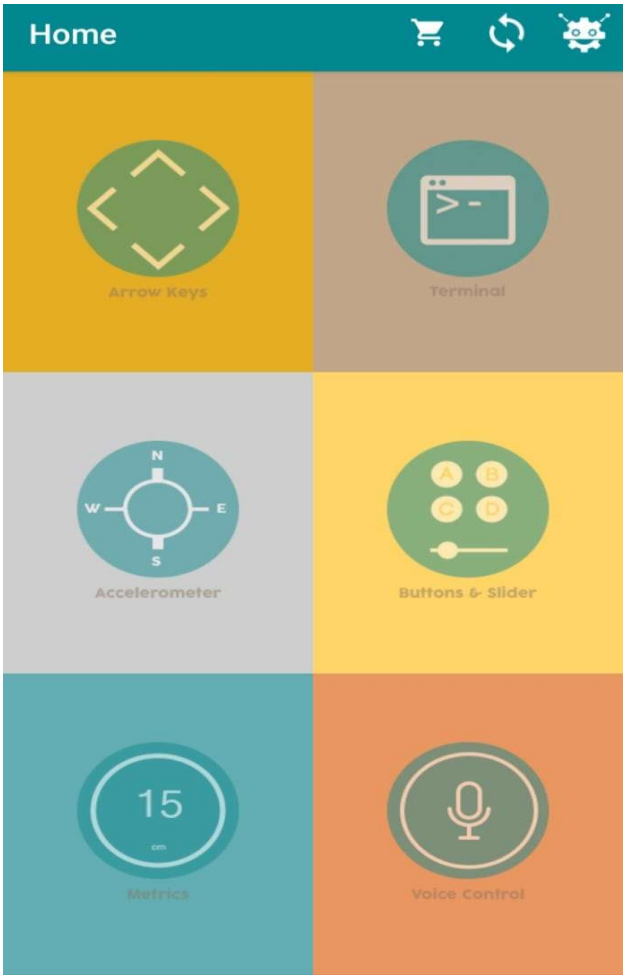

FIG 12 ARDUINO BLUEETOOTH CONTROL: MOBILE APPLICATION

RESULTS

Therefore, our voice-controlled obstacle-avoiding car prevents the car from collisions and is aware of its surroundings. It also finds obstacles and makes movements according to the user voice command. Our car is accurate because the Bluetooth module is used for communication and works best between short ranges as the robot can travel in two seconds when input is provided. We have used an ultrasonic sensor helping the car to avoid collision. Voice command is used for detection advanced communication with the car using the android app. Therefore, a good performance is available for this project.

ADVANTAGES AND LIMITATIONS

Advantages:

1. Versatility: The project demonstrates a versatile platform capable of various functionalities, including obstacle avoidance, remote control via Bluetooth, and voice command recognition. This versatility makes it suitable for a wide range of applications.
2. Educational Value: The project serves as an excellent educational tool for learning about robotics, electronics, programming, and sensor integration. It provides hands-on experience with Arduino and allows for experimentation and exploration.
3. Accessibility: With the integration of Bluetooth and voice command capabilities, the robot becomes more accessible and user-friendly. Users can control the robot remotely using a smartphone or issue commands using voice inputs, making it suitable for individuals with limited mobility.
4. Scalability: The project can be expanded and modified to add new features, sensors, or functionalities. This scalability allows for continuous improvement and customization according to specific requirements or preferences.
5. Practical Applications: The robot car has practical applications in areas such as education, hobby robotics, home automation, and prototyping. It can be used for tasks like surveillance, exploration, or assistance in various environments.

Limitations:

1. Sensing Range: The ultrasonic sensor used for obstacle detection has a limited sensing range and may not detect obstacles beyond a certain distance accurately. This limitation can affect the robot's ability to navigate effectively in open spaces or detect distant obstacles.
2. Accuracy and Reliability: The accuracy and reliability of the sensor readings, especially in dynamic or unpredictable environments, may vary. Factors such as environmental conditions, sensor calibration, and interference can affect the performance of the obstacle avoidance system.
3. Complexity: Implementing Bluetooth communication and voice command recognition adds complexity to the project, requiring additional hardware components and software integration. This complexity may pose challenges for beginners or individuals with limited technical expertise.
4. Cost: The cost of the required hardware components, including the Arduino board, motor driver, sensors, and communication modules, can add up, making the project relatively expensive compared to simpler robotics projects.

CONCLUSION:

- We are able to say that Voice controlled cars can certainly dominate the longer-term marketplace for many industrial and domestic purposes associated with automating daily tasks.
- It may require several tests but the car works quiet well with very less errors in recognizing voice commands.
- Little modifications within the android application may end up during a far more clarity in voice recognition.
- Power Optimization algorithms can be used.
- Best for handicapped people that can believe this car as there's very less chance of accident. Once the car identifies an obstacle it will stop instantly by slowing down.
- This Internet of Things product gives a totally new direction to automobile.
- As an application it is often used for military purposes where the commands are often given to car with none risk of accelerating the range and that we can install small camera on the robot-car to get enemy view.
- Also, can be used for Home Security purpose with installed cameras.
- Use of AI alongside voice commands will take this research to a replacement dimension.

FUTURE SCOPE:

The project of an Arduino robot car equipped with an ultrasonic sensor, Bluetooth module, and voice command capability offers a wide range of future scope and potential applications. Here are some possibilities:

1. Enhanced Navigation: Implementing advanced algorithms for obstacle avoidance based on data from the ultrasonic sensor can improve the robot's ability to navigate complex environments autonomously.
2. Integration with IoT: Connecting the robot to the Internet of Things (IoT) opens up opportunities for remote control and monitoring. For example, you could control the robot from a smartphone app or receive real-time sensor data from the robot over the internet.
3.Machine Learning Integration: Introducing machine learning techniques can enhance the robot's capabilities, such as recognizing objects or patterns in its environment, improving navigation, or optimizing its behaviour based on past experiences.
4.Human-Robot Interaction: Expanding the voice command capabilities can lead to more intuitive human-robot interaction. Integrating natural language processing (NLP) algorithms can allow the robot to understand and respond to more complex commands and queries.
5.Education and Research: The project can be used as an educational tool for teaching robotics, programming, and electronics. It can also serve as a platform for research in fields like autonomous navigation, human-robot interaction, or machine learning.
6.Commercial Applications: The technology developed in this project could be adapted for various commercial applications, such as delivery robots, security robots, or robotic assistants in retail or hospitality settings.

Overall, the Arduino robot car project with ultrasonic sensor, Bluetooth module, and voice command capability has a promising future scope with numerous possibilities for further development and application in various domains.

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