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VOICE CONTROLLED ROBOTIC VEHICLE IN 2D

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ABSTRACT

This project aims to construct a robot car that can be controlled by voice commands. The core components include an Arduino micro-controller, motor drivers for movement, and a Bluetooth module for wireless communication. The development process involves an initial hardware design phase, followed by coding the robot's behavior using our programming expertise. The code will be simulated in software before being integrated with the physical hardware. A Bluetooth module will enable the robot's control unit to receive voice instructions from a Bluetooth-equipped Android device running a specific application. We were motivated to undertake this project by the pervasive influence of robotics in modern life and its significant role in advancing engineering and technology.

KEYWORDS: HC-05 Bluetooth Module, Arduino Uno, L298N Motor Driver, DC Gear Motors.

1. INTRODUCTION

Robotics is a constantly developing field. There are various approaches to robot design, and the dominant methods or technologies of the future are uncertain. Robotics is evolving in a manner similar to Darwin's theory of natural selection, where the most adaptable approaches are likely to persist.

The robot car's physical structure incorporates a controller with integrated Bluetooth communication capabilities. This controller will manage the car's motors and other essential parts. By establishing a Bluetooth connection with a dedicated application, users can remotely operate the car using the app's programmed functions. The car will respond to commands for forward, backward, right, and left movement. Forward movement will be executed by all motors rotating in unison, and backward movement by their counter-rotation. Turning will involve the activation of motors on one side, while stopping will halt all motor activity. Users will issue instructions to the motors through the Bluetooth application on their Android smartphone. This project will explore the control of a robot car using a Bluetooth module and an Android mobile phone application. A key advantage of a robot-controlled car is its potential to reduce manual labor. Furthermore, this project could be readily expanded to include a camera for real-time video streaming to the user via Wi-Fi, utilizing a Wi-Fi module.

At the heart of sophisticated voice control lies Natural Language Processing (NLP). This field of Artificial Intelligence enables computers to understand and interpret human language. For a voice-controlled robot to effectively respond to a variety of commands, a degree of NLP is often involved. This can range from simple keyword recognition ("forward," "left") to more complex parsing of sentences to understand the user's intent.

Components and Technologies Involved:

Microcontroller (e.g., Arduino, Raspberry Pi): The "brain" of the robot, processing voice commands, controlling motors, and managing other peripherals. More advanced robots might utilize more powerful microprocessors for complex tasks.

Bluetooth Module: Facilitates wireless communication between the voice control interface (e.g., smart phone) and the robot's controller. Other wireless communication methods like Wi-Fi or RF could also be used depending on the application's range and bandwidth requirements.

Motor Drivers: Interface between the micro-controller and the motors, providing the necessary power and control signals to drive the wheels or other actuators.

Power Source (e.g., Batteries): Provides the necessary electrical energy to operate all the robot's components.

Smartphone/Tablet with Voice Control App: The user interface for issuing voice commands. The app typically handles voice recognition and transmits the corresponding commands to the robot via Bluetooth.

2. HARDWARE DESCRIPTION:

The hardware part used in this voice controlled robotic vehicle are mentioned below.

Arduino Uno Board

The Arduino Uno is a micro-controller board built around the ATmega328 chip. It features 14 digital input/output pins (6 of which can function as PWM outputs), 6 analog input pins, a 16 MHz crystal oscillator, a USB connector, a power jack, an ICSP header, and a reset button. This board provides all the necessary components to run the micro-controller; users simply need to connect it to a computer via USB or power it with an AC adapter or battery to begin development. Unlike earlier Arduino boards that relied on an FTDI USB-to-serial driver, the Uno utilizes an Atmega8U2 micro-controller programmed as a USB-to-serial converter. The name "Uno," meaning "one" in Italian, was chosen to commemorate the upcoming release of Arduino 1.0. Moving forward, the Uno and version 1.0 will serve as the standard reference for the Arduino platform. The Uno represents the latest evolution in the USB-based Arduino board series and acts as the benchmark model for the entire platform.

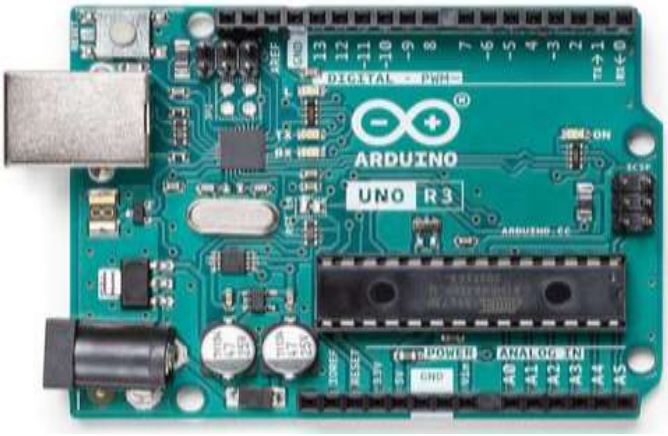

Fig.1. Arduion Uno

HC-05 Bluetooth Module:

Used and affordable Bluetooth module that enables wireless serial communication between micro controllers (like Arduino), computers, smartphones, and other Bluetooth-enabled devices. It operates in the 2.4 GHz ISM (Industrial, Scientific, and Medical) band, a globally recognized frequency range for short-range wireless communication.

This module essentially acts as a transparent serial port over Bluetooth. Data sent to its serial input pin (typically RXD) is wireless transmitted via Bluetooth, and data received wireless is presented at its serial output pin (TXD). This makes it straightforward to replace wired serial connections with a wireless Bluetooth link in various projects.

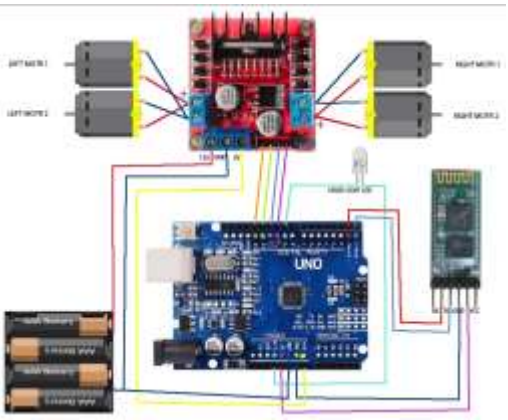

Fig. 2. Bluetooth Module

The HC-05 can operate in two distinct modes:
Master Mode: In this configuration, the HC-05 can initiate a connection to other Bluetooth slave devices. It actively searches for and pairs with compatible devices within its range.
Slave Mode: In slave mode, the HC-05 passively waits for connection requests from Bluetooth master devices. It advertises its presence and allows other devices to initiate the pairing process.Configuration of the HC-05 module, such as its Bluetooth name, baud rate, pairing PIN, and operating mode (master or slave), is typically done using AT commands. These are text-based commands sent to the module over its serial interface. Often, a separate setup involving connecting the module to a microcontroller or a USB-to-serial adapter is required to send these AT commands before the module is integrated into the final project.
L298N Motor Driver Module:

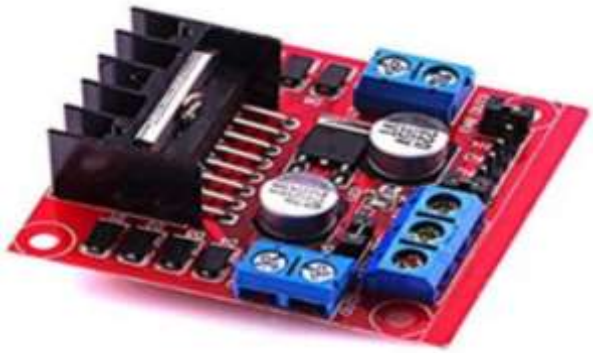

Fig. 3 Motor Driver Module

The L298 is a dual full-bridge driver integrated into 15-lead Multiwatt and PowerSO20 packages. This high-voltage, high-current circuit is designed to interface with standard TTL logic levels and drive inductive loads, including relays, solenoids, and both DC and stepper motors. The device features two enable inputs that allow for independent activation or deactivation of each bridge, regardless of the input signals. Furthermore, the emitters of the lower transistors within each bridge are internally connected and accessible via an external terminal, facilitating the use of an external current sensing resistor. A separate supply input is included to allow the logic circuitry to operate at a lower voltage.
DC Gear Motors:

Fig 4: DC Gear Motor

Movement of the robotic vehicle is achieved using 12V DC gear motors. Two motors are used to independently drive two wheels, providing rotational motion in both clockwise and counterclockwise directions, which translates to the robot's movement. The control of these motors is facilitated by an H-bridge circuit, an electronic configuration that allows for bidirectional voltage application across a load. This gives a micro-controller, logic circuit, or remote control the capability to electronically command a standard DC motor to move forward, backward, left, right, and stop. A geared DC motor integrates a gear mechanism with the motor. The motor's speed is quantified as revolutions per minute (RPM). The attached gear assembly serves to increase the output torque while decreasing the rotational speed. Through careful selection of gear ratios, the speed of a gear motor can be tailored to specific requirements. This concept of

speed reduction accompanied by torque amplification is termed gear reduction. A detailed examination of the gear head and the operational principles of geared DC motors will be provided.

3. SOFTWARE DISCRIPTION (ARDUINO IDE):

The Arduino IDE is an open-source software environment primarily designed for writing and compiling code for Arduino boards. As the official software for Arduino, it simplifies code compilation to the point where individuals without prior technical expertise can begin learning and programming. Compatible with operating systems such as macOS, Windows, and Linux, it operates on the Java platform and includes built-in functions and commands that are essential for debugging, editing, and compiling code within the environment. The Arduino ecosystem offers a variety of modules, including the Uno, Mega, Leonardo, and Micro, among others. Each of these boards features a micro-controller that is programmed and receives instructions in the form of code. The main program, often referred to as a sketch, created in the IDE, is ultimately compiled into a Hex file, which is then transferred and uploaded to the micro-controller on the Arduino board. The IDE essentially comprises two key components: an Editor for writing the code and a Compiler for processing and uploading it to the Arduino module. This environment supports both the C and C++ programming languages.

4. BLOCK DIGRAMOF BLACK BOX:

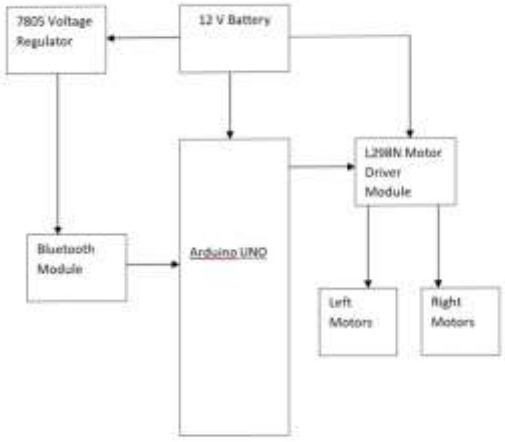

Fig 5: Block Diagram

Working Principle:

The operational flow of a basic voice-controlled robotic vehicle begins with a smartphone capturing voice commands. These commands are then wireless transmitted to an HC-05 Bluetooth module. The module converts these commands into a series of characters, which are subsequently sent to an Arduino micro-controller for processing. The Arduino deciphers the received character string and performs corresponding actions by sending signals to the motor driver, which in turn powers and controls the connected motors, enabling the robot's movement.

On the transmitting end, voice instructions are given to a mobile application via the microphone. This smartphone communicates wireless with the robotic vehicle through the Bluetooth module. The mobile application is designed to receive voice input through the microphone and convert these simple voice commands into digital character sequences (analog-to-digital transformation, conceptually). These stored sequences are then transmitted to the robotic vehicle via the Bluetooth transceiver module and received by the onboard transceiver controller. An Android application transceiver is used to decode the signal received by the Bluetooth module on the robot. The micro-controller compares these decoded signals with per-programmed instructions stored within it and translates them into control signals. These control signals are then used to operate the servo motors (if that's the type of motor used, though the earlier description mentioned DC gear motors) for the appropriate duration. The micro-controller sends instructions that, when

executed by the motor driver IC, control the specific motors. A DC power supply is essential to power the entire system, providing energy to both the micro-controller and the Bluetooth module.

Steps to control the robotic vehicle:

Install any Bluetooth application designed for Arduino control.

Establish a Bluetooth connection between the HC-05 module and the mobile device. The default pairing password is typically "1234" or "0000".

Activate the microphone icon within the application and speak your commands to the robot.

Your spoken words will be recognized and converted into text within the application. This text is then transmitted wireless via Bluetooth.

The Bluetooth module on the robot receives this text string, decodes it, and compares it to the instructions defined in the robot's program. Based on this comparison, the robot will execute the corresponding action, such as moving in the forward direction (as per the example).

5. RESULT:

The design and implementation of our proposed system have yielded the following results:

The robot can be controlled using voice commands issued by the operator.

These voice commands are input through a dedicated Android application installed on the user's mobile device. Speech recognition is processed within the Android application, and a corresponding command is then transmitted to the voice-controlled robot vehicle. The micro-controller integrated into the vehicle interprets these received commands and sends appropriate signals to the connected motors.

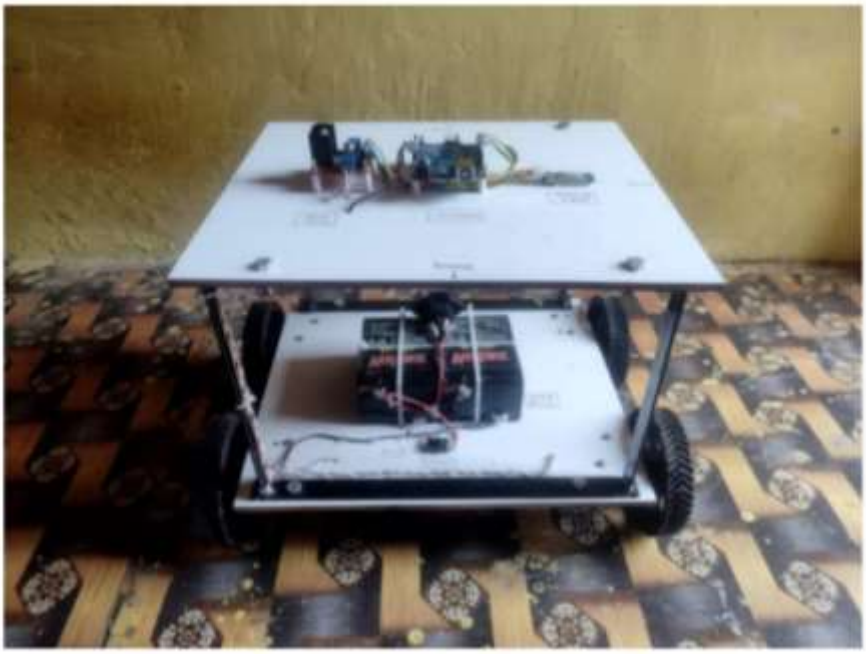

Fig. 6 Final Project Model

6. CONCLUSION

The design of our project demonstrates the feasibility of controlling a robot wirelessly using Bluetooth technology. Voice commands are efficiently transmitted via Bluetooth, resulting in the successful execution of desired actions by the robot. This project has the potential to minimize human effort in environments or situations where direct human involvement is challenging. Such systems could find practical use in various sectors, including industries, military and defense, and exploratory missions.

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