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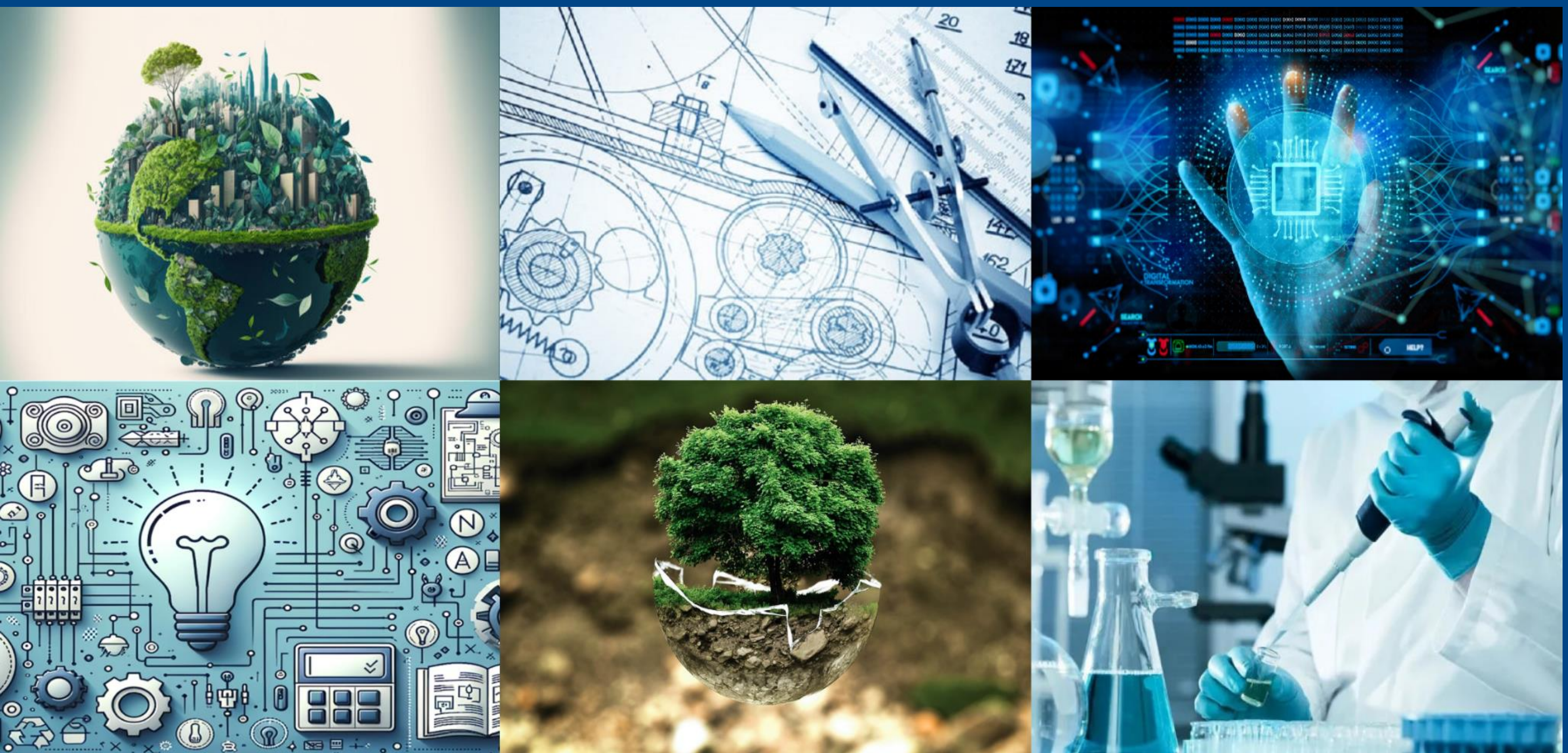

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Adriano Based Bluetooth Control Car

Prof. Vandana.G.Dake, Adifaah.A.Attar, Omkar.S.Bhondave, Pushkaraj.S.Mane

Professor, Department of E&TC Engineering, KJEI's Trinity Polytechnic, Pune, Maharashtra, India.

Adifaah.A.Attar, Omkar.S.Bhondave, Pushkaraj.S.Mane

Department of E&TC Engineering Students, KJEI's Trinity Polytechnic, Pune, Maharashtra, India

Abstract: This paper presents the design and implementation of a Bluetooth-controlled robotic car using an Arduino Uno microcontroller and an L293D motor driver IC. The aim is to create a low-cost, wireless vehicle control system that can be operated using a smartphone. The car's movements—forward, backward, left, right, and stop—are controlled via an Android application or any standard Bluetooth terminal app, which communicates wirelessly with the system through the HC-05 Bluetooth module.Upon receiving directional commands from the smartphone, the HC-05 module sends the data to the Arduino Uno. The Arduino interprets these commands and controls the DC motors accordingly through the L293D motor driver, which acts as the interface between the low-power control signals and the higher-power motors. The system offers smooth and real-time operation with minimal latency, making it suitable for educational projects, basic robotics training, and prototype development.This project demonstrates the effective use of Arduino-based embedded control, Bluetooth wireless communication, and motor driver integration in robotics. It also opens avenues for further enhancements such as obstacle avoidance, speed variation, sensor integration, and autonomous navigation.

