Arduino Based Bluetooth

Control Device

Supervised by:

Dr. Nishat Anwar

Presented by:

Harshit Jajoo(2102109)

Vinod Kumar (2102048)

L.Harsha Vardhan (2102069)

Palaparthi Vamsi (2102127)

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Introduction

The **Arduino Bluetooth control device** is an innovative system that combines hardware and software to enable wireless, real-time control and monitoring of various components. This device provides seamless communication between the Arduino board and external devices through a mobile app via Bluetooth, offering users the ability to control and monitor sensors from a remote location. The integration of Bluetooth technology makes it possible to receive real-time data from sensors and transmit that data to a mobile app for immediate feedback and control.

At the heart of the hardware is the **HC-05 Bluetooth module**, which is connected to the Arduino board. This module facilitates the wireless communication between the smartphone app and the Arduino system. The Arduino board serves as the core processing unit, receiving and interpreting data from connected components such as sensors and LEDs. The **IR sensor** captures real-world data, and the LED provides visual feedback, allowing the system to be highly interactive and responsive to user commands. The wireless connection not only enables control of the components but also allows the user to receive sensor data in real time.

On the software side, an Arduino program is uploaded to the board, allowing it to interpret and execute commands sent via Bluetooth. The **mobile app** acts as the user interface, sending commands to the Arduino system and displaying real-time sensor data. Beyond the mobile app, the system also includes a **website** that is remotely accessible. This website, hosted on **Vercel** and integrated with GitHub, displays the same real-time data seen on the mobile app, providing remote users with the ability to monitor and control the system from any location with internet access.

This combination of hardware and software creates a robust and flexible platform for controlling devices wirelessly while monitoring real-time data. The integration of Bluetooth, mobile app functionality, and remote web access makes the Arduino Bluetooth control device a powerful tool for managing and observing devices remotely, whether for home automation, industrial monitoring, or educational purposes

Components

The Bluetooth-controlled system integrates both hardware and software components to facilitate seamless wireless control and real-time monitoring of devices. Each element plays a pivotal role in ensuring the system's overall functionality, user-friendliness, and adaptability for a variety of applications.

Software Components

The **software components** of the system provide the foundation for control and monitoring, offering a seamless user experience. These components are:

Centralized Functionality: The mobile app acts as a centralized platform for controlling and monitoring devices. The app utilizes Bluetooth technology, allowing users to send and receive commands to the Arduino board wirelessly.

Device Control:

- **On/Off LED Control**: Users can toggle LED states via the app, which communicates with the Arduino through the HC-05 Bluetooth module, enabling remote operation.
- **Normal Light Control**: Beyond just controlling LEDs, the app also extends its functionality to managing other devices like normal lighting, providing a unified platform for control.

Real-Time Monitoring:

- **App Terminal Feature**: The app includes a terminal for displaying real-time data, such as readings from the IR sensor. This feature ensures that users can receive immediate feedback on sensor data, allowing for timely actions or adjustments based on the sensor's output.
- **IR Sensor Data**: Real-time readings from the IR sensor are streamed directly to the app's terminal, enabling users to monitor environmental parameters like temperature or motion.

Website Integration: In addition to the app's real-time display, the system includes a **website** that receives and displays data from the app. This website, hosted on **Vercel** and integrated with **GitHub**, provides remote access and monitoring capabilities. Users can view real-time sensor data and control devices remotely, offering a seamless experience for monitoring and management from any location.

Hardware Components

The hardware components form the foundation of the Bluetooth-controlled system, each playing a pivotal role in ensuring seamless functionality and user interaction.

Arduino Board: The Arduino Board serves as the central processing unit, functioning as the brain of the Bluetooth-controlled system. This compact microcontroller interprets instructions, executes commands, and orchestrates the overall functionality, providing the computational intelligence that drives the entire system.

Relay: A relay is an electrically operated switch that uses a small control signal to control a larger electrical load. It consists of an electromagnet, armature, spring, and contacts. When the coil is energized by the control signal, the magnetic field moves the armature, opening or closing the contacts to control the connected circuit. Relays provide electrical isolation and enable control of high-power devices with low-power signals. They come in various types, such as electromechanical, solid-state, and reed relays, and are used in home automation, industrial systems, automotive applications, and embedded systems for switching, protection, and automation tasks.

