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Software Controlled Car

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Abstract: *This project aims to build a Bluetooth-controlled car using Arduino technology. A smartphone controls the vehicle wirelessly. The main part of the system is the Arduino Uno, which processes signals from the HC-05 Bluetooth module and sends them to the L298 motor driver to control the DC motors. Users can easily move the car forward, backward, left, or right by sending commands through a mobile application.*

Features:

• Wireless Operation – Controlled via smartphone using Bluetooth connectivity.
• Cost-Effective – Uses affordable and easily available components.
• Multi-Directional Movement – Moves forward, backward, left, and right.
• Easy to Use – Simple mobile app interface for real-time control.
• Portable Design – Compact and battery-powered for mobility.

Requirements:

• Hardware:- Arduino UNO, TT Gear Motor, L298 motor driver, Wheels, HC – 05 Bluetooth module, Jumper Wires, Lithium Battery.
• Software:- Arduino IDE C/C++, Arduino Bluetooth Controller.

Advantages and Disadvantages:

• Advantages:
- Real-Time Response – Provides smooth and quick movement based on user commands.
- Low Cost – Built using inexpensive and easily available components.
- Customizable – Can be enhanced with sensors for obstacle avoidance, line following, or automation.
• Disadvantages:
- Limited Range – Bluetooth control works only within a short distance (about 10 meters).
- Low Speed & Power – DC motors and battery power restrict heavy load or highspeed operation.

Existing system (feedback):

The Arduino Bluetooth-controlled car is a simple, low-cost project that demonstrates wireless control using a smartphone. It provides hands-on learning in Arduino programming, motor control, and Bluetooth communication, while also offering scope for future upgrades like sensors and automation.

Keywords: Software , Bluetooth, Arduino, Motor Drivers

I. INTRODUCTION

The rapid advancement of embedded systems and wireless communication technologies has opened new frontiers in the field of robotics and automation. Among the many innovative applications, wirelessly controlled vehicles have emerged as a fundamental concept that bridges the gap between theoretical knowledge and practical implementation. These systems are not only essential for educational purposes but also serve as the building blocks for more complex technologies such as autonomous drones, smart vehicles, and industrial automation.

The Software Controlled Car project is designed to demonstrate the seamless integration of hardware and software to achieve wireless control of a vehicle using a smartphone. The system is built around the Arduino UNO microcontroller,

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which acts as the brain of the car. It receives commands via an HC-05 Bluetooth module from a smartphone application and translates them into specific actions such as moving forward, backward, turning left or right, and stopping.

To drive the motors, the system employs an L298N motor driver module, which acts as an interface between the low-power Arduino and the high-power TT gear motors. This driver not only controls the direction of each motor but also allows for speed regulation, providing precise control over the vehicle's movement. The car is powered by a rechargeable lithium-ion battery, ensuring a stable and portable energy source for all components, including the Arduino, Bluetooth module, and motors.

This project is more than just a simple remote-controlled car; it is a comprehensive learning tool that covers key concepts in microcontroller programming, wireless communication, motor control, and circuit design. It offers students and hobbyists an opportunity to explore the practical aspects of robotics and embedded systems in a hands-on manner. Moreover, the modular design of the project allows for future enhancements, such as integrating sensors for obstacle avoidance, adding cameras for live video streaming, or connecting to the cloud for IoT-based remote monitoring.

In conclusion, the Software Controlled Car project exemplifies how fundamental engineering principles can be applied to create a functional and scalable system. It lays the groundwork for more advanced innovations and serves as an inspiring starting point for anyone interested in the world of robotics and automation.

II. LITERATURE SURVEY

The development of remote-controlled vehicles has evolved significantly from simple radio-frequency toys to sophisticated, software-driven systems. This project, titled the Software Controlled Car, focuses on integrating several core technologies that define modern robotics and automation.

A central theme in current literature is the use of open-source microcontrollers like the Arduino UNO. Research shows that the Arduino platform is highly effective for processing real-time commands and managing the complex logic required for vehicle movement. This is especially important in academic settings where students use it to learn the fundamentals of embedded systems and hardware-software integration.

Wireless communication is another critical area of study. The use of the HC-05 Bluetooth Module is a well-documented method for creating a wireless link between a smartphone and a robotic chassis. Literature suggests that Bluetooth technology provides a reliable and low-power solution for short-range control, allowing for movements like forward, backward, and turning without the need for physical cables.

Furthermore, the mechanical aspect of these systems relies on motor control interfaces. Since microcontrollers cannot provide sufficient current for physical motion, the L298N Motor Driver Module is commonly used to act as an interface between the Arduino and the TT Gear Motors. Studies highlight that this component is essential for controlling the speed and direction of DC motors. Power management for these systems has also shifted toward Lithium-ion batteries, which are preferred for their high energy density and rechargeability, making the system portable and efficient.