I. INTRODUCTION

In recent years, wireless control systems have gained significant popularity due to their flexibility, user-friendliness, and ease of implementation. Among these systems, Bluetooth-based control is widely used for short-range wireless communication between devices. This project utilizes Bluetooth technology to control a robotic car using an Arduino Uno and an L293D motor driver, providing a simple and cost-effective platform for basic wireless robotics.The system is designed to be operated using an Android smartphone, which sends directional commands via Bluetooth. These commands are received by the HC-05 Bluetooth module and processed by the Arduino Uno. Based on the received input, the Arduino sends signals to the L293D motor driver, which controls the DC motors to move the car in the desired direction.The main objective of this project is to demonstrate how easily embedded systems and wireless communication can be combined to create a functional remote-controlled vehicle. The use of the Arduino platform simplifies hardware integration and code development, making it suitable for beginners, hobbyists, and students interested in robotics and embedded systems. The project also lays the foundation for more advanced applications, such as autonomous navigation, sensor-based obstacle avoidance, or IoT-enabled smart vehicles.

II. METHODOLOGY

The development of the Bluetooth-controlled car was carried out through a structured process involving component selection, hardware assembly, circuit connections, software development, and thorough testing. To begin with, essential components were selected, including the Arduino Uno microcontroller, HC-05 Bluetooth module, L293D motor driver IC, two DC motors, a chassis with wheels, and a battery pack. The Arduino Uno was chosen as the central processing unit due to its versatility and ease of programming. The HC-05 Bluetooth module was used for wireless communication with a smartphone, while the L293D motor driver enabled bidirectional control of the motors.Once the components were gathered, the hardware was assembled by mounting the Arduino and other modules onto the car chassis. The DC motors were fixed to the rear end, with proper support given using a caster wheel at the front for balance. Circuit connections were made carefully to ensure proper communication and control. The HC-05 module was connected to the Arduino's TX and RX pins for serial communication, and the L293D motor driver inputs were connected to the Arduino's digital pins. The motor outputs from the L293D were wired to the DC motors, and power was supplied through a battery pack with careful attention to voltage levels.

The software part of the project was developed using the Arduino IDE. The Arduino was programmed to continuously

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listen for incoming data from the Bluetooth module. Specific characters received, such as 'F' for forward or 'L' for left, were used to determine the direction in which the motors should rotate. Based on these inputs, the Arduino sent HIGH or LOW signals to the L293D input pins to control the motion of the car. For user input, a simple Android application or Bluetooth terminal app was used to transmit these character commands over Bluetooth.Following assembly and coding, multiple rounds of testing were conducted. Each movement command was individually verified to ensure proper response from the motors. The system was also tested for Bluetooth range, power efficiency, and response time. Troubleshooting involved checking connections, verifying code logic, and ensuring the power supply was consistent and adequate. After successful testing, the car was able to move in all four directions and stop reliably based on user input via smartphone.This methodology ensured a smooth integration of hardware and software, resulting in a responsive and user-friendly Bluetooth-controlled car. The modular design of the project allows for future enhancements such as obstacle avoidance using sensors, speed control via PWM, voice commands, and camera integration for live streaming and surveillance.

