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ArtiBot: A Bluetooth-Controlled Drawing Robot Car Powered by Arduino

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Abstract: A remote control vehicle (RCV) is characterized as a mobile device manipulated by external means without restricting its motion, often employing mechanisms such as radio control, cabling, infrared, or Bluetooth controllers. This paper focuses on utilizing Bluetooth wireless technology as the communication medium to remotely control a robot car for drawing different shapes and patterns based on external user choices. The controlling interface employed is an Android device equipped with built-in Bluetooth capabilities. The user installs a dedicated mobile application and activates Bluetooth on the device. Through this application, users can execute various commands, including drawing distinct shapes and controlling movements such as forward, backward, left, and right. A Bluetooth module integrated into the robot car establishes a connection with the Bluetooth of the mobile phone, facilitating communication and enabling command execution. The Arduino UNO, powered by the ATMEGA32 microcontroller, plays a pivotal role in the execution of control commands for the car.

Keywords: HC05 Bluetooth module, Colored Pens, Drawing robot car, Motor driver shield L293D, Micromotors and Gripper Wheels

1. Introduction

The presented study introduces a novel and innovative approach to remote controlling a drawing robot car by leveraging Arduino technology and Bluetooth connectivity. This paper unveils a comprehensive design that integrates the capabilities of Arduino and the wireless convenience of Bluetooth to facilitate the remote control of a robot car, fostering intricate movements and patterns.

Contrasting traditional methods reliant on buttons or gestures for control, this system capitalizes on the pervasive presence of Android smartphones as multifunctional control interfaces. By developing a dedicated smartphone application, this project establishes a seamless connection between the user's Android device and the robot car, rendering the smartphone a pivotal tool for real-time interaction. The key highlight of this endeavor is the synergy between the Android smartphone and the Arduino-powered robot car, orchestrated through Bluetooth technology. The smartphone serves as the command transmitter, sending directives through its built-in Bluetooth capabilities to the Bluetooth module integrated within the robot car, which acts as the receiver. This intelligent framework dispenses with the need for conventional physical controls, such as buttons or joysticks, streamlining the control process into a touch-based interface on the smartphone application.

The smartphone's interface empowers users to navigate the robot car with precision, commanding it to move forward, backward, left, or right, effectively orchestrating its movements. Additionally, this platform caters to creativity, enabling users to generate diverse patterns by manipulating the robot car's trajectories through the intuitive smartphone interface.

In essence, the paper redefines the landscape of remote-control mechanisms by merging the power of Android smartphones, Arduino microcontrollers, and Bluetooth communication. By transforming the smartphone into a dynamic control center, this endeavor not only streamlines the control process but also encourages innovation through the creation of intricate patterns. The ensuing sections of this paper delve deeper into the technical implementation, methodology, and outcomes of this Arduino-based, Bluetooth-controlled drawing robot car.

Figure 1. shows the Artibot drawing different patterns on the white paper sheet as being commanded by the user through the android application.

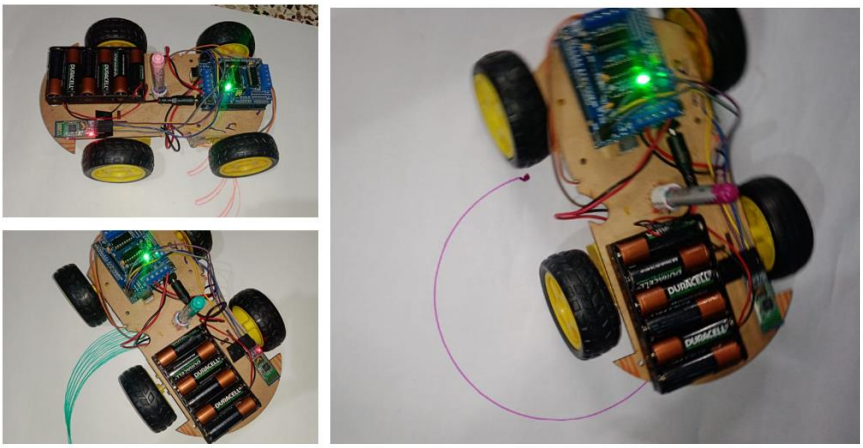

Figure 1: Artibot drawing different patterns on paper sheet.