HC05 Bluetooth Module: The HC05 Bluetooth Module serves as a vital component enabling wireless communication within the system. This module establishes a seamless connection between the Arduino-controlled system and external devices, acting as the bridge for remote control and real-time monitoring through the Bluetooth-controlled app. Its wireless capabilities enhance user convenience and extend the system's reach, allowing for control and monitoring from a distance.

IR Sensor: The Infrared (IR) Sensor significantly enhances the system's capabilities by capturing real-world data. This versatile sensor detects infrared radiation, enabling the monitoring of environmental parameters such as temperature or motion. Its adaptability broadens the system's utility, making it a versatile tool for diverse applications.

LED (Light-Emitting Diode): The LED acts as a visual feedback mechanism, offering immediate indications of the system's status. Whether illuminating to signify an active Bluetooth connection or conveying specific states, the LED enhances user awareness and interaction, providing tangible feedback during system operations.

Working Principle

On/Off Bulb Control

The **on/off bulb control** enhances the Bluetooth-controlled system by incorporating a bulb, extending its functionality to real-world applications. This demonstrates the system's ability to manage higher electrical loads effectively while maintaining the same operational flow. A relay module is utilized to handle the bulb's higher current requirements, ensuring electrical isolation, safety, and seamless operation.

User Input:

The process begins when the user sends an "on" or "off" command through the Bluetooth-controlled app. This command is wirelessly transmitted to the Arduino board via the HC-05 Bluetooth module.

Bluetooth Communication:

The HC-05 Bluetooth module enables wireless communication between the app and the Arduino board. It ensures the reliable transmission of user commands, enabling real-time control of the connected bulb.

Arduino Processing:

The Arduino board interprets the user's command and determines the appropriate action. Using a **relay module**, the Arduino safely switches the power supply to the bulb:

- The relay provides electrical isolation, enabling the Arduino to handle higher voltages and currents required by the bulb without direct contact with the high-power circuit.

Bulb State Adjustment:

1. **Bulb On**:
    a. Upon receiving the "on" command, the Arduino activates the relay.
    b. The relay's switch closes, completing the circuit and allowing current to flow to the bulb, lighting it up.
2. **Bulb Off**:
    a. Upon receiving the "off" command, the Arduino deactivates the relay.
    b. The relay's switch opens, breaking the circuit and cutting off power to the bulb, turning it off.

Visual Feedback:

The bulb serves as a visual indicator of the system's actions. Users can instantly verify the command execution by observing whether the bulb is illuminated or off.

Website Monitoring:

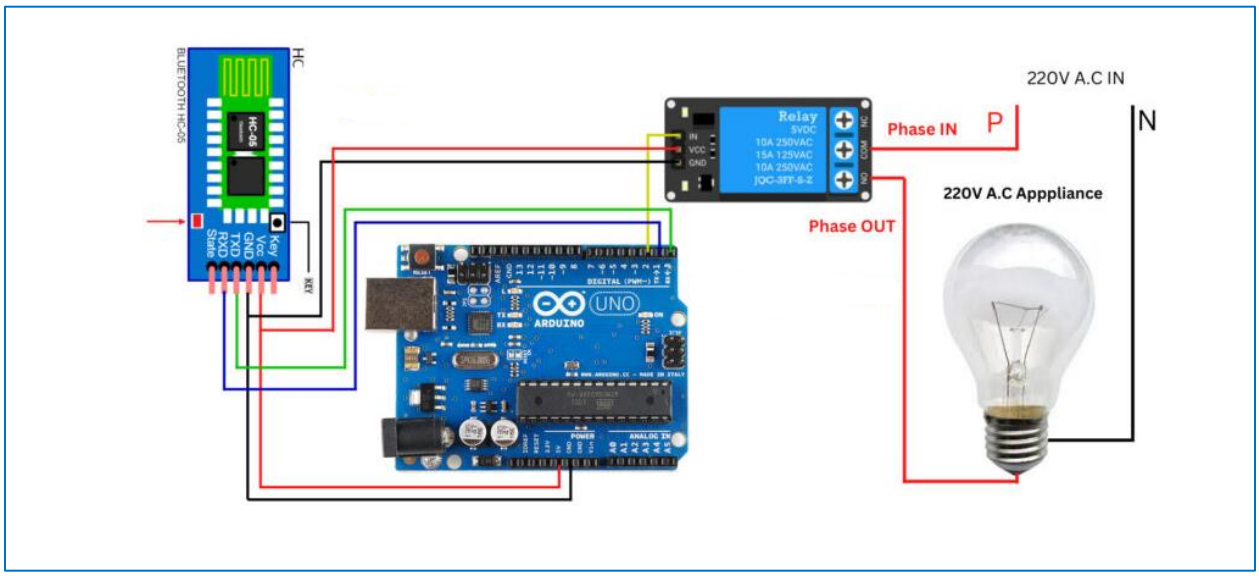
The system updates the bulb's status on a remote website for real-time monitoring:

- The website displays the bulb's current state (on/off), providing users with transparency and accessibility.
- This synchronization ensures users can monitor and control the bulb from any location, enhancing the system's versatility.