In conclusion, this project builds on established concepts in robotics by combining wireless communication, power electronics, and embedded programming into a single functional model.

Scope of The Project

The scope includes the following key areas:

• Wireless Communication: Implementing short-range remote control using a smartphone and an HC-05 Bluetooth module to send directional commands.

• Embedded System Integration: Using the Arduino UNO as a central processing unit to interpret software inputs and coordinate hardware responses.

• Motor Control & Power Management: Utilizing an L298N driver to manage the speed and direction of four TT gear motors, all powered by a portable lithium-ion battery system.

• Educational Foundation: Serving as a learning model for students to understand the fundamentals of robotics, circuit design, and real-time software-hardware interaction.

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• Future Development: Providing a base platform that can be expanded with sensors, cameras, or IoT capabilities for more advanced automation tasks.
• Integration of Embedded Systems: The project demonstrates the successful synchronization of software code with physical hardware components, such as the Arduino UNO, to execute real-time commands.
• Power Efficiency and Portability: The project evaluates the use of rechargeable lithium-ion battery packs to ensure the system is self-contained and portable for testing in various environments.
• Hardware Interfacing and Motor Control: The scope includes the use of the L298N motor driver to bridge the power gap between the low-voltage Arduino and the high-torque requirements of the four TT gear motors.

III. METHODOLOGY/APPROACH

To execute the Software Controlled Car project, the development follows a systematic process of hardware assembly, software programming, and wireless integration. Here is the methodology broken down into steps:
• System Design and Planning: The project begins by defining the architecture, identifying the Arduino UNO as the primary microcontroller , and selecting the L298N motor driver to handle the power requirements of the four TT gear motors.
• Hardware Assembly: The physical structure is built by mounting the four wheels to the gear motors. The L298N motor driver is wired to the Arduino UNO using jumper wires to ensure proper signal transmission , while the HC-05 Bluetooth module is connected to the microcontroller's communication pins to facilitate wireless reception.
• Power System Integration: A rechargeable lithium-ion battery pack is incorporated as the central power source, carefully wired to provide sufficient voltage to the Arduino UNO, the Bluetooth module, and the motor driver for consistent operation.
• Software Development: Code is developed and uploaded to the Arduino UNO to process serial data received via the HC-05 Bluetooth module. This code interprets specific control characters corresponding to forward, backward, left, right, and stop commands and converts them into electrical signals for the motor driver.
• Wireless Configuration and Testing: The system is paired with a smartphone using an Arduino Bluetooth Controller App. The final phase involves testing the responsiveness of the motors to the app's interface, ensuring the wireless commands translate into accurate vehicle movement.

Details of designs, working and processes

Design and Hardware Architecture

• Central Control Unit: The Arduino UNO acts as the primary microcontroller. It is responsible for receiving data from the communication module and processing those signals into logic levels that control the drive system.
• Wireless Communication: The HC-05 Bluetooth Module is integrated to allow for wireless interaction. It acts as a receiver for the control signals transmitted from a smartphone.
• Motor Driving Interface: Because the Arduino UNO cannot provide enough power to drive motors directly, an L298N Motor Driver Module is used. This module acts as an interface that regulates both the speed and direction of the motors based on inputs from the microcontroller.
• Drive System and Power: The vehicle utilizes four TT Gear Motors attached to wheels to provide physical movement. Power is supplied by a rechargeable lithium-ion battery pack, which ensures the entire system remains portable.

Circuit Diagram

Working Process

• Command Input: The user sends a specific signal (such as "forward," "backward," or "turn") via an Arduino Bluetooth Controller App on a smartphone.
• Signal Processing: The HC-05 Bluetooth module receives these wireless signals and passes them to the Arduino UNO. The microcontroller then executes the pre-programmed logic to determine which pins should be activated.

