MINI PROJECT REPORT

ON

Automatic Home Application System using Arduino

Submitted by

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Submitted to

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1. Abstract

This project presents a Home Automation System designed using an Arduino Uno and an HC-05 Bluetooth module, allowing wireless control of household appliances through a smartphone. Traditionally, appliances like lights, fans, and televisions require manual operation, which can be inconvenient, especially for the elderly, disabled, or busy individuals. The primary objective of this project is to provide a low-cost, efficient, and user-friendly system that enables controlling multiple appliances without direct physical interaction. In this prototype, LEDs simulate appliances, turning ON or OFF according to commands received from the smartphone. The system is implemented using Arduino IDE with C programming, leveraging the microcontroller's digital pins for output and the Bluetooth module for wireless communication. By establishing a short-range Bluetooth connection, users can reliably operate appliances from a distance of 5–10 meters. The outcome demonstrates the practical application of Internet of Things (IoT) concepts in smart living. The results, validated through LED indicators and serial monitor feedback, confirm the system's effectiveness,

responsiveness, and simplicity. Moreover, this project serves as an educational platform for understanding embedded systems, wireless communication, and the integration of hardware and software to create smart solutions.

2. Introduction

Home automation has emerged as a critical aspect of modern technology, enabling users to monitor and control home appliances remotely for convenience, safety, and energy efficiency. With the rapid advancement of IoT and embedded systems, implementing smart systems has become more accessible and cost-effective. The primary focus of this project is to design a wireless home automation system using Arduino Uno and a Bluetooth module (HC-05). Arduino provides a versatile, easy-to-program microcontroller platform, while Bluetooth offers a short-range, reliable, and low-power communication medium. By integrating these components, users can operate appliances like lights, fans, and televisions directly from a smartphone app without physically interacting with switches. This approach is highly relevant in real-world applications, such as controlling home appliances for elderly or differently-abled individuals, automating office equipment, and

creating smart classrooms or laboratories. The objectives include providing wireless control, demonstrating the practical use of Arduino and C programming, and offering a hands-on learning experience in electronics, embedded systems, and IoT concepts. Additionally, the project highlights energy conservation by allowing users to switch off appliances when not in use, reinforcing smart living principles.

3. Literature Review / Background Study

Previous home automation systems have explored various communication protocols, including Wi-Fi, GSM, and Zigbee, to achieve remote appliance control. While Wi-Fi and GSM enable long-range communication, they often involve higher costs, increased complexity, and dependence on network availability. Zigbee offers reliable wireless communication but requires specialized hardware and setup, making it less suitable for educational and small-scale projects. In contrast, this project utilizes Bluetooth technology (HC-05), which provides a cost-effective, energy-efficient, and easily implementable solution for short-range wireless communication. Existing projects mostly focus on internet-based control or sensor-triggered automation, often overlooking the simplicity and accessibility required for beginners. This project addresses that gap by

offering a low-cost, standalone system that simulates real appliances using LEDs. Its simplicity makes it ideal for students and hobbyists to understand embedded system design, serial communication, and integration with smartphone applications. The system demonstrates instant response, reliability, and ease of use, setting it apart from more complex systems. It also serves as a foundational project for expanding into more advanced IoT-enabled home automation systems with sensors, Wi-Fi modules, or cloud integration**.**

4. Problem Statement

In conventional homes, appliances such as lights, fans, and televisions are operated manually using physical switches. This approach presents several challenges: it is inconvenient for elderly or physically challenged individuals, increases energy consumption due to accidental oversight, and lacks integration with modern smart technologies. The problem addressed by this project is to develop a simple, low-cost, and user-friendly system that allows appliances to be controlled remotely through a smartphone. The motivation behind this initiative is to enhance convenience, safety, and energy efficiency in daily life. By leveraging widely available components such as Arduino and Bluetooth modules, the system

demonstrates practical solutions to modern home automation problems. The project aims to minimize manual intervention, provide instant control, and enable users to manage multiple appliances simultaneously. Additionally, this project highlights educational benefits, as students gain hands-on experience with microcontroller programming, hardware interfacing, and wireless communication. Overall, the system addresses real-world problems while offering a scalable platform for further development and integration with IoT technologies for smart home applications.

