International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Design and Development of a Bluetooth Controlled Robot

Abhijit Kr[1], Badal Raj[2], Farhan Ahmad[3], Mohamad Raza[4]

Department of Electronics and Communication Engineering, NIET, Greater Noida, India

Abstract

The project **"Design and Development of a Bluetooth Controlled Robot"** involves the designing and development of an affordable and easy-to-use wireless robotic vehicle controlled by a Bluetooth communication system through a cell phone. The system consists of a microcontroller, a Bluetooth module, motor driver, DC motors and power supply, and receives and decodes the commands for the movements such as forward, backward, left, right etc. It offers low-power, low-cost and rapid-response short-range communications. It also provides hands-on experience of control systems, programming and modern automation technologies applications. The proposed work is designing a remote-controlled robot using DC motor and motor driver module and embedded system microcontroller that uses Bluetooth communication with android application, and the robot is controlled wirelessly. With the help of this proposed work, we are able to design a remote-controlled robot using DC motor.

Keywords: Bluetooth Communication, Robotics, Wireless Control, Embedded System, Microcontroller, Android Application, DC Motor Automation, Remote-Control, Robot, Motor Driver Module I.

I. Introduction

Robotics and wireless communication technologies are rapidly growing fields in modern engineering and automation. The project **"Design and Development of a Bluetooth Controlled Robot"** is designed to develop a robot that can be controlled wirelessly using Bluetooth Communication technology through a smartphone or other Bluetooth-enabled device.

The robot consists of a microcontroller, Bluetooth module, motor driver circuit, DC motors, and a power supply system. The Bluetooth module receives commands from the user's mobile application and sends them to the controller, which operates the motors to move the robot in different directions such as forward, backward, left, and right.

The main purpose of this project is to reduce human effort and provide an easy method of wireless robotic control. Bluetooth-controlled robots are widely used in industrial automation, surveillance systems, military applications, and educational projects due to their simplicity, low cost, and efficient performance.

This project helps in understanding the concepts of robotics, embedded systems, and wireless communication while demonstrating the practical implementation of automation technology.

II. Related Works

Several researchers and developers have worked on wireless robotic systems using Bluetooth Communication and microcontrollers. A study on **Voice Controlled Robot using Bluetooth** developed a robot that responds to voice commands through a Bluetooth-enabled smartphone application.

Another research project "Bluetooth Controlled Robot with Ultrasonic Object Detection using Arduino and L293D Driver" integrated obstacle detection sensors with Bluetooth control to improve navigation and safety.

The paper Arduino-Controlled Multi-Function Robot with Bluetooth and nRF24L01+ Communication proposed a multifunction robotic system capable of wireless communication and remote operation using Arduino technology.

A related work on Multipurpose Surveillance Robot using Arduino Mega 2560 and HC-05 Bluetooth Module focused on surveillance applications by combining Bluetooth communication, camera modules, and ultrasonic sensors for remote monitoring.

These existing works demonstrate that Bluetooth-controlled robots are widely used in automation, surveillance, and smart robotic applications. The present project aims to develop a simple, cost-effective, and efficient Bluetooth-controlled robotic system for educational and practical purposes.

III. Literature Review

Robotics and wireless communication technologies have gained significant importance in recent years due to their applications in automation, surveillance, healthcare, and industrial systems. Many researchers have developed Bluetooth-controlled robotic systems using microcontrollers and Android applications for remote operation.

A study titled *"Arduino Based Bluetooth Controlled Robot"* explained the use of Bluetooth Communication with Arduino Uno to control robot movement through an Android application. The system used UART communication between the Bluetooth module and the microcontroller for wireless control.

Another research work, *"Android Phone Controlled Bluetooth Robot"*, presented a robotic vehicle controlled through a smartphone. The study highlighted the advantages of robots in surveillance, industrial automation, and hazardous operations while focusing on wireless robotic navigation.

The paper *"Voice Controlled Robot using Bluetooth"* introduced a robot that responds to voice commands transmitted through Bluetooth communication. This work demonstrated improved user interaction and ease of robotic control using mobile devices.

Researchers also developed systems integrating obstacle avoidance with Bluetooth-controlled robots. In *"Design and Implementation of an IoT-Enabled Bluetooth Robot Car with Obstacle Avoidance"*,

ultrasonic sensors were combined with Bluetooth technology to improve navigation and collision prevention.