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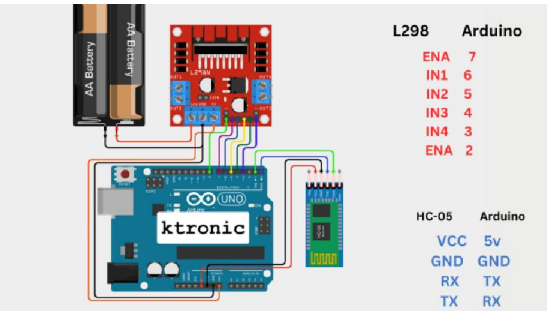
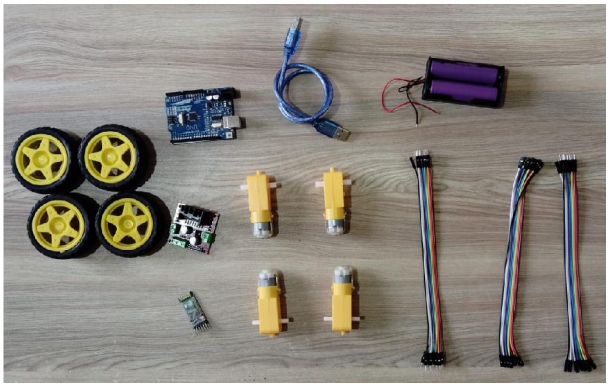
• Motor Activation: The Arduino UNO sends control signals to the L298N Motor Driver. The driver then routes the high-current power from the lithium-ion battery to the specific TT gear motors required for the requested movement.
• Circuit Construction: All components are linked using jumper wires. The L298N motor driver is wired to the Arduino UNO's digital pins (as shown in the schematic), and the HC-05 module is connected to the transmitter (TX) and receiver (RX) pins to enable serial communication.
• Real-Time Execution: Once powered by the lithium-ion battery, the system initializes. It waits for a Bluetooth handshake with the smartphone, after which it enters a real-time loop where it constantly monitors the serial buffer for new directional commands.



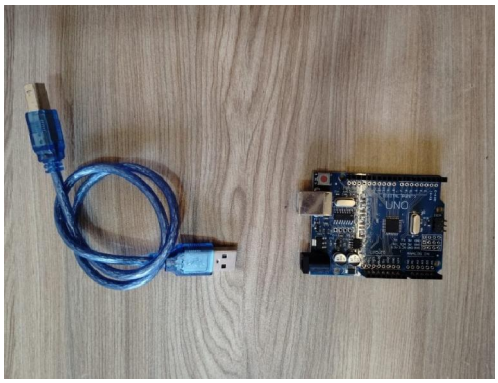
IV. RESULTS AND APPLICATIONS

Results

Components used



Arduino UNO and Data Cable



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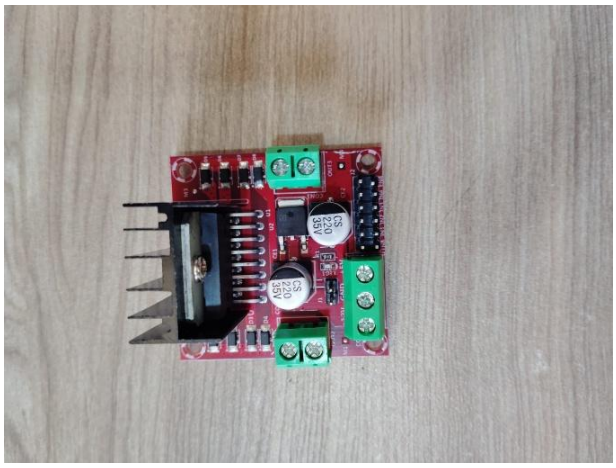
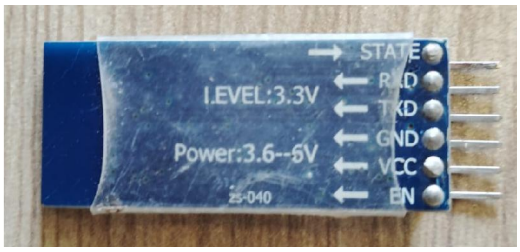
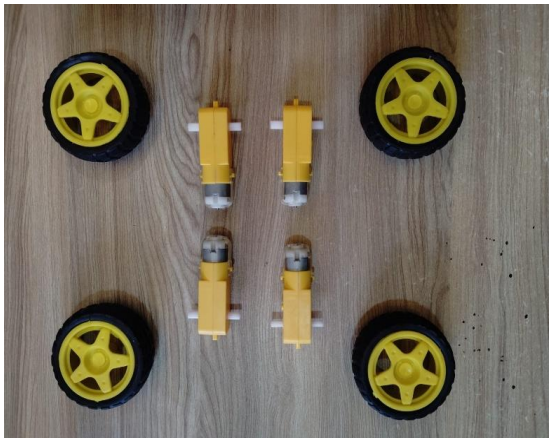


L2N8 Motor Driver



HC-05 Bluetooth Module



TT Gear Motors (x4)

