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Bluetooth Controlled Robot Car Using Arduino

Project Report

Submitted for the partial fulfilment of the degree of

Bachelor of Technology

In

Internet of Things (IOT)

Submitted By

Aman Singh Gurjar
(0901IO221010)

UNDER THE SUPERVISION AND GUIDANCE OF

Dr.Aftab Ahmed Ansari
Assistant Professor

Centre for Internet of Things

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR (M.P.), INDIA
माधव प्रौद्योगिकी एवं विज्ञान संस्थान, ग्वालियर (म.प्र.), भारत
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June 2024

DECLARATION BY THE CANDIDATE

I hereby declare that the work entitled **"Bluetooth Controlled Robot Car Using Arduino"** is my work, conducted under the supervision of **Dr.Aftab Ahmed Ansari, Assistant Professor,** during the session Jan-May 2024. The report submitted by me is a record of bonafide work carried out by me.

I further declare that the work reported in this report has not been submitted and will not be submitted, either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university.

Aman

Aman Singh Gurjar
0901IO221010
B.Tech. V Sem

Date: 19TH Nov,2024
Place: Gwalior

This is to certify that the above statement made by the candidates is correct to the best of my knowledge and belief.

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Abstract (For Projects)

Bluetooth Controlled Robot Car Using Arduino

This paper describes the design and development of a Bluetooth-controlled robot car. It receives instructions from a smartphone app via Bluetooth. These instructions are then translated into electrical signals, which are sent to a motor driver. The Arduino Uno then processes these commands and controls the car's DC motors using a motor driver. The paper highlights the following aspects of the project:

Hardware components: Arduino Uno, HC-05 Bluetooth module, L298N motor driver, DC motors, battery, jumper wires

Software components: Arduino IDE software for programming the Arduino, Android app for sending control commands

Functionality: The car can be controlled remotely using the smartphone app for forward, backward, left, and right movements.

Potential improvements: Obstacle detection, camera integration, autonomous navigation, improved user interface, security measures, power efficiency

ACKNOWLEDGEMENT

The full semester Internship/ Project has proved to be pivotal to my career. I am thankful to my institute, **Madhav Institute of Technology & Science** to allow me to continue my disciplinary/interdisciplinary Internship/ Project as a curriculum requirement, under the provisions of the Flexible Curriculum Scheme approved by the Academic Council of the institute. I extend my gratitude to the Director of the institute, **Dr. R. K. Pandit** and Dean Academics, **Dr. Manjaree Pandit** for this.

I would also like to extend my gratitude to the entire team at **Organization's Name**, especially **Industry Mentor Name(s)**, for their collaboration and support during my time with the organization. I am grateful for the opportunity to work alongside such talented individuals and to learn from their expertise and experiences.

I would sincerely like to thank my department, **Centre for Internet of Things**, for allowing me to explore this project. I humbly thank **Dr. Praveen Bansal**, Assistant Professor and Coordinator, Centre for Internet of Things, for his continued support during the course of this engagement, which eased the process and formalities involved. I am sincerely thankful to my faculty mentors. I am grateful to the guidance of **Dr.Aftab Ahmed Ansari**, Assistant Professor, and Centre for Internet of Things, for his continued support and guidance throughout the project. I am also very thankful to the faculty and staff of the department.

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Centre for Internet of Things

CONTENT

ACRONYMS

- **Arduino:** Arduino Uno acts as the brain, managing and coordinating the operation of all connected components.
- **Bluetooth:** A wireless technology standard for short-range communication.
- **HC-05:** A specific Bluetooth module commonly used for wireless communication with microcontrollers like Arduino.
- **L298N:** A popular motor driver IC used to control DC motors.
- **DC motor:** A type of electric motor that converts direct current electrical energy into mechanical energy.
- **UART:** Universal Asynchronous Receiver-Transmitter, a serial communication protocol used for data transmission between devices.
- **IDE:** Integrated Development Environment, a software application that provides a comprehensive set of tools for software development.