Another study on *"Obstacle Avoiding Bluetooth Robot Car using the Internet of Things"* discussed both manual and automatic modes of robot control using Arduino Uno, HC-05 Bluetooth modules, motor drivers, and ultrasonic sensors.

These studies show that Bluetooth-controlled robots are effective for remote control and automation applications. The present project focuses on designing a simple, low-cost, and efficient Bluetooth-controlled robot for educational and practical use.

IV. **System Architect**

The **Bluetooth Controlled Robot** is designed using a layered architecture that integrates hardware components, communication modules, and control logic to achieve wireless movement control.

a. Input Layer

The input commands are given by the user through a smartphone application. These commands include movement instructions such as forward, backward, left, and right, transmitted via Bluetooth Communication.

b. Communication Layer

The HC-05 Bluetooth module receives the wireless signals from the mobile device and converts them into serial data. This data is then sent to the microcontroller for processing.

c. Control Layer

The Arduino Uno R3 acts as the central control unit. It processes the received commands and generates appropriate control signals for motor operation based on the programmed logic.

d. Actuation Layer

The ICL293D motor driver receives signals from the Arduino and drives the BO motors accordingly. These motors control the wheels, enabling movement of the robot in different directions.

e. Output Layer

The mechanical structure (wheels and chassis) executes the movement commands, resulting in real-time robot motion.

f. Summary Flow

Mobile App → Bluetooth Module → Arduino → Motor Driver → DC Motors → Robot Movement

This architecture ensures efficient communication, accurate control, and smooth operation of the robotic system.

V. Processing Module

The processing module of the **Bluetooth Controlled Robot** is responsible for receiving, interpreting, and executing the commands sent by the user through Bluetooth Communication.

The main processing unit is the Arduino Uno R3, which acts as the brain of the system. It receives serial data from the HC-05 Bluetooth module and processes the incoming instructions using the embedded program.

Once a command is received (such as forward, backward, left, or right), the Arduino decodes it and generates corresponding control signals. These signals are then sent to the motor driver (ICL293D), which activates the DC motors accordingly.

The processing module ensures real-time response, accurate decision-making, and smooth coordination between input commands and robot movement. It plays a key role in converting wireless user inputs into physical actions of the robot.

VI. Evidence Capture Module

The Evidence Capture Module is an optional extension of the **Bluetooth Controlled Robot** that is used to record and monitor the robot's surroundings during operation. This module is mainly used in surveillance and security-based applications.

It typically includes a camera module or sensor system mounted on the robot, which captures images or video in real time. The data collected is either stored locally or transmitted wirelessly for monitoring purposes.

The module can be integrated with the Arduino Uno R3 or an external processing unit to control when and how the data is captured. In advanced versions, the captured evidence can be displayed on a mobile application connected through Bluetooth Communication or other wireless networks.

This module enhances the functionality of the robot by enabling real-time observation, data collection, and remote monitoring, making it suitable for security, military, and inspection-based applications.

VII. Communication Module

The Communication Module in the **Bluetooth Controlled Robot** is responsible for enabling wireless data transfer between the user and the robot using Bluetooth Communication.

The HC-05 Bluetooth module acts as the main communication interface. It receives control commands from a smartphone or other Bluetooth-enabled device and transmits them to the control unit in serial form. These commands include directional instructions such as forward, backward, left, and right.

The communication module works in a master-slave configuration, where the mobile device acts as the master and the HC-05 module acts as the slave. It ensures short-range, low-power, and real-time communication between the user and the robot.

This module provides reliable wireless connectivity within a range of approximately 8–10 meters in open space. It plays a key role in enabling smooth and responsive control of the robot without physical wiring.

E. Remote Monitoring Unit

The Remote Monitoring Unit in the **Bluetooth Controlled Robot** is an optional subsystem used to observe and track the robot's activity from a distance during operation.

This unit allows the user to monitor robot movement and surroundings in real time while controlling it through Bluetooth Communication. It typically includes a smartphone or external display interface connected to the system.

In advanced versions, sensors or a camera module can be added to collect live data, which is then displayed or recorded for analysis. The control signals are processed by the Arduino Uno R3, while the monitoring interface shows the robot's status and actions.

The main purpose of this unit is to improve user awareness, enhance control accuracy, and support applications like surveillance, inspection, and remote operations.