Real-World Integration:

By integrating a bulb and a **relay module**, the system demonstrates its practical applications for controlling high-power devices. The relay ensures safe and efficient operation, enabling the system to scale from simple prototypes (e.g., LEDs) to practical IoT solutions for home automation and industrial use cases.

This integration highlights the system's adaptability, showcasing its ability to manage both low-power devices like LEDs and high-power appliances like bulbs within a single, Bluetooth-controlled infrastructure.

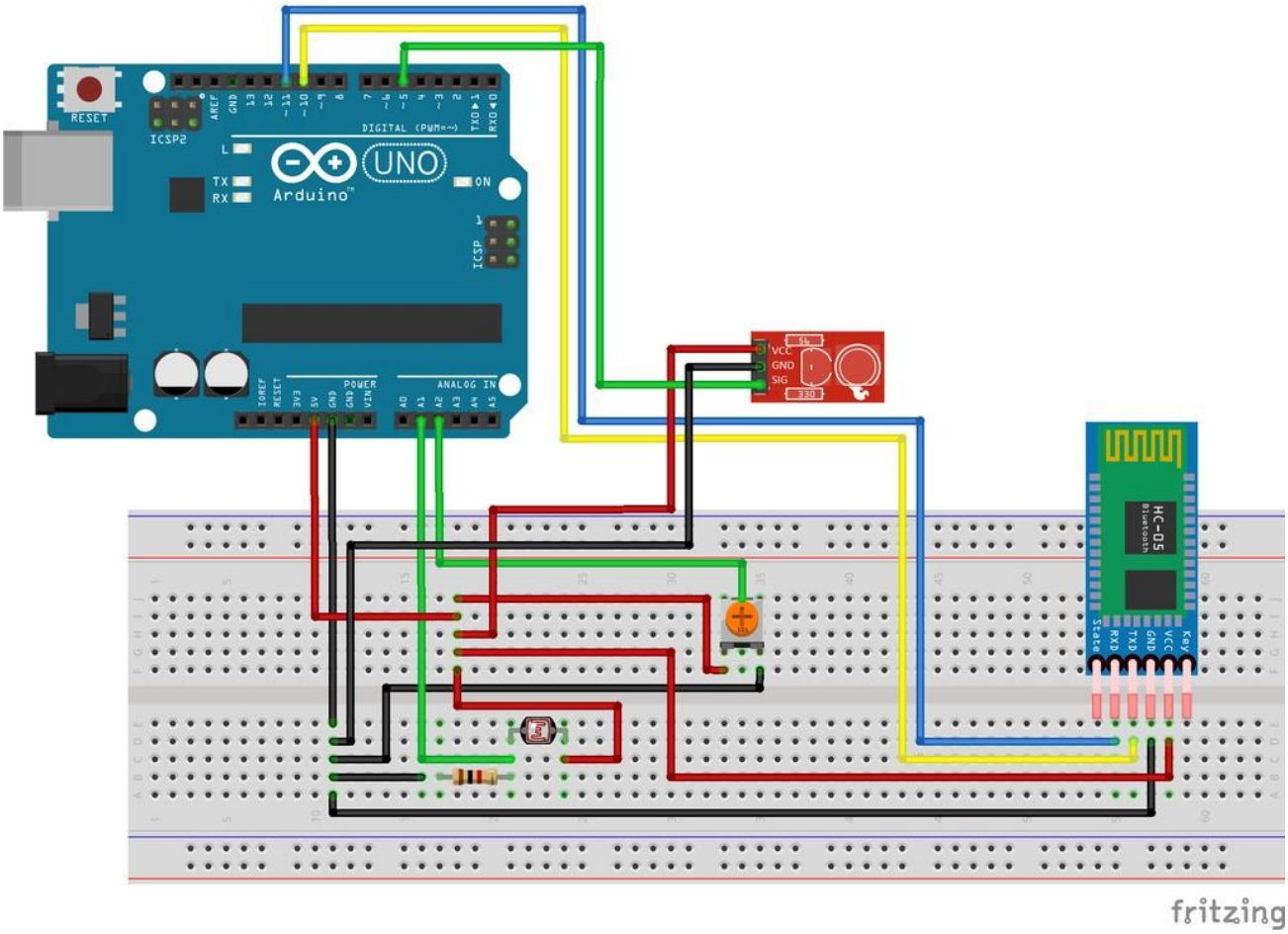


Real-Time Monitoring

The real-time monitoring feature enables continuous observation of data from the IR sensor, with information displayed both on the app and the remote website, allowing users to track environmental changes dynamically.