NOMENCLATURE

Core Components:

- **Microcontroller:** The "brain" of the system, often an Arduino board, which processes instructions and controls other components.
- **Motor Driver:** An electronic circuit that amplifies the weak signals from the microcontroller to control the motors.
- **DC Motor:** An electric motor that converts direct current electrical energy into mechanical energy.
- **Bluetooth Module:** A device that enables wireless communication between the microcontroller and a smartphone or other Bluetooth-enabled device.
- **Power Supply:** The source of electrical energy for the system, often a battery.

Key Concepts:

- **Firmware:** Software that is embedded in hardware devices like microcontrollers.
- **Serial Communication:** A method of transmitting data one bit at a time over a single wire.
- **H-Bridge:** A common circuit configuration used to control the direction of a DC motor.

Common Terms:

- **Node:** A device in a network, such as the Arduino board.
- **Pin:** A physical connection point on a microcontroller or other electronic component.
- **Voltage:** The electric potential difference between two points.
- **Current:** The flow of electric charge.
- **Resistance:** The opposition to the flow of electric current.

List of Figures

CHAPTER 1: INTRODUCTION

Recent advancements in technology, particularly in wireless communication like Bluetooth, have paved the way for innovative applications such as remote-controlled cars and robots. As technology continues to evolve, there is a growing demand for wireless solutions that offer flexibility and convenience.

This paper presents the design and implementation of a Bluetooth-controlled robotic car. The car is designed to be controlled remotely using an Android smartphone. The core component of the system is an Arduino Uno board, which processes commands received from the smartphone via Bluetooth and controls the car's DC motors.

This technology has the potential to revolutionize various industries, including logistics and manufacturing. For instance, these robotic cars can be used to transport goods efficiently within warehouses or factories. Additionally, they can be employed in delicate tasks like handling small components in assembly lines.

The potential applications of these wheeled robots are vast and continue to expand as research and development in this field progress.

CHAPTER 2: LITERATURE SURVEY

Mobile Technology and Bluetooth Integration: The dominance of Android smartphones in today's market offers a cost-effective platform for designers and students familiar with Java programming. Developers appreciate the extensive functionality and accessibility of Android hardware due to its open nature.

Bluetooth technology utilizes radio frequencies (RF) to transmit signals wirelessly. This allows for remote control of various devices without physical tethers or risks. The effective range for Bluetooth communication falls within a personal area network (PAN), typically spanning 5-10 meters. This technology is increasingly incorporated into diverse electronic devices like laptops, printers, and notebooks. The Android operating system, built upon the Linux kernel, continues to receive significant upgrades, offering exciting new features and customization options for developers. The freely available Software Development Kit (SDK) facilitates the creation of custom applications catering to specific user needs.

Shifting Communication Landscape: Previously, communication presented challenges, fostering a sense of isolation. The rise of Internet of Things (IoT) devices like smartphones and laptops has completely transformed the way we connect with others. These advancements have enabled convenient and seamless interactions, eliminating the need for physical proximity.

A Brief History of Bluetooth: Bluetooth technology, originally conceived by Jaap Haartsen in the 1990s and further developed by Ericsson, aimed to eliminate the clutter of wired connections in workspaces. The Institute of Electrical and Electronics Engineers (IEEE) formally adopted Bluetooth as IEEE 802.15.1 through a dedicated special interest group in the late 1980s. The standard was subsequently promoted and released to the market.

While typical Bluetooth communication operates with a data rate of 9600 kbps, it allows for seamless connection with multiple devices simultaneously.

1. Arduino Uno: The Arduino Uno, named after a bar in Ivrea, Italy ("Uno" meaning "one" in Italian), is the central controller of this project. Developed by Massimo Banzi and Hernando Barragan in 2003, it builds upon the Wiring platform by adding microcontroller support (ATmega168). Affordable, user-friendly, and widely available, the Arduino Uno empowers creators of all skill levels to develop projects seamlessly.

The Arduino IDE software serves as the command centre for programming the Uno board. Introduced in 2008, this open-source platform facilitates the creation of engineering projects. At its core lies an Atmega328P microcontroller, which receives instructions through the Arduino IDE software. The Uno operates on a stable output voltage ranging from 3.3V to 5V, while accepting input voltages from 7V to 20V.