2. Literature Review

Numerous scholars have delved into the realm of robotics, developing innovative systems to alleviate human exertion, and presenting their technological advancements. These robotic constructs are steered by sophisticated software algorithms, highlighting their usefulness and impact.

Winter et al. embarked on the creation of an Android-controlled robot, employing wireless transmission to facilitate seamless information transfer [1]. Alternatively, a robotics setup reliant on an 8051 microcontroller and a Bluetooth module, bolstered by an integrated camera for surveillance, was engineered [2]. Guardi et al. introduced a communication-oriented robotic platform that harnessed the synergies of Android and Bluetooth technologies [3].

Ritika Pahuja and Narender Kumar engineered an Android-controlled Arduino-based robot car, establishing user-friendly interaction via Bluetooth connectivity [4]. Nelson et al. introduced a Bluetooth-controlled robot model incorporating sensor feedback and Bluetooth technology. Importantly, this design negotiated physical impediments such as walls and doors [5]. Despite these remarkable advancements, Bluetooth-controlled robotic systems tailored for drawing have not yet garnered widespread recognition.

3. Methodology

The methodology employed in this study encompasses the utilization of several key components and technologies to construct and control the Bluetooth-controlled drawing robot car. The components discussed in this section include the Arduino Uno microcontroller, the HC05 Bluetooth module, and the L293D motor driver shield.

3.1 Arduino Uno

The Arduino Uno, an open-source microcontroller platform, forms the foundation of this project's control system. Conceived by Massimo Banzi, Arduino Uno gained its name from an Italian bar in Ivrea and signifies "one" in Italian. Its development traces back to 2003 when Hernando Barragan integrated microcontroller support (Atmega16) into the wiring framework. Arduino Uno is widely available at a low cost and is designed for ease of use and customization. It is powered by the ATMEGA328P microcontroller and is programmed using the Arduino IDE software. Operating within a voltage range of 3.3V to 5V, the Arduino Uno receives input voltage between 7V and 20V. With 6 analog pins and 14 digital pins, it facilitates both analog and digital functions. The serial communication between the Arduino board and external devices is achieved using Tx and Rx pins. Arduino Uno's pivotal role lies in controlling various aspects of the designed model.

3.2 HC05 Bluetooth Module

The HC05 Bluetooth module serves as the wireless communication bridge between the robot car and external devices. Born out of Nils Rydbeck's radio technology development, Bluetooth was introduced to the market in 1999. The HC05 module, a low-cost solution, enables short-range communication through wireless bandwidth. It consists of 6 pins, with Tx for transmission and Rx for reception. It operates within a range of up to 100 meters and employs radio waves in the frequency band of 2.400GHz to 2.483.5GHz. This module's versatility supports wireless serial communications and contributes to replacing wired technology with wireless solutions in pro**je**ct design.

3.3 L293D Motor Driver Shield

The L293D motor driver shield plays a crucial role in controlling the movement of the robot car. This H-bridge module allows control over the direction and speed of two DC motors. The module is equipped with 4 output and 4 input pins, enabling independent motor control. It utilizes TTL logic levels to manage heavy loads and can handle voltage ranges from 5V to 35V. The L293D motor driver facilitates the conversion of low voltages to higher ones without disruptions, ensuring effective control over the robot's movement.

3.4 Wire Connections

Jump wires are employed to establish electrical connections between components. These wires, equipped with connectors or pins at each end, eliminate the need for soldering. Male connectors, referred to as plugs, and female connectors, known as jacks, facilitate secure connections. Male connectors possess solid pins for the center conductor, while female connectors feature a center conductor with a hole for accommodating the male pin.