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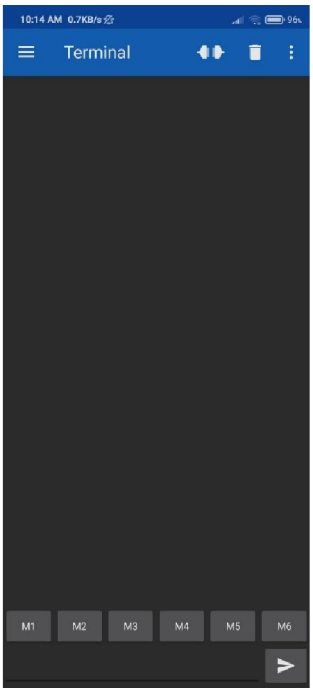
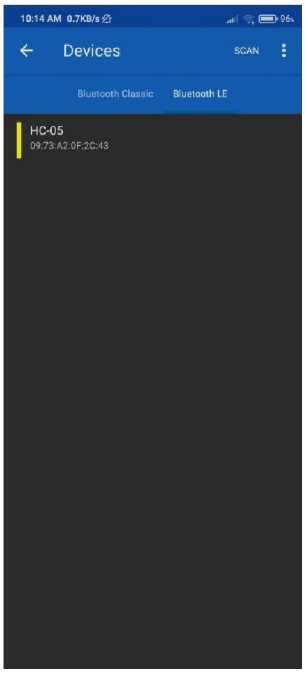
Jumper Wires

Lithium Ion Batteries (x2)



Arduino Bluetooth Controller App Interface



Bluetooth Controller USING F,B,S,L,R Commands

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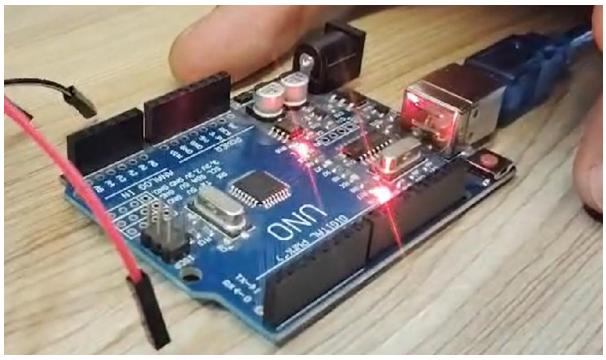
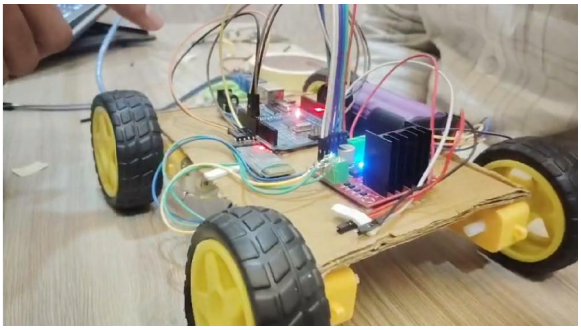
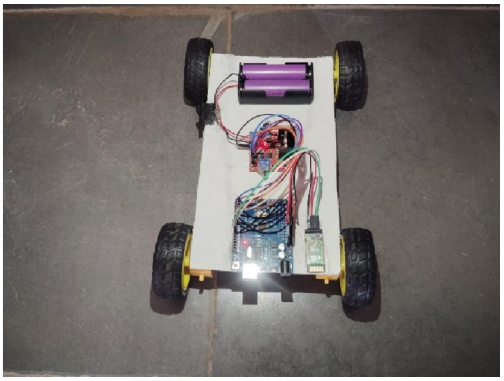


Searching for HC-05 Module

All components assembled and mounted



Finalized Model (Software Controlled Car)



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V. CONCLUSION

The software controlled car project demonstrates how a vehicle can be operated using software and wireless communication. Using components such as a microcontroller, motor driver, and Bluetooth module, the system successfully receives commands from a smartphone and controls the movement of the car. The project helps understand embedded systems, wireless control, and basic robotics..

VI. ACKNOWLEDGMENT

We express our sincere gratitude to the Vishweshwarayya Institute of Engineering and Technology, Almala for giving us the opportunity to work on the Major Project during my final year of Diploma in Computer Engineering is an important aspect in the field of engineering. We would like to thank Mr. Kazi A S M, Head of Department, Computer Engineering at Vishweshwarayya Institute of Engineering and Technology, Almala for their kind support. We also owe our sincerest gratitude towards Prof. Dharashive A. S. for her valuable advice and healthy criticism throughout my project which helped me immensely to complete my work successfully.
I would also like to thank everyone who has knowingly and unknowingly helped me throughout my work. Last but not least, a word of thanks for the authors of all those books and papers which I have consulted during my project work as well as for preparing the report.

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