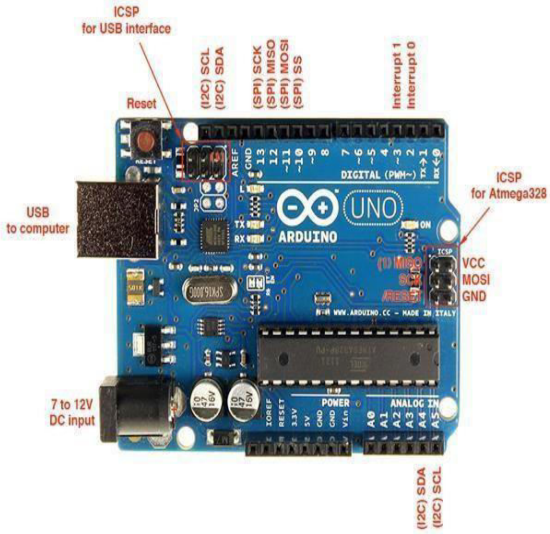

Figure 2.1: Arduino uno

III. MODELING AND ANALYSIS

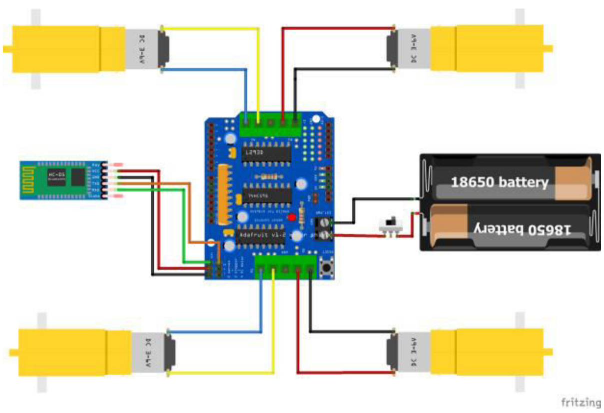

Figure3.1: Diagram of model

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The modeling of the Arduino-based Bluetooth controlled car involves both hardware and software architecture, with the main objective of achieving seamless interaction between user commands and physical movement of the vehicle. The system follows a layered design approach, where the user interface (mobile application), communication module (Bluetooth), control logic (Arduino), and actuation unit (DC motors via L293D) are all logically and functionally connected.The functional model of the system can be visualized as a real-time control system where input data (commands from a smartphone) are transmitted wirelessly via the HC-05 Bluetooth module. These commands act as triggers that are received by the Arduino Uno through its serial communication interface. The microcontroller is programmed to interpret these commands and respond accordingly by generating logic signals that drive the motor controller. The L293D motor driver acts as an intermediary that accepts low-voltage control signals from the Arduino and supplies higher current outputs required to drive the DC motors, allowing the car to perform forward, backward, left, right, and stop operations.In terms of system behavior analysis, the car responds to discrete single-character commands, each corresponding to a specific motion. This simplifies decision-making logic within the Arduino and reduces computational overhead, making the system efficient. The Arduino Uno and Bluetooth module require a regulated 5V supply, while the motors need higher voltage (typically 6–12V) for optimal performance. A dual power supply configuration was modeled—where one supply powers the logic components and the other is dedicated to motor actuation—to prevent voltage drop or interference between control and power sections. Additionally, heat dissipation in the L293D IC during prolonged operation was accounted for, ensuring that the motors operated within safe thermal and current limits.From a performance standpoint, the analysis showed that the car operated reliably within the Bluetooth range of 5–10 meters. The delay between command transmission and motor response was negligible, making the control experience smooth and intuitive. The mechanical structure and wheelbase of the chassis were analyzed to ensure balance and turning efficiency, especially while executing sharp turns or changing directions rapidly.In conclusion, the modeling and analysis confirmed that the system is highly functional, responsive, and adaptable. It showcases a well-coordinated interaction between software commands and hardware execution. The modular design also provides a strong foundation for upgrades, such as adding sensors for autonomy or integrating IoT features for remote monitoring and control.

IV. RESULTS

The Arduino-based Bluetooth controlled car was successfully designed, implemented, and tested. The car responded accurately to directional commands sent from a smartphone via the HC-05 Bluetooth module. Movements including forward, backward, left, right, and stop were executed smoothly using the L293D motor driver. The system demonstrated reliable wireless control within a range of approximately 10 meters, with minimal response delay and consistent performance during operation.

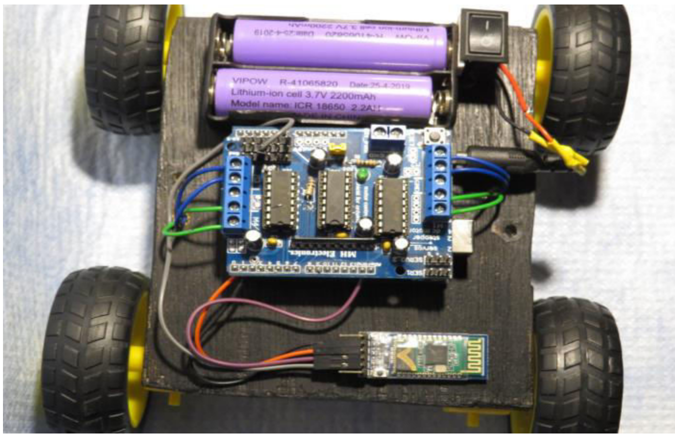

Figure 4.1: Model

V. CONCLUSION

The Arduino-based Bluetooth controlled car project was successfully implemented, achieving the primary objective of demonstrating a wireless control system for a robotic vehicle using commonly available and affordable components. The integration of the Arduino Uno microcontroller with the HC-05 Bluetooth module and the L293D motor driver enabled smooth and responsive control of the car's movement through a smartphone. By leveraging the simplicity and versatility of Arduino, the project showcases how embedded systems can be utilized for real-time wireless control applications. This made it possible to control the motor speed and direction accurately, ensuring smooth navigation of

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the car.From a performance perspective, the system was highly reliable. The Bluetooth communication maintained a stable connection within a range of 5–10 meters, and the motor driver responded promptly to control signals with minimal delay, ensuring an intuitive and effective user experience. The design of the system also accounted for power management, using separate power supplies for the logic and motor sections, preventing voltage drops and ensuring consistent operation.In terms of hardware, the modular design of the car allows easy customization and future enhancements. The project also lays the groundwork for further exploration into autonomous vehicles, IoT-based remote control, and sensor-based navigation systems.In conclusion, this project not only demonstrates the practical application of embedded systems in a simple yet effective robotic platform but also highlights the potential for future innovations in wireless control and robotics. The knowledge gained from the project can be applied to more complex robotic systems, paving the way for future developments in robotics, smart devices, and automation. The simplicity, cost-effectiveness, and versatility of this design make it an ideal project for educational purposes, hobbyists, and researchers interested in the fields of robotics and embedded systems.

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