For data communication, the Uno utilizes six analog pins (supporting Pulse Width Modulation) and fourteen digital pins for reading and writing functions. Serial data transmission occurs via the Tx (Transmit) pin for sending data from the Arduino to your project, and the Rx (Receive) pin for receiving data from your project back to the Arduino. In this project, the Arduino Uno acts as the brain, managing and coordinating the operation of all connected components.

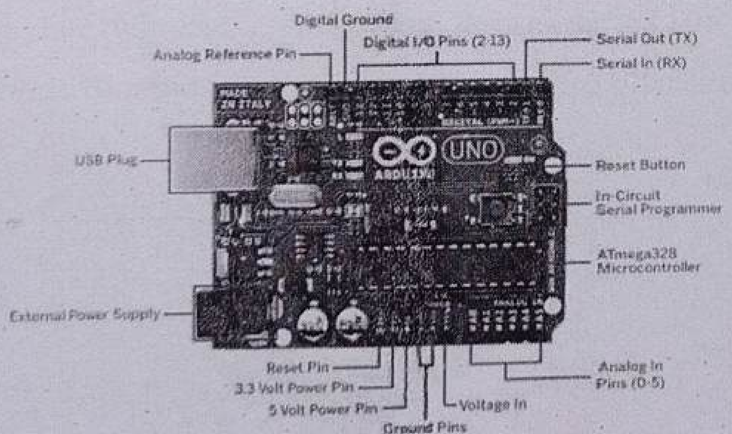

Fig.1 Arduino Uno

2. Motor Driver L298N: The L298N Motor Driver is a versatile component used to control two DC motors simultaneously. It employs an H-bridge configuration, enabling bidirectional control over each motor's direction and speed. The enable pin allows for convenient on/off control of all motors. With four input and output pins, the L298N offers independent and seamless control over each motor. Designed to handle heavy loads, it operates efficiently with TTL logic levels. It can accommodate input voltages ranging from 5V to 35V, making it suitable for various applications. The L298N's voltage regulation capabilities ensure smooth operation of DC motors, even when supplied with lower voltages.

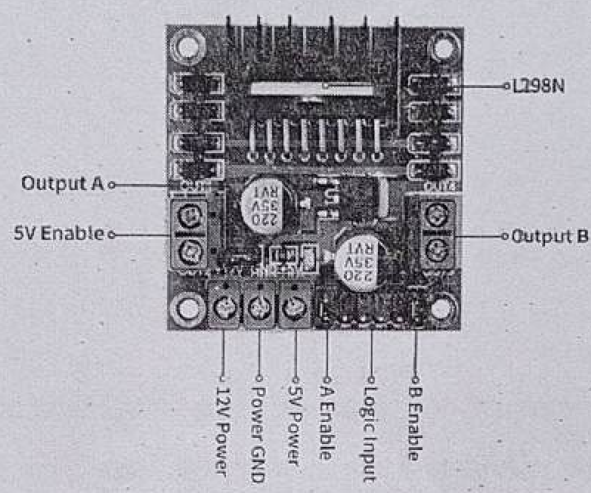

Fig.2 Motor Driver L298N

3. HC-05 Bluetooth Module: The HC-05 Bluetooth Module is a wireless communication device that can be easily integrated with microcontrollers. It utilizes the UART protocol to transmit and receive data wirelessly. As a slave device, the HC-05 module can establish connections with various Bluetooth-enabled devices, including phones and computers.

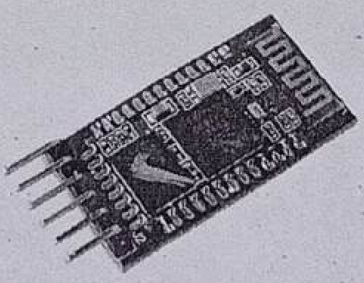

Fig.3 HC-05 Bluetooth Module

CHAPTER 5: MODELLING AND PROTOTYPING

Modelling

The Bluetooth-controlled robot car's design and development were based on a structured modelling process that emphasized simplicity, functionality, and cost-effectiveness. The process included hardware integration, software configuration, and iterative prototyping.