5. System Requirements

Hardware Components:

- Arduino Uno: Acts as the central microcontroller controlling appliance operations.
- HC-05 Bluetooth Module: Enables wireless communication between smartphone and Arduino.
- LEDs (3): Represent household appliances like lights, fans, and televisions.
- Resistors (220Ω, 3): Limit current to prevent LED damage.
- Breadboard: Provides a convenient platform for circuit connections.

- Jumper Wires: Facilitate connections between components.
- Power Supply: USB cable or 9V battery to power the system**.**

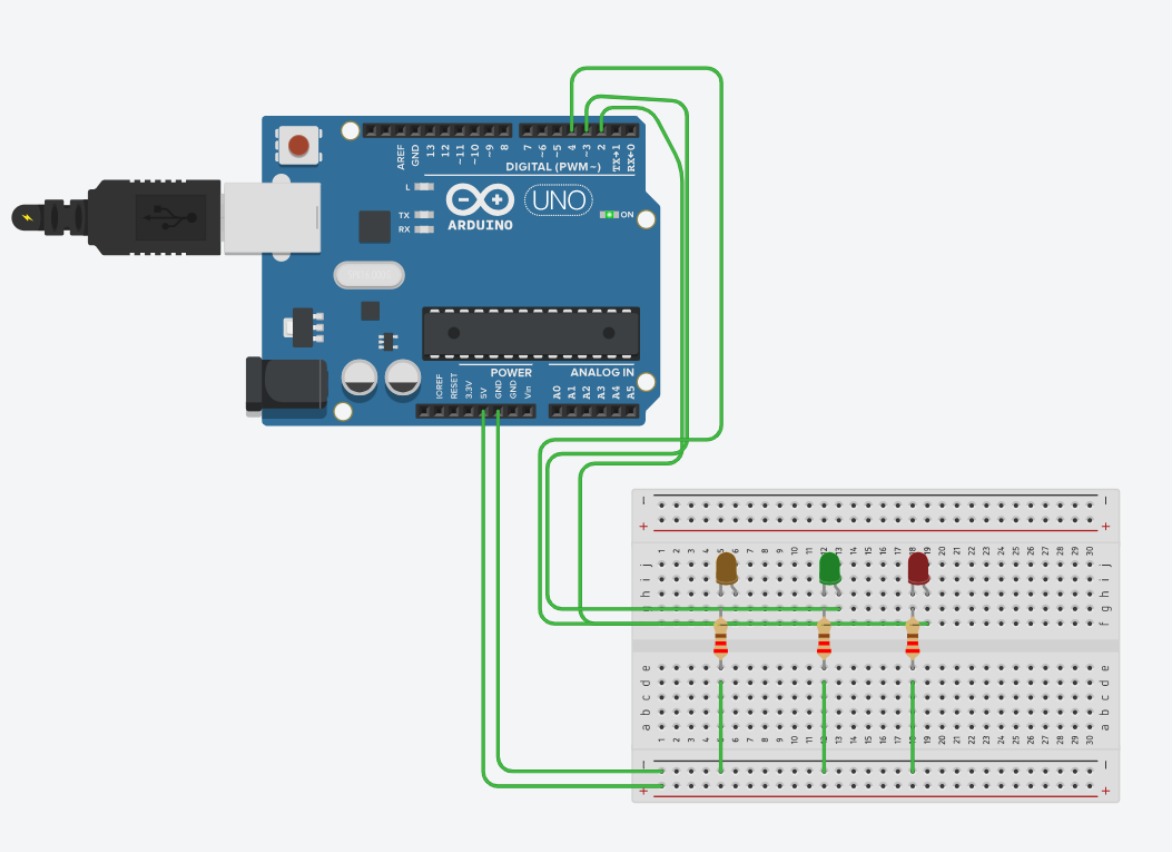
Software Components:

- Arduino IDE: For programming the Arduino in C/C++.
- Bluetooth Controller App (Android): Sends commands to control appliances.
- Arduino Libraries: Built-in libraries for serial communication and pin control.

These requirements ensure that the system is low-cost, accessible, and easy to implement. The combination of hardware and software components enables wireless control of multiple appliances, providing a functional model of smart home automation.

6. System Design

Circuit Diagram :



Explanation of Components:

- Smartphone App: User interface to send appliance control commands.
- HC-05 Bluetooth Module: Short-range wireless communication.
- Arduino Uno: Microcontroller that interprets commands and controls output.
- LEDs & Resistors: Indicate appliance state and prevent current overload.

Algorithm / Flowchart:

1. Initialize Arduino pins and Bluetooth communication.
2. Wait for input from the smartphone app.

3. On receiving a valid command, activate/deactivate corresponding LED.
4. Display action in serial monitor.
5. Repeat indefinitely for continuous control.

7. Implementation

The system is implemented using Arduino Uno and C programming in the Arduino IDE.

- LEDs are connected to digital pins D2, D3, D4, each with a 220Ω resistor.
- HC-05 TX and RX pins are connected to Arduino RX and TX pins. Voltage dividers are used to prevent damage to the HC-05 module.
- The code initializes pins, sets up serial communication, and continuously listens for commands from the smartphone app.
- Commands 1–6 correspond to turning ON/OFF LEDs simulating light, fan, and TV.
- Serial Monitor provides feedback for each operation.

Arduino C Code:

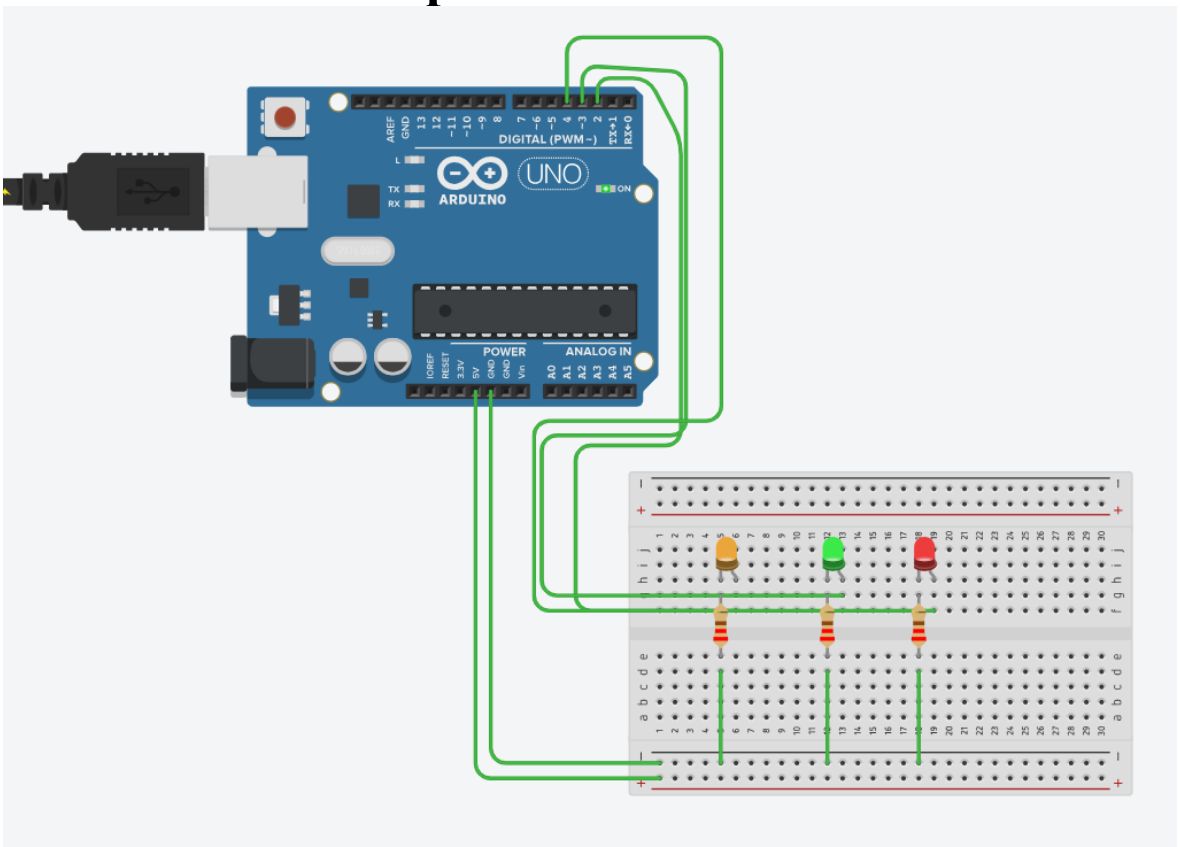
```
A light = 2;
int fan   = 3;
int tv    = 4;
```

```
char command;
void setup() {
  pinMode(light, OUTPUT);
  pinMode(fan, OUTPUT);
  pinMode(tv, OUTPUT);
  Serial.begin(9600);
  Serial.println("welcome to home automation
      system");
  Serial.println("Send commands:");
  Serial.println("'1' = Light ON, '2' = Light
      OFF");
  Serial.println("'3' = Fan ON,   '4' = Fan OFF");
  Serial.println("'5' = TV ON,    '6' = TV OFF");
}
void loop() {
  if (Serial.available()) {
    command = Serial.read();
    switch (command) {
      case '1':
        digitalWrite(light, HIGH);
        Serial.println("Light ON");
```

```
  break;
case '2':
  digitalWrite(light, LOW);
  Serial.println("Light OFF");
  break;
case '3':
  digitalWrite(fan, HIGH);
  Serial.println("Fan ON");
  break;
case '4':
  digitalWrite(fan, LOW);
  Serial.println("Fan OFF");
  break;
case '5':
  digitalWrite(tv, HIGH);
  Serial.println("TV ON");
  break;
case '6':
  digitalWrite(tv, LOW);
  Serial.println("TV OFF");
```

```
      break;
    default:
      Serial.println("Invalid Command! Use 1–6");
      break;
  }
 }
}
```

8. Results and Output



```
welcome to home automation system
Send commands:
'1' = Light ON, '2' = Light OFF
'3' = Fan ON,   '4' = Fan OFF
'5' = TV ON,    '6' = TV OFF
Light ON
Invalid Command! Use 1â6
Fan ON
TV ON
Light ON
Light OFF
TV OFF
Fan ON
Light OFF
Fan OFF
```

- LEDs successfully indicate appliance states according to commands sent via smartphone app.
- Serial Monitor confirms every action, providing real-time feedback.
- The system responds within 5–10 meters range, suitable for small homes or lab demonstrations.
- **Sample outputs:**

Command 1 -- Light ON

Command 3 -- Fan ON

Command 5 -- TV ON

Command 2 -- Light OFF

Command 4 -- Fan OFF

Commend 6 -- TV OFF

- Demonstrates practical implementation of IoT

concepts in smart living.

- Energy efficiency is highlighted by remote control and real-time operation feedback.

9. Discussion and Analysis

The project successfully meets its objectives by enabling wireless, real-time control of multiple appliances. Challenges included ensuring proper voltage compatibility between Arduino and HC-05 and debugging serial communication. These were addressed using voltage dividers and testing commands via Serial Monitor. The system demonstrates quick response, reliability, and user-friendliness, making it ideal for educational purposes. While the current prototype uses LEDs, the design can be extended to control real household appliances with relays and higher power circuits. Overall, the system showcases how embedded systems and wireless communication can create smart, efficient solutions for everyday problems.

10. Applications and Future Scope

Applications:

- Home and office appliance control
- Smart classrooms and laboratories

- Energy-saving automation

Future Scope:

- Integration with Wi-Fi or IoT platforms for internet-based control
- Addition of sensors (motion, light, temperature) for automatic appliance operation
- Compatibility with voice assistants like Google Assistant or Alexa
- Expansion to large-scale home automation systems

These improvements will make the system more advanced, intelligent, and user-friendly.

11. Conclusion

This project successfully demonstrates a low-cost, user-friendly Home Automation System using Arduino and Bluetooth. It allows remote control of appliances via a smartphone, reduces manual effort, and encourages energy-saving practices. The project provides hands-on experience with Arduino, C programming, and wireless communication, serving as a strong foundation for further IoT-based home automation projects. The system is scalable, reliable, and easily extendable, illustrating the practical benefits of embedded systems and

smart living solutions.

12. References

1. TutorialsPoint – Arduino Bluetooth Control
2. Tinkercad Circuits – Online Arduino Simulator

13. GitHub link of the project