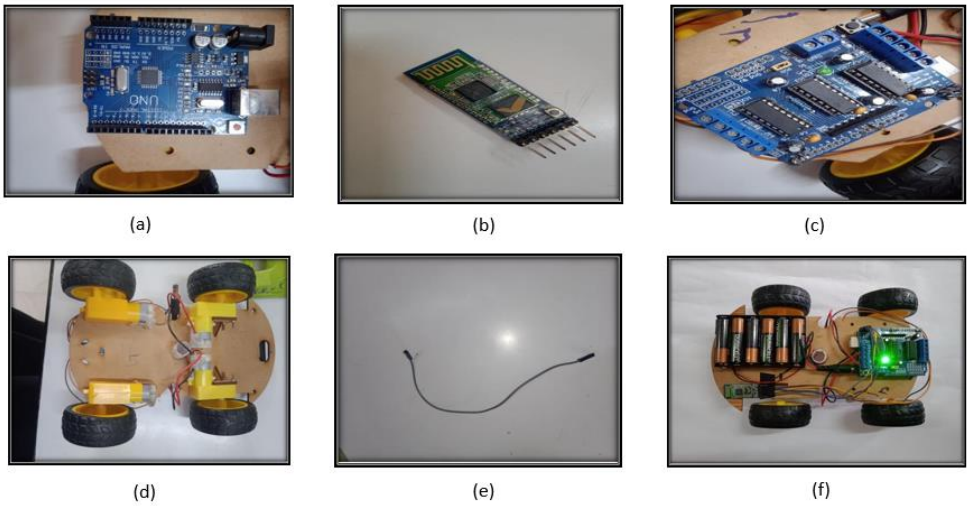

Figure 2: (a) Arduino UNO (b) HC05 Bluetooth Module (c) L293D Motor Driver Shield (d) Micromors and Gripper Wheels (e) Jumper Wire (f) Artibot: Bluetooth Controller Drawing Robot Car powered by Arduino UNO

3.5 Precise Movement and Pattern Creation

The Bluetooth-controlled car is operated through an Android mobile phone, rendering traditional control methods like buttons or gestures obsolete. Control of the car's movements – forward, backward, left, and right – is achieved by a simple touch on the Android phone's interface. In this setup, the Android phone serves as the transmitting device, while a Bluetooth module integrated within the car functions as the receiver. Utilizing its built-in Bluetooth capabilities, the Android phone transmits commands to the car, enabling precise movements necessary to create a variety of intricate patterns.

4. Software Requirements

The software infrastructure employed in this project plays a pivotal role in orchestrating the entire functionality of the system. Arduino software serves as the platform through which comprehensive instructions are provided to the microcontroller. The programming language of choice for coding the software is 'C'.

In the Android application interface, user inputs are translated into corresponding signals that are transmitted via Bluetooth to the Bluetooth module (HC-05), which maintains a connection with the NodeMCU ESP8266. Similarly, a distinct Android application is developed for the Wi-Fi module. Upon button presses within the application, corresponding signals are relayed through the NodeMCU ESP8266, consequently initiating motor driver actions that drive the wireless car's movement.

Upon arrival of signal data at the NodeMCU ESP8266, the designated input pin is set to a high state. Subsequently, this high state signal is transmitted to the motor driver section. The motor driver responds by toggling data bits in accordance with the incoming signal. If the data bit is low, the respective motor driver pin remains inactive; conversely, if the data bit is high, the corresponding motor driver pin is activated.

For the development and writing of the program, the Arduino Integrated Development Environment (IDE) version 1.8.1 is employed. The software programming process comprises two distinct sections: the 'setup' section and the 'loop' part. In the 'setup' section, crucial variables are defined and initialized to create a stable foundation for program execution. The 'loop' part subsequently facilitates the continuous and iterative execution of the program, allowing the system to operate seamlessly.

