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Voice Control Robot – Design & Development for Various Domestic Applications

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Abstract

Creating a voice-controlled humanoid robot is a sophisticated undertaking that involves multiple components working together seamlessly. At its core, this project entails building a physical humanoid robot with advanced hardware and software capabilities. The hardware aspect involves designing and constructing the robot itself. This typically includes installing servos, sensors, microphones, and speakers. These components enable the robot to move, perceive its environment, hear spoken commands, and respond with speech. The abstract of the project "*Voice-Controlled Bluetooth-Controlled Obstacle-Avoiding Robot*" describes a robotic system that can be controlled both through voice commands and Bluetooth communication. The robot is equipped with obstacle detection capabilities, allowing it to navigate and avoid obstacles in its path. The voice control aspect enables users to provide commands to the robot using spoken instructions, while the Bluetooth control feature enables remote operation through a smartphone or other Bluetooth-enabled device. This project combines voice recognition technology, wireless communication, and obstacle avoidance algorithms to create a versatile and interactive robotic platform. Developing a voice-controlled humanoid robot is a multidisciplinary endeavour that combines robotics, artificial intelligence, and human-computer interaction. It has numerous applications, from assisting people with tasks to providing information and entertainment. This field continues to evolve with ongoing research and technological advancements.

Introduction

In the world of robotics, creating an intelligent and versatile robot can be an exciting challenge. In this project, we combine the power of Arduino, a popular microcontroller platform, with three fascinating functionalities - Obstacle Avoidance, Voice Control, and Bluetooth Control, to build a highly interactive and autonomous robot [1].

Obstacle Avoidance : The first key feature of our Arduino robot is its ability to navigate autonomously while avoiding obstacles in its path [2].

Voice Control : The second exciting feature of our robot is its voice control capability. By integrating a voice recognition module or leveraging the power of machine learning algorithms, the robot can understand and respond to voice commands [2].

Bluetooth Control : The third major functionality of our Arduino robot is its ability to be remotely controlled via Bluetooth. By connecting the robot to a smartphone or computer using Bluetooth technology, users can send commands wirelessly. A voice-controlled humanoid robot is a robotic system designed to interact with humans using spoken language commands. It typically consists of a humanoid body equipped with various sensors, actuators, and a speech recognition system. Users communicate with the robot by speaking commands, which are processed by the speech recognition software. The robot then interprets the commands and executes corresponding actions through its mechanical movements [3].

These robots often integrate artificial intelligence to understand and respond to natural language inputs, enabling them to perform tasks such as fetching objects, providing information, or even engaging in conversations. Voice-controlled humanoid robots have applications in areas like customer service, entertainment, healthcare, and assistance for people with disabilities. They combine advanced robotics, speech recognition, and AI technologies to create interactive and engaging experiences [5].

Literary Survey

Title : " Design and Development of Obstacle Avoiding Robot Using Arduino". Authors : Pankaj Kumar Singh, Ashish Kr. Luhach, and Ravi Prakash Singh Published in: International Journal of Science and Research (IJSR), Volume 4, Issue 5, May 2015.This paper presents the design and development of an obstacle-avoiding robot using Arduino . It discusses the hardware components, obstacle detection, and avoidance algorithms implemented in the robot. Few disadvantages of this project is Limited Sensing Range, Slow Response Time, Complex Environment, Complexity In Design, Limited Terrain Adaptability.

Title: "Bluetooth-Controlled Robot Using Android Mobile Phone "Authors: Saurabh Kumar and Vaibhav Chauhan. Published in: International Journal of Scientific & Engineering Research (IJSER), Volume 4, Issue 8, August 2013. This paper presents a Bluetooth-controlled robot that can be operated using an Android mobile phone. The communication between the phone and robot is established via Bluetooth. Few disadvantages of this project are Latency, Limited Range, Signal Interference, Compatibility, Security.

Scopes & Objectives

Voice Control: The primary outcome of the robot is its ability to be controlled using voice commands. Users can give verbal instructions to the robot, such as "move forward," "turn left," "stop," etc. Bluetooth Connectivity: By using Bluetooth, the robot can be controlled wirelessly from a smartphone, tablet, or computer. Bluetooth communication allows for greater mobility and flexibility in controlling the robot from a distance [7].

Obstacle Avoidance: The robot's obstacle-avoidance feature enables it to navigate autonomously [6].

