Practical Robotics Projects with Arduino

(CSE 4571)

Lab Assignment No – 08

Bluetooth Communication

Submission Date: _____

Branch: CSE		**Section:**
Name	**Registration No.**	**Signature**

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Aim:

To interface an HC-05/HC-06 Bluetooth module with Arduino UNO for wireless serial communication between the Arduino and a Bluetooth-enabled device.

Objectives:

1) **To gain familiarity with the HC-05/HC-06 module and Arduino UNO serial communication.**
   - Learn the pin configuration (VCC, GND, TXD, RXD, EN/KEY) of the HC-05/HC-06 module.
   - Understand the role of baud rate, pairing code, and serial communication protocol.
2) **To establish a basic wireless link between Arduino UNO and a smartphone/PC.**
   - Connect the HC-05/HC-06 module to the Arduino UNO (using SoftwareSerial).
   - Write a simple Arduino sketch to send and receive data over Bluetooth.
   - Pair the module with a smartphone/PC using a Bluetooth terminal app and verify successful two-way communication.
3) **To implement bidirectional communication and LED control.**
   - Build an external circuit with an LED connected to Arduino digital pin 6.
   - Modify the Arduino program to turn the LED ON when the smartphone sends the character 1, and OFF when it sends 0.
   - Send acknowledgment messages back to the smartphone (e.g., “LED ON” / “LED OFF”).
4) **To Evaluate communication performance.**
   - Test and record the effective communication range of the Bluetooth module.
   - Measure response latency between sending a command (from phone) and Arduino execution.

Pre-Lab Questionnaire:

1) Name all the pins of the HC-05/HC-06 module and their functions.
2) Why is a voltage divider required between Arduino TX and HC RX?
3) What is the default baud rate of the HC-05/HC-06 module?
4) Explain the difference between HC-05 and HC-06 modules.
5) What is Software Serial in Arduino, and why is it used in this experiment?
6) What is the purpose of pairing a Bluetooth device before communication?
7) How does Arduino interpret commands sent from a smartphone?
8) How can you verify if the HC-05/HC-06 module is powered and ready for pairing?
9) List the factors that can affect Bluetooth communication range.
10) Explain the role of the Serial Monitor in this experiment.

Answers to Pre-Lab Questions

Components/Equipment Required:

Sl. No.	Name of the Component / Equipment	Specification	Quantity
1)	Arduino UNO R3	16MHz	1
2)	Arduino UNO cable	USB Type A to Micro-B	1
3)	HC-05 / HC-06 Bluetooth Module	Bluetooth 2.0 SPP, 3.3V TTL logic, default baud rate 9600 bps	1
4)	Resistors (carbon type)	220Ω / 2.2kΩ/ 1 kΩ	1 each
5)	LED	Any colour of your choice	1
6)	Breadboard	840 Tie points	1
7)	Smartphone with Bluetooth / PC with Bluetooth	Android/iOS device or Windows PC, for testing wireless serial communication	1
8)	Bluetooth Terminal App	Android/iOS app like "Serial Bluetooth Terminal" or "Bluetooth Terminal	1
9)	Jumper Wire	----------	As per requirement

Objective 1

To Gain familiarity with the HC-05/HC-06 module and Arduino UNO serial.

Circuit / Schematic Diagram

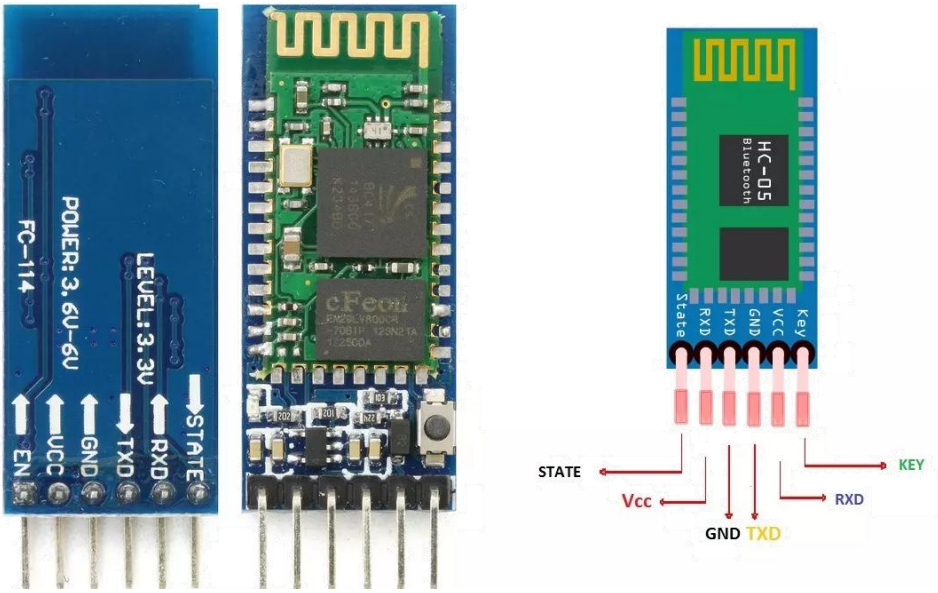


Figure 1: HC-05/HC-06 module Pinout

Objective 2

To establish a basic wireless link between Arduino UNO and a smartphone/PC.

Circuit / Schematic Diagram

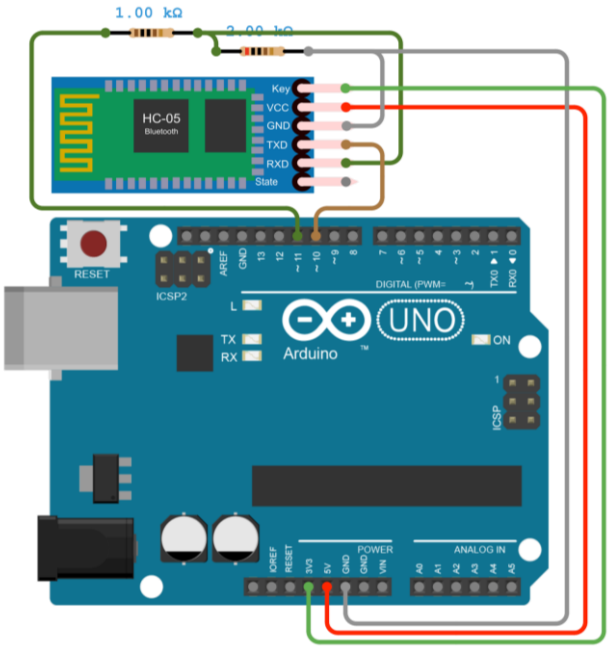


Figure 2: Interface between Arduino UNO and HC-05/HC-06 module

Code

```
#include <SoftwareSerial.h>
SoftwareSerial BT(10, 11); // RX, TX
void setup() {
  Serial.begin(9600);
  BT.begin(9600);
  Serial.println("Ready to communicate. Type on Serial Monitor or Bluetooth app.");
}
void loop() {
  if (Serial.available()) {
    char data = Serial.read();
    BT.write(data);
  }
  if (BT.available()) {
    char data = BT.read();
    Serial.write(data);
  }
}
```

Figure 3: Interface of Arduino UNO with HC-05/HC-06 module

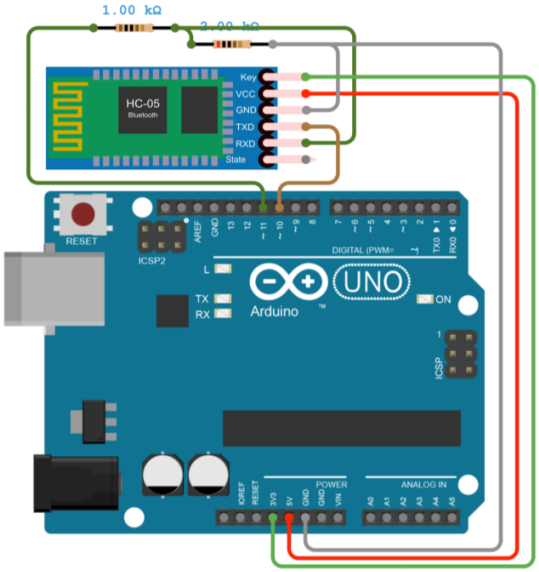
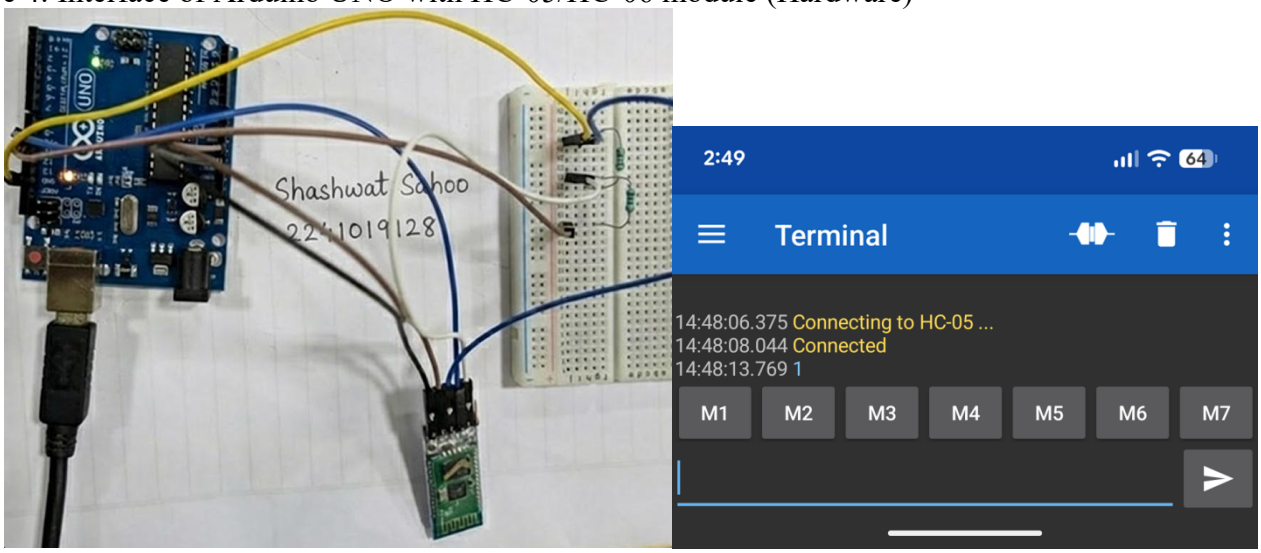


Figure 4: Interface of Arduino UNO with HC-05/HC-06 module (Hardware)



Objective 3

To implement bidirectional communication and LED control.

Circuit / Schematic Diagram

