



## BLUE

# TOOTH-CONTROLLED HOME AUTOMATION USING ARDUINO

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### ABSTRACT

Nowadays Everyone wants to handle any device or machine simply and effectively. The Bluetooth-controlled home automation system using Arduino is a smart and efficient way to control home appliances remotely. This project utilizes a Bluetooth Module (HC-05) and an Arduino UNO to control various home appliances such as gates, lights, fans, and many other electrical devices wirelessly through a smartphone or any other device. The Android application developed for this system allows users to pair their smartphones with the Bluetooth module and control the connected devices with ease. Bluetooth-controlled Home Automation system enables users to operate home appliances from a distance, providing convenience and energy efficiency. This project is a cost-effective, user-friendly, and customizable solution for home automation, this project is enhancing the comfort and convenience of modern living.

**Keywords:** Arduino, Home automation, Wireless, Bluetooth, Smartphone.

### INTRODUCTION

In recent years, the concept of Bluetooth-controlled home automation has gained significant traction due to the growing demand for smart and efficient living solutions and the advancement of technology. Bluetooth Bluetooth-controlled home automation systems enable users to control various household appliances and devices remotely, providing energy efficiency, convenience, and enhanced security. Among the various technologies used for home automation, Bluetooth communication stands out as a popular and cost-effective solution due to its widespread availability and ease of implementation.

The basic objective of this research is to design and implement a reliable and user-friendly Bluetooth-controlled home automation system using Arduino. The system's hardware and software components will be discussed in detail, along with the methodology used for system development.

This research aims to advance the field of home automation by creating a cost-effective and user-friendly solution. Leveraging Arduino and Bluetooth technology, the proposed system ensures efficiency. It has the potential to improve the comfort, convenience, and energy efficiency of modern homes, appealing to homeowners, builders, and technology enthusiasts alike.

### SYSTEM ARCHITECTURE

The Bluetooth-controlled home automation system comprises both hardware and software components, working together to provide seamless control over various home devices.

#### 2.1. Hardware Components:

The system is composed of various hardware components, including:

##### 2.1.1. Arduino Uno:

The Arduino Uno board stands out as a cornerstone in electronics and embedded systems projects. Central to its functionality is the ATmega328P microcontroller, clocked at 16MHz. With 14 digital input/output pins, including 6 PWM outputs, and an additional 6 Analog input pins, it offers extensive versatility for project development and experimentation.

Operating at 5V, it can accept voltages between 7V and 20V, making it adaptable to various power sources. With its USB interface for programming and serial communication, barrel jack for power supply, and ICSP header for in-circuit programming, the Arduino Uno is versatile and easy to use. Programmable using the Arduino IDE, the Uno board is open-source hardware, allowing for modifications and customizations. It is widely used in prototyping, experimentation, and the development of various electronic projects, including home automation systems, robotics, and IoT devices.

Figure 3(a) of the Arduino UNO board is given below.



Figure 3(a): Arduino Uno Board

### 2.1.2. Relay Module:

A relay module is a crucial component in electronic circuits, facilitating the control of high-power devices using low-power signals. Comprising one or more relays, a driver circuit, and input/output pins, the module acts as an interface between the low-power control signals from microcontrollers and the high-power devices. The relay, an electromechanical switch, can open or close its contacts in response to an electrical signal, allowing or interrupting the flow of current in the high-power circuit. Typically available in various configurations, such as single-channel or multi-channel, relay modules are widely used in applications such as home automation, robotics, and industrial automation, providing efficient and reliable control over a wide range of electrical devices and systems.

Figure 3(b) of the 5v Relay Module is given below.



Figure 2(b): Relay Module

### 2.1.3. Bluetooth Module (HC-05):

The HC-05 Bluetooth module is an incredibly versatile component widely employed in electronic projects. It facilitates seamless wireless communication between microcontrollers and various devices. Operating in both master and slave modes, this module supports serial UART communication, simplifying its integration with microcontroller platforms such as Arduino. With its wide operating voltage range, compact form factor, and support for an AT command set, the HC-05 module is ideal for applications requiring wireless data transmission, remote control systems, and Bluetooth-based home automation projects. Its ability to establish reliable connections over short distances, typically up to 10 meters, makes it a popular choice for a wide range of wireless communication needs in electronics projects.