Component Selection and System Architecture:

- **Arduino Uno**: Central controller processing commands and managing hardware.
- **HC-05 Bluetooth Module**: Enables wireless communication between the smartphone and Arduino.
- **L298N Motor Driver**: Controls two DC motors for bidirectional movement with higher current capacity.
- **Bluetooth RC Car App**: Smartphone interface for sending directional commands.
- **DC Motors**: Provide movement in forward, backward, left, and right directions
- **Battery:** A battery is a device that stores electrical energy in chemical form.

Design Process:

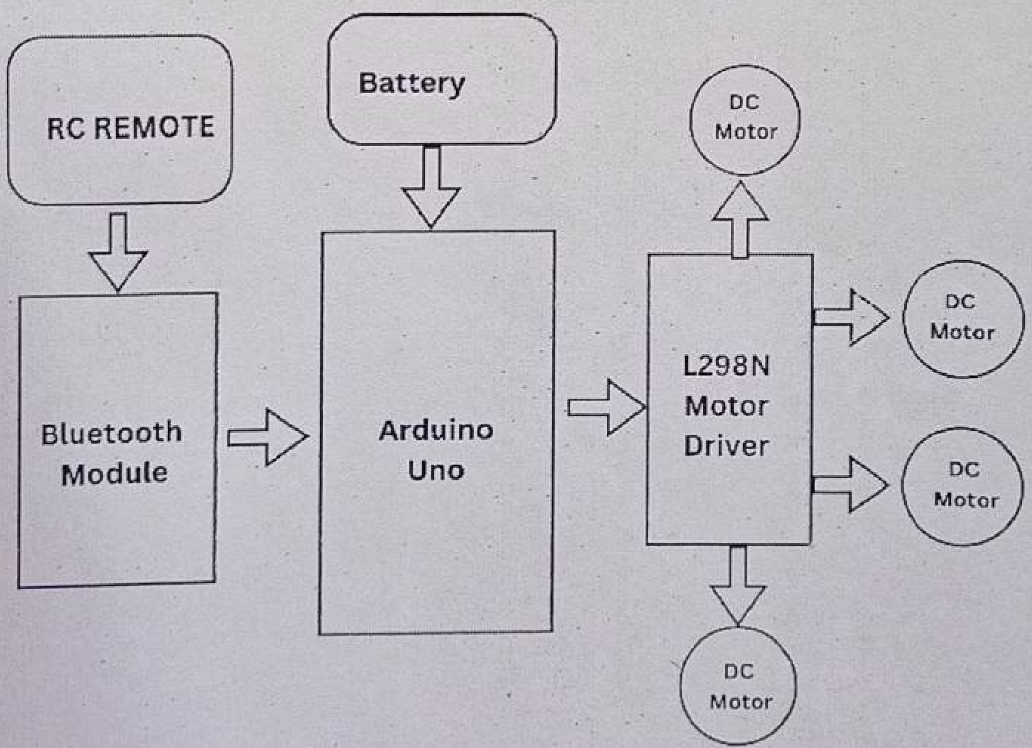

Fig.7 Design Process

Prototyping and Testing:

The prototyping and testing phase involved assembling the Bluetooth-controlled robot car using components like Arduino Uno, HC-05 Bluetooth module, L293D motor driver, and DC motors mounted on a custom-built chassis. The system was programmed through Arduino IDE to process directional commands sent via a smartphone app. Functional tests ensured seamless Bluetooth connectivity, accurate command execution, and consistent power supply. Performance tests validated the car's operation within a 10-meter range and its adaptability to different terrains. Minor issues, such as latency at the connectivity range limit and slight directional deviations, were addressed by recalibrating motor speed and optimizing the wiring. These efforts ensured a reliable prototype, with potential future enhancements, including extended range and obstacle detection.