There has been a great demand for contactless services since Covid-19, thus, this robot serves as a great tool for contactless services, minimising the risk of transmission of diseases. In case a person is unable to be present physically or there is lack of labour, this robot is immensely useful in such situation as it can be operated from remote location & it fulfills the following objectives:

- To complete a task by listening to the user's commands
- Allow robot to navigate in unknown environment by avoiding collisions
- To design machines that can help and assist humans
- The robot designed to operate safely and robustly in various environments

Components

Fig. 1 : Arduino board

Here, we describe the various parts used in the project work.

Arduino Board

Microcontroller: Arduino boards are equipped with microcontrollers, which are small computing units that execute programs you upload to the board.

I/O Pins: These boards have a variety of input/output (I/O) pins, which allow you to connect sensors, actuators, and other components. These pins can be used to read inputs (like button presses) or control outputs (like LED lights).

Programming: Arduino boards are programmed using the Arduino Integrated Development Environment (IDE). The IDE makes it easy to write, compile, and upload code to the board.

Motor Driver

The L293D is a popular motor driver IC (integrated circuit) commonly used to control DC motors and stepper motors. Here's some information about the L293D motor driver as

Fig. 2 : Motor driver circuitry

Function: The L293D is designed to provide bidirectional control for up to two DC motors or one stepper motor. It can handle the current and voltage requirements necessary for driving small to medium-sized motors.

H-Bridge Configuration: The L293D uses an H-bridge configuration to control the direction of rotation and speed of the connected motors. It consists of four sets of switches that allow current to flow in either direction through the motor.

Pin Configuration: The L293D typically comes in a 16-pin package. It has input pins for controlling motor direction (enable, input 1, input 2) and output pins for connecting to the motor terminals.

Gear Motors

Gear motors are a type of electric motor combined with a gearbox, designed to provide controlled movement with increased torque. Here are some key points about gear motors:

Fig. 3 : Geared motors

Torque and Speed: Gear motors are used when you need to trade-off between speed and torque. They provide higher torque at lower speeds compared to regular motors, making them suitable for applications that require more power.

Ultrasonic Sensor

An ultrasonic sensor is a device that uses sound waves of frequencies higher than the upper audible limit of human hearing to measure distance or detect objects. Here are some key points about ultrasonic sensors:

Fig. 4 : Ultrasonic sensors

Working Principle: Ultrasonic sensors work on the principle of echolocation. They emit ultrasonic waves (sound waves beyond the range of human hearing) and measure the time it takes for the waves to bounce back after hitting an object. By calculating the time delay, the sensor can determine the distance to the object.

Servo Motor

A micro servo motor is a small, compact motor designed for precise control of angular movement. Here are some key points about micro servo motors:

Fig. 5 : Servo motor used for the project work

Function: A micro servo motor is a type of rotary actuator that can rotate within a specific range of angles. It's commonly used for controlling things like the movement of robot arms, remote control vehicles, miniature aircraft control surfaces, and other similar applications.

Control: Micro servo motors are typically controlled using PWM (Pulse Width Modulation) signals. The width of the pulses determines the angle of rotation of the motor shaft.

Bluetooth Module

The HC-05 is a popular Bluetooth module that allows wireless communication between devices using the Bluetooth protocol. Here are some key points about the HC-05 Bluetooth module:

Fig. 6 : Bluetooth module

Function: The HC-05 Bluetooth module facilitates wireless communication between devices, enabling data transmission, control signals, and more over short distances.

Communication Range: The HC-05 module typically has a range of a few meters to around 10 meters, depending on the environmental conditions and any obstacles between the devices.

Proposed Working Methodology

The proposed system will be designed based on microcontroller which is connected to smart android phone through Bluetooth module for receiving voice command. The voice command is converted to text by an app of the android phone and sends necessary data to the microcontroller for controlling robot movement. After receiving the data the robot responses according to the command by performing proper movement to the proper direction according to the voice command. The obstacle-avoiding voice-controlled Bluetooth robot presents an exciting and interactive platform that combines obstacle avoidance, voice control, and wireless communication.

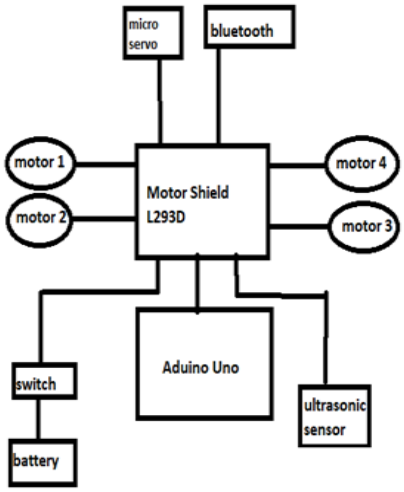

Fig. 7 : Overall block diagram of the proposed system

The Steps for Flow of Method

Step 1: Gather Required Components: Ensure you have all the necessary hardware components for the project.