1. **Continuous IR Sensor Reading**:
    a. The **IR sensor** is continuously active, capturing real-world data such as temperature, motion, or other parameters. This data is transmitted in real time to the Arduino board for processing.
2. **Arduino Processing**:
    a. The Arduino board processes the incoming data from the IR sensor, interpreting the readings and preparing them for transmission to the Bluetooth-controlled app.
3. **Bluetooth Communication**:
    a. The **HC-05 Bluetooth module** facilitates wireless communication between the Arduino board and the app, transmitting the processed sensor readings seamlessly in real time.
4. **App Terminal Display**:
    a. The Bluetooth-controlled app includes a terminal display feature that shows real-time data such as IR sensor readings. Users can monitor these readings and make decisions based on the live data.
5. **User Interface Interaction**:
    a. Through the app, users can observe real-time changes in the data, such as temperature fluctuations or motion detection, providing instant feedback on the monitored environment.
6. **Website Monitoring**:
    a. In addition to the app, the sensor data is also displayed on the **remote website**, allowing users to access and monitor this information from any location. The app ensures that the sensor data is regularly updated on the website for remote monitoring. This integration enables the user to track environmental conditions even when they are not physically near the system.
7. **Practical Application**:
    a. The real-time monitoring system proves to be highly practical for applications like home automation, security systems, or environmental monitoring. The continuous data flow between the sensor, the app, and the website ensures that users remain informed of any changes in the environment, allowing them to respond promptly.

In both **LED control** and **real-time monitoring**, the system integrates hardware components, wireless Bluetooth communication, user interfaces, and remote monitoring through the website. This combination creates a robust, user-friendly, and adaptable Bluetooth-controlled system that can be managed both locally and remotely.



Conclusion

The Bluetooth-controlled system presented in this report demonstrates an effective integration of hardware and software components, resulting in a versatile and user-friendly solution for wireless device control and real-time monitoring. The seamless communication between the Arduino board, HC-05 Bluetooth module, and the mobile app forms the core of the system, enabling intuitive control of devices like LEDs and bulbs, as well as dynamic, real-time monitoring of sensor data, particularly from the IR sensor.

Incorporating the **LED control function**, the system offers precise and immediate visual feedback both on the app and through a remote-access website. This feature allows users to monitor and control the LED state from any location, adding convenience and reliability. Additionally, the inclusion of **bulb control** expands the system's capability to manage higher-power devices, bridging the gap between simulation and real-world applications. The relay module ensures safe and efficient operation of the bulb, highlighting the system's scalability for broader IoT applications, such as home automation and industrial device management.

The real-time monitoring feature further enhances the system's practicality by continuously streaming sensor data to the app and website. This capability enables users to remotely observe and respond to environmental changes, making the system valuable for applications like security, environmental monitoring, and automation.

Overall, this Bluetooth-controlled system stands as an innovative, robust, and flexible solution for both local and remote device control and monitoring. Its ability to handle a range of devices, from low-power LEDs to high-power bulbs, alongside real-time data streaming, offers significant potential for future expansion and adaptability across diverse use cases.

References

Software Resources:

- **Arduino Software**: https://www.arduino.cc/en/software
- **Android Studio**: https://developer.android.com/studio
- **Vercel**: https://vercel.com
- **GitHub**: https://github.com

Hardware Resource:

- HC-05 Bluetooth Module Datasheet
- Programming Arduino: Getting Started with Sketches
- Arduino Board Uno Documentation

Important Links:

- **Monitoring Website**: https://aurdino-control-frontend.vercel.app
- **Electronics For You**: https://www.electronicsforu.com
- **ElectronicWings**: https://www.electronicwings.com
- **GeeksforGeeks**: https://www.geeksforgeeks.org
- **Arduino Official Website**: https://www.arduino.cc