VIII. Hardware Implementation

The hardware implementation of the **Bluetooth Controlled Robot** involves assembling and integrating all electronic and mechanical components to achieve proper wireless control and movement.

The system is built around the Arduino Uno R3, which acts as the main control unit. The HC-05 Bluetooth module is connected to the Arduino to receive wireless commands from a smartphone using Bluetooth Communication.

The ICL293D motor driver is interfaced with the Arduino to control the direction and speed of the BO motors. The motors are mounted on the chassis along with wheels and a caster wheel for stable movement. A 9V battery is used to power the entire circuit.

All components are connected using a breadboard and connecting wires to ensure proper signal flow. After uploading the control program to the Arduino, the robot is tested by sending movement commands through the mobile application.

The final hardware setup successfully enables real-time wireless control, smooth motion, and stable operation of the robot.

.

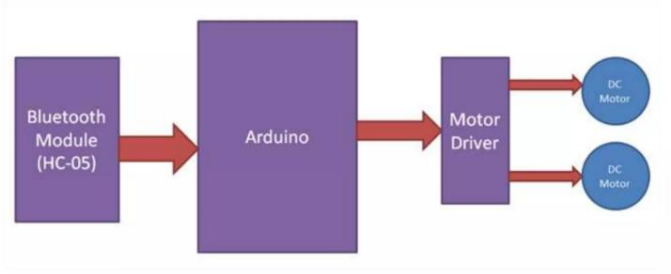

Fig. 1. Block Diagram of Bluetooth controlled Robot

IX. Software implementation

The software implementation of the **Bluetooth Controlled Robot** involves writing and uploading a control program to the Arduino Uno R3 to manage robot movements based on user commands.

The program is developed using the Arduino IDE, where the code is written in C/C++ language. The HC-05 Bluetooth module is configured for serial communication to receive data from a smartphone using Bluetooth Communication.

In the software logic, specific characters or commands (such as 'F' for forward, 'B' for backward, 'L' for left, and 'R' for right) are defined. The Arduino continuously reads incoming Bluetooth signals and compares them with predefined conditions. Based on the received input, it sends appropriate signals to the motor driver to control BO motors.

The software ensures real-time response, smooth control, and accurate execution of movement commands. This implementation plays a key role in converting wireless instructions into physical actions of the robot.

X. Results

The **Bluetooth Controlled Robot** was successfully designed, developed, and tested using Arduino Uno R3, HC-05 Bluetooth module, motor driver IC, and DC motors. The robot responded accurately to commands sent from a smartphone through Bluetooth Communication.

During testing, the robot performed all required movements—forward, backward, left, and right—smoothly and without significant delay. The communication between the mobile application and the robot remained stable within the effective Bluetooth range.

The motor control system worked efficiently, and the robot showed good stability due to proper chassis design and balanced weight distribution. The system also demonstrated low power consumption and simple operation.

Overall, the project successfully achieved its objective of developing a low-cost, user-friendly wireless robotic system suitable for educational and basic automation applications.