Step 2: Assemble the Robot: Assemble the robot's chassis and mount the motors and wheels securely. Connect the ultrasonic sensor to the front of the robot, facing forward. Connect the motor driver module to the motors and the Arduino board. Connect the Bluetooth module to the Arduino board as well.

Step 3: Write the Arduino Code with the Arduino sketch that will control the robot. Design the motor control logic to enable the robot to move forward, backward, turn left, and turn right based on the received commands.

Step 4: Integrate the Functionality: Combine the obstacle avoidance, voice control, and Bluetooth control functions into a coherent program. Use conditional statements to prioritize the control modes (e.g., voice control over Bluetooth control). Implement mechanisms to switch between control modes.

Step 5: Test and Debug .Upload the code to your Arduino board and test the robot. Make sure the obstacle avoidance works as expected, and the robot responds correctly to both voice and Bluetooth commands. Debug any issues you encounter during testing

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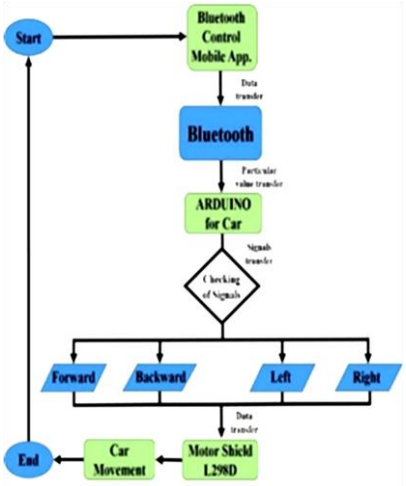

Fig. 8 : Flow chart of operation of the developed module

Software Tools

In this section, various software tools used in the completion of the project is presented.

Arduino IDE

The Arduino IDE (Integrated Development Environment) is a software platform designed for programming and developing projects with Arduino boards. Here are some key points about the Arduino IDE:

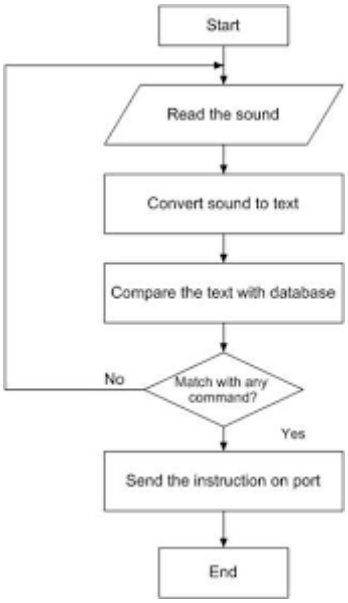

Fig. 9 : Flow chart of the proposed module

Programming Environment: The Arduino IDE provides an easy-to-use interface for writing, compiling, and uploading code to Arduino boards. It's designed to simplify the process of programming microcontrollers.

Open Source: The Arduino IDE is open-source software, which means it's freely available for anyone to use, modify, and distribute.

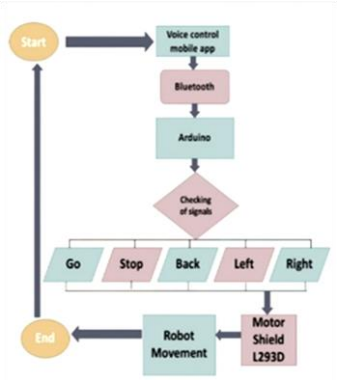

Fig. 10 : Flow chart of the voice control

Supported Platforms: The Arduino IDE is compatible with various operating systems, including Windows, macOS, and Linux.

Programming Language: The Arduino IDE uses a programming language based on C and C++. The language is simplified and tailored for beginners, making it accessible to those with limited programming

Bluetooth RC Controller

Bluetooth RC controller app is a mobile application that allows you to remotely control devices, such as robots or vehicles, using Bluetooth communication. These apps typically provide a user interface on your smartphone or tablet, enabling you to send control signals to your devices wirelessly. Here's how these apps generally work:

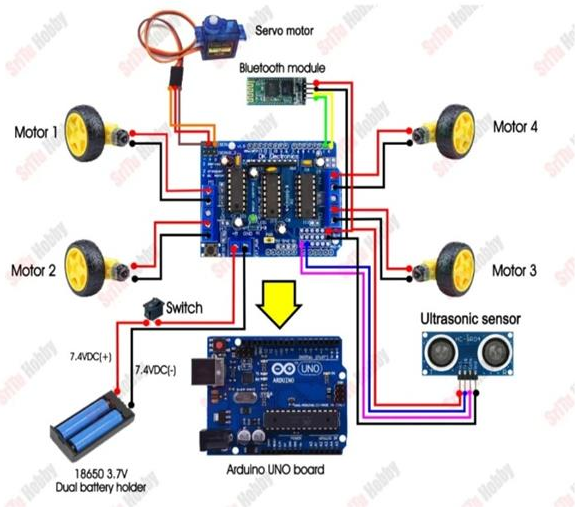

Fig. 11 : Circuit diagram of operation

Bluetooth Communication: The app establishes a Bluetooth connection between your mobile device and the target device (e.g., an Arduino-powered robot or vehicle) that has a Bluetooth module.

User Interface: The app's user interface provides virtual buttons, joysticks, sliders, or other interactive elements that simulate the controls of a remote control.

Fig. 12 : Arduino symbol

Commands: As you interact with the virtual controls on the app, it generates specific commands or signals corresponding to the chosen control actions (forward, backward, left, right, speed adjustments, etc.).

Arduino Blue-control

The “ArduinoBlue Control”" app is likely a third-party mobile application designed to control Arduino projects using Bluetooth communication. While I don't have access to real-time information on specific apps developed after September 2021, I can provide you with a general understanding of what such an app might be used for various applications.

Fig. 13 : Bluetooth RC Controller

Bluetooth Communication: The app is likely designed to establish a Bluetooth connection between a smartphone or tablet and an Arduino board equipped with a Bluetooth module (such as HC-05 or HC-06).Wireless Control:

Once connected, the app may provide a user interface on the mobile device that allows users to send commands, data, or control signals to the Arduino board wirelessly.

Fig. 14 : Arduino Bluetooth controller

Experimental results

The primary outcome of the robot is its ability to be controlled using voice commands. Users can give verbal instructions to the robot, such as "move forward," turn left" ,etc. We'll have a tangible product that demonstrates your ability to integrate hardware components, write code, and create a functional system using Bluetooth, the robot can be controlled wirelessly from a smartphone, tablet, or computer.

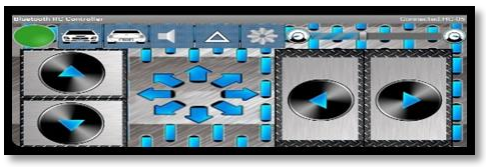

Fig. 15 : Mobile application for controlling robot through Bluetooth is successfully connected

Advantages & Applications

- Versatility
- Educational
- Obstacle Avoidance
- Wireless Bluetooth Control
- Voice control
- Real-World Problem Solving
- Cost-Effectiveness
- Open source community

Fig. 16 : GUI or app developed, Mobile application for controlling robot through voice commands is connected

Applications

Home Automation, Surveillance and Security, Assistive Robotics, Exploration and Inspection and Gaming, Education and Research, Warehouse and Logistics, Interactive Museum Exhibits, Prototyping and Testing

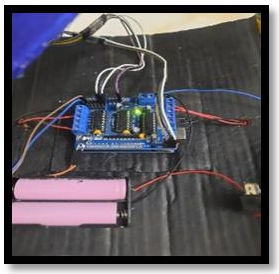

Fig. 17 : Hardware connections done

Conclusions

In conclusion, the obstacle-avoiding voice-controlled Bluetooth robot presents an exciting and interactive platform that combines obstacle avoidance, voice control, and wireless communication.

User Applications: The robot's functionality has a wide range of potential applications, including but not limited to home automation, entertainment, educational purposes, and even assistance for individuals with mobility impairments.

The robot can be controlled wirelessly from a smartphone, tablet, or computer.

Bluetooth communication allows for greater mobility and flexibility in controlling the robot from a distance. The robot's obstacle-avoidance feature enables it to navigate autonomously.

We can conclude that this multifunctional robot is helpful to overcome problems in hospitals ,Hotels , Industries etc through simple code and programme

Future Scope

The "*Obstacle Avoiding Voice Control Bluetooth Control Robot*" provides a foundation for further advancements and improvements in robotics technology. We'll learn about voice recognition technologies, including their capabilities and limitations. This knowledge can be applied to other voice-controlled projects. You'll encounter challenges related to voice recognition accuracy, motor control, and sensor integration. Overcoming these challenges hones your problem-solving skills. This project combines elements of robotics, electronics, programming, and potentially even AI if you integrate more advanced features. You can customize the project by adding features such as obstacle avoidance, remote control via a smartphone app, or even integrating other IoT technologies.

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