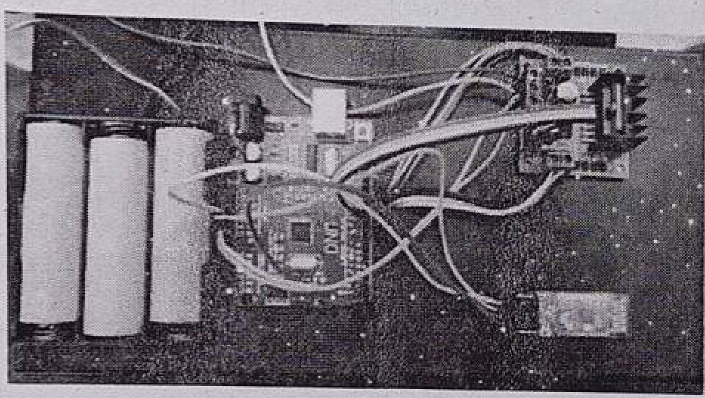

Fig-9 Prototype Design

CHAPTER 6: RESULTS ANALYSIS

System Initialization and Setup:

The Arduino Uno successfully initialized the connected components, including the HC-05 Bluetooth module, L298N motor driver, and DC motors, without errors. Upon powering the system, all devices responded correctly, and communication between the smartphone and the Bluetooth module was established seamlessly..

Bluetooth Connectivity and Command Accuracy:

The HC-05 Bluetooth module maintained stable connectivity within a 10-meter range. Commands transmitted from the smartphone application were accurately interpreted by the Arduino, resulting in precise movements of the robot car. The response time between sending a command and motor activation was negligible, ensuring a smooth operation.

Motor Control and Directional Movement:

The motor driver effectively controlled the DC motors for forward, backward, left, and right movements. The transitions between these states were smooth, with minimal latency or jerky motion. The robot car demonstrated consistent performance on flat and slightly uneven surfaces.

Load Handling and Power Efficiency:

The system handled a payload of up to 200 grams without compromising mobility. The dual power supply (one for Arduino and another for the motors) ensured uninterrupted operation, with adequate energy distribution across all components.

Overall System Performance and Stability:

The robot car demonstrated stability and robustness, maintaining reliable performance throughout continuous operation. Simultaneous execution of multiple functions (e.g., receiving commands while controlling motors) was achieved without system crashes or significant delays, showcasing the prototype's reliability.

CHAPTER 7: CONCLUSION AND FUTURE SCOPE

The Bluetooth-controlled robot car successfully combines Arduino microcontroller technology with Bluetooth communication to create a reliable, user-friendly system for wireless vehicle control. By leveraging modular components like the HC-05 Bluetooth module, L298N motor driver, and smartphone application, the system provides a robust solution for various applications, including material handling, surveillance, and assistive mobility. The prototype demonstrated consistent performance within a 10-meter range, handled moderate payloads effectively, and provided seamless directional control through a smartphone interface.

This project represents a scalable and cost-efficient platform for exploring wireless robotics. Future enhancements could include integrating advanced sensors for obstacle detection, GPS modules for location tracking, and autonomous navigation systems. To address power limitations, higher-capacity rechargeable batteries or renewable energy sources like solar panels could be incorporated. Additionally, adopting more versatile communication protocols like Wi-Fi or Zigbee could extend the operational range and adaptability of the robot car.

While the prototype yielded promising results, further research and field testing are necessary to refine features such as terrain adaptability, latency under range constraints, and multi-tasking capabilities. With continued development, this technology has the potential to evolve into a versatile tool for industrial, educational, and domestic applications, further bridging the gap between robotics and everyday problem-solving.

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SELF-EVALUATION OF INTERNSHIP/ PROJECT

Month	Start date – End date (DD/MM/YY) - (DD/MM/YY)	Progress of Project
Month- 1	05/08/24 - 31/08/24	Topic Selection and Project planning
Month- 2	01/09/24 - 30/09/24	Hardware selection and Prototype Development
Month- 3	01/10/24 - 31/10/24	Data Analysis and Results
Month- 4	01/11/24 - 18/11/24	Documentation of the Project

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