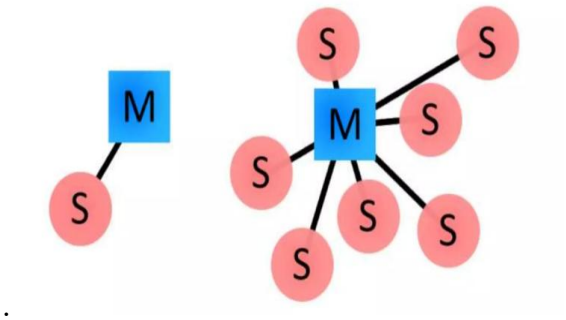

Fig 2. Bluetooth Master/Slave piconet topologies

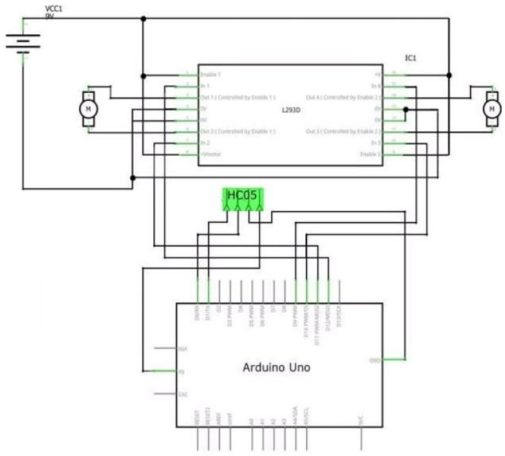

Fig 3. Schematic diagram of Bluetooth Controlled car

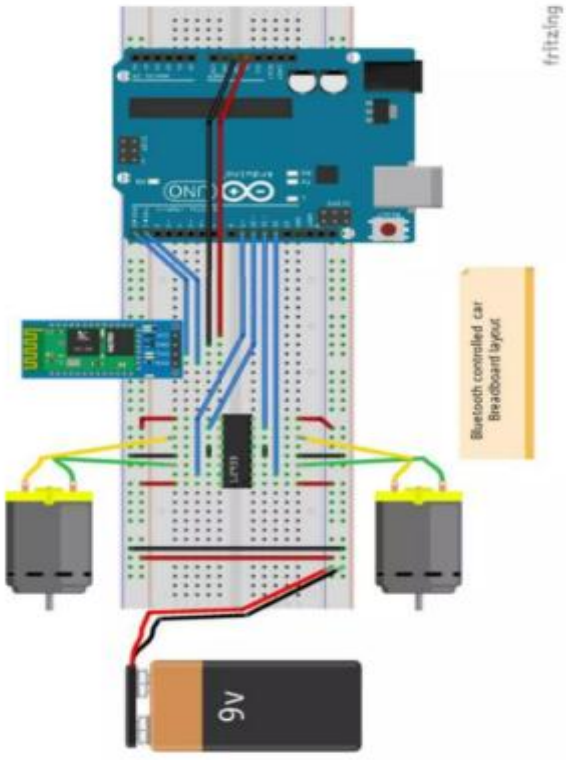

Fig 4. Circuit Diagram

XI. Conclusion

The **Bluetooth Controlled Robot** was successfully designed and implemented using Arduino Uno R3 and HC-05 Bluetooth module with efficient integration of hardware and software components. The system effectively demonstrates wireless robot control using Bluetooth Communication.

The robot performed all intended movements accurately based on commands received from a smartphone application. The project proved to be simple, cost-effective, and reliable for short-range wireless control applications.

This work enhances understanding of robotics, embedded systems, and wireless communication. It also provides a strong foundation for future improvements such as obstacle avoidance, voice control, and advanced sensor integration for smarter robotic systems.

REFERENCES

[1]. Nelwan, P. Manembu, and F. Wauran, "Wireless Residential Electric Controller Using Arduino Uno and HC-05 Bluetooth Module," *Journal Edunitro*, vol. 3, no. 1, pp. 1–6, 2023.

[2] S. S. M. Ghouse et al., "Landmine Detection HC-05 Bluetooth Controlled Robot using GPS and GSM Technology," *International Journal of Computer Sciences and Engineering*, vol. 7, no. 14, pp. 448–452, 2026.

[3] R. Brindha et al., "Enviro Guard: A Bluetooth-Controlled Sensing Robot for Environmental Monitoring," *IEEE ICIRCA Proceedings*, pp. 304–312, 2025.

[4] A. Chairunnas and T. G. Pamungka, "Balancing Robot Control System Based on Arduino Using PID Method with HC-05 Bluetooth Communication," *Komputasi Journal*, 2024.

[5] A. Kumar et al., "Wheeled Robotic Arm Using Arduino Controlled Through Bluetooth," *Recent Developments in Electronics and Communication Systems*, 2023.

[6] G. D. Perkasa and F. Y. Setiono, "Advanced Line Follower Robot with Smartphone-Based Control using HC-05 Bluetooth," *Elektrika Journal*, 2024.

[7] M. Z. H. Bhuiyan et al., "Multipurpose Surveillance Robot using Arduino Mega 2560 and HC-05 Bluetooth Module," 2024.

[8] R. Umamaheswari et al., "Design and Fabrication of an Automated Robot using Arduino-Assisted HC-05 Bluetooth Module," *Engineering Proceedings*, 2024.

[9] V. Kramov and O. Bauzha, "Remote Monitoring System using Arduino and Bluetooth HC-05 Modules," 2020.

[10] D. Kulkarni et al., "Speech Controlled Robot using Arduino and Bluetooth Module HC-06," 2015.