Figure 3(c) of the Bluetooth Module HC-05 is given below.



Figure 3(c): Bluetooth Module (HC-05)

## 2.2. Hardware Components:

### 2.2.1. Arduino IDE:

The Arduino Integrated Development Environment (IDE) serves as the primary platform for writing, compiling, and uploading code to the Arduino board. Utilizing Arduino Sketch, a simplified version of the C++ programming language, the IDE provides an intuitive interface for programming the Arduino microcontroller.

In the Arduino IDE code provided below, a state variable is utilized to store the value of the received byte. This value is then compared with different conditions to perform specific operations, such as turning the light ON and OFF.

```
char state = '0';

void setup() {
  Serial.begin(9600);
  pinMode(3, OUTPUT);
}
```

```

void loop() {
  if (Serial.available() > 0) {
    state = Serial.read();
    if (state == '1') {
      digitalWrite(3, HIGH);
      Serial.println("Light is ON");
    } else if (state == '0') {
      digitalWrite(13, LOW);
      Serial.println("Light is OFF");
    }
  }
}

```

The code above demonstrates how to control a light using Bluetooth communication. When the Arduino receives the byte '1' via Bluetooth, it turns the light ON. Conversely, when it receives the byte '0', it turns the light OFF.

### 2.2.2. Bluetooth Communication Protocols:

Bluetooth communication protocols are vital for establishing a secure and reliable connection between the Arduino board and the smartphone. In this system, we utilize a Bluetooth Serial Port Profile (SPP) for communication. The SPP enables a transparent serial data connection between devices, facilitating seamless communication. Once the smartphone is paired with the Bluetooth module (HC-05/HC-06) connected to the Arduino board, a trusted connection is established.

The smartphone sends commands to the Arduino board via Bluetooth, which are then received by the Bluetooth module and forwarded to the Arduino board for processing. The Arduino board processes the received commands and controls the connected appliances accordingly. For example, if the command received is '1', the Arduino board turns the light ON, and if the command is '0', it turns the light OFF. Additionally, the Arduino board sends feedback to the smartphone confirming the execution of the command, ensuring that the user is informed about the status of the connected appliances. By employing Bluetooth communication protocols, we ensure that the communication between the Arduino board and the smartphone is secure, reliable, and efficient, providing a seamless user experience.

## METHODOLOGY

The methodology for implementing a Bluetooth-controlled home automation system using Arduino involves designing the system architecture, comprising both hardware and software components. The hardware setup includes selecting and connecting the necessary components such as an Arduino board, Bluetooth module, and relay modules. In the Bluetooth-controlled home automation system, the Bluetooth module is

connected to the Arduino's Rx and Tx pins, facilitating data exchange with the microcontroller.

The Arduino reads this data and sends it to the relay drivers, which act as switches for controlling home appliances. The relay modules are connected to the Arduino's digital output pins, allowing the microcontroller to control them. By uploading specific programs to the Arduino, it performs necessary mathematical and logical operations, enabling precise control of the relay drivers based on user commands received via Bluetooth as you can see the Figure3(a) below.

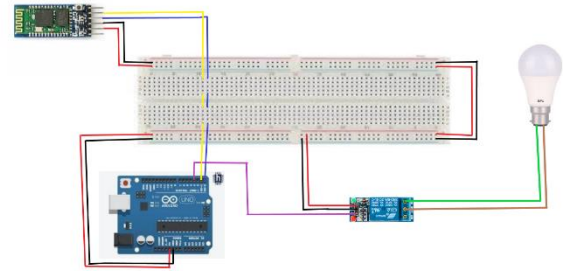


Figure 3(a): Connection Diagram

The connection of the diagram is as follows:

### 3.1. Bluetooth Module (HC-05) to Arduino:

1. Connect the Tx and Rx pins of HC-05 to the Rx and Tx pins of the Arduino Board respectively.
2. Connect the VCC and GND pins of HC-05 to the 5v and GND pins of the Arduino board respectively.

### 3.2. Relay Module to Arduino Board:

1. Connect the VCC and GND pins of the relay module to the 5v and GND pins of the Arduino Board.
2. Connect the pin IN of the relay module to pin 3 of the Arduino board.

### 3.3. Bluetooth Module to Android Device:

1. First, download the Android app Arduino Bluetooth Control from the Play Store.
2. Open the app and connect the Bluetooth with Android Device.
3. Now press the "1" to on and the "2" buttons to close the LED.

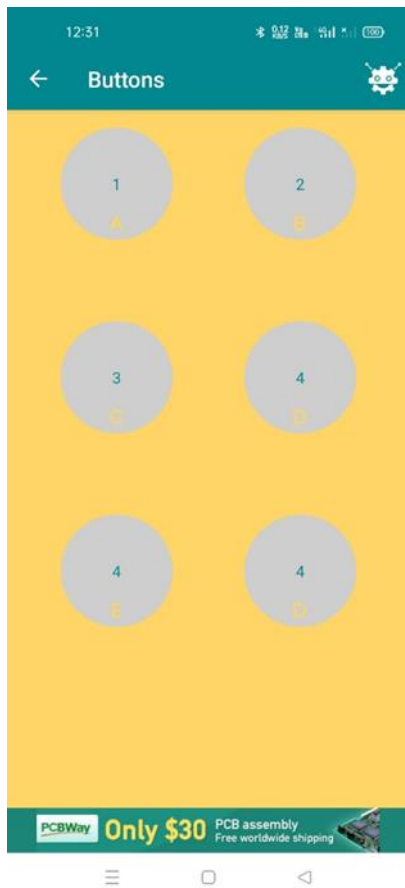


Figure 3(b): Arduino Bluetooth Control

## BENEFITS:

### 4.1. Convenience:

Control your appliances from anywhere within Bluetooth range, eliminating the need to be physically present near them for operation.

### 4.2. Customization:

Arduino-based home automation systems provide extensive customization options. Users can write their code to tailor the system precisely to their needs. Additionally, they can easily integrate additional sensors or features as required, ensuring a highly adaptable and personalized home automation experience.

### 4.3. Wireless Control:

Control home appliances and devices wirelessly from smartphones or tablets, providing convenience and flexibility in managing household tasks.

### 4.4. Easy Installation and Setup:

Arduino boards are easy to program using the Arduino IDE, and Bluetooth modules can be easily interfaced with the Arduino, simplifying the installation and setup process for home automation systems.

### 4.5. User-Friendly Interface:

Home automation systems equipped with Bluetooth technology can be conveniently controlled through

user-friendly Android applications, offering an intuitive interface for effortless management of home appliances.

## RESULT:

The implementation and testing of the Bluetooth-controlled home automation system using Arduino were successful. We began by setting up the hardware, which involved connecting the Bluetooth module (HC-05) and relay module to the Arduino Uno board. Once the hardware setup was complete, we uploaded the Arduino code to enable communication between the board and the Android application via Bluetooth.

The Android application, named "Arduino Bluetooth Control" and available on the Play Store, established a stable connection with the Bluetooth module. This allowed users to remotely control home appliances.

During testing, the system demonstrated reliable performance. It promptly responded to commands sent from the Android application, without significant latency or connectivity issues.

## CONCLUSION:

In conclusion, our research paper has successfully demonstrated the development and implementation of a Bluetooth-controlled home automation system using Arduino. Through this project, we have illustrated the feasibility and practicality of using Bluetooth technology to remotely control home appliances.

Our system offers several advantages. First and foremost, it provides unparalleled convenience. Users can control home appliances from anywhere within Bluetooth range using a smartphone or tablet, eliminating the need for physical interaction with the appliances. This not only increases convenience but also improves accessibility for people with mobility limitations.

Another advantage of our system is its flexibility. The Arduino platform allows for easy customization and expansion. Users can write their code to tailor the system precisely to their needs. Additionally, they can easily integrate additional sensors or features as required, ensuring a highly adaptable and personalized home automation experience.

Furthermore, our system offers a cost-effective solution for home automation. By leveraging affordable components and open-source software, we have developed an economical system that is accessible to a wider range of users, irrespective of their budget constraints. The user-friendly interface of our mobile application enhances the overall user experience. With intuitive controls and real-time monitoring, users can easily manage their home appliances with just a few taps on their smartphone or tablet.

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