Figure 3: Arduino IDE

5. Circuit Diagram

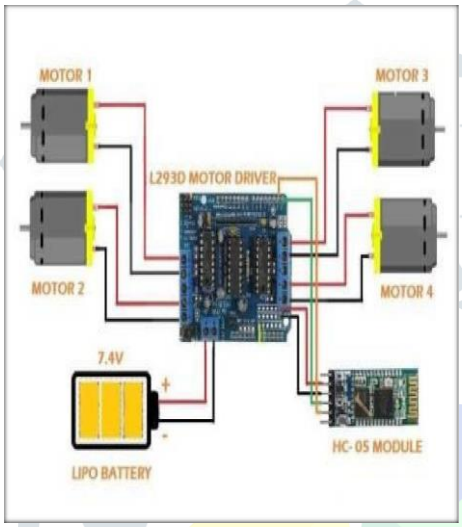

Figure 4: Circuit Diagram

In this circuit configuration, the focus is solely on transmitting data concerning the movement of the robot from an Android phone to the Bluetooth module. As the intention is to exclusively transmit data and not receive any from the Arduino, a unidirectional connection is established between the TX (transmit) pin of the Bluetooth module and the RX (receive) pin of the Arduino. This connection setup allows for seamless data transmission.

Specifically, the RX pin of the Bluetooth module is interlinked with the TX pin of the Arduino. Notably, the Arduino's RX and TX pins are designated using the Software Serial library, with Pin 2 configured as RX and Pin 3 as TX. This strategic pin arrangement forms the basis for effective communication. The circuit encompasses the L298N Motor Driver Module, within which, digital I/O Pins 9 through 12 of the Arduino have been configured as Input pins for the Motor Driver. These pins, denoted as IN1 through IN4, establish the connection with the corresponding pins on the L293D Motor Driver Module. Furthermore, both Enable Pins are seamlessly linked to the 5V power source using provided jumper connections. This arrangement ensures the necessary power supply for motor control operations. The robot chassis employed in this Bluetooth Controlled Robot Car initiative is outfitted with four geared motors. As the L298N Motor Driver Module accommodates slots for precisely four motors, the configuration aligns harmoniously with the system's motor requirements.

6. Flowchart

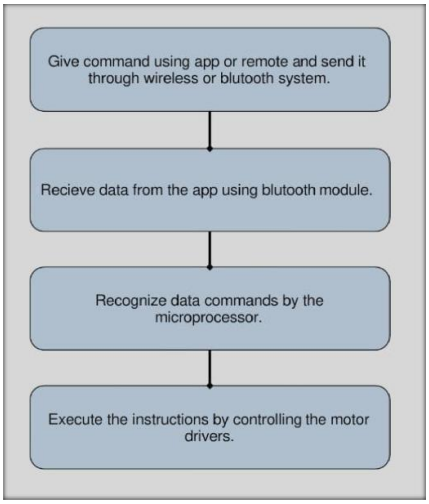

Figure 5: Flowchart

Figure 5 represents the flow control of the proposed model.

Step 1: Connect Robot Car via Bluetooth to Android and send signal through wireless connection.

Step 2: Upon receiving the signal, our designed model i.e. Artibot starts moving in the direction specified by the instructor.

Step 3: Select the patterns and shapes to be drawn on the android application and press enter.

Step 4: Arduino UNO execute the instruction given by the instructor in a specified direction as commanded earlier.

Conclusion

The "ArtiBot" project represents an innovative approach that combines Arduino technology, Bluetooth communication, and smartphone control to remotely operate a drawing robot car. This project's uniqueness lies in its integration of diverse technologies to enhance control precision, interactivity, and the generation of intricate patterns.

The Arduino is an open-source device that has been the brain for numerous projects. With the combination of Arduino, and the Bluetooth Shield we can control over many other things, like home Lightings, air conditioner and many more through our cell phones. Arduino can also contribute at large for the Smart Home system. By doing this Project we found out a lot about the Arduino, and how it has made us easier to convert digital signals into physical movements. One more advantage of Arduino is that once a program is burned, we don't need to worry about the program getting erased as long as it is not RESET. Arduino has also over all other microcontrollers because of its efficiency and user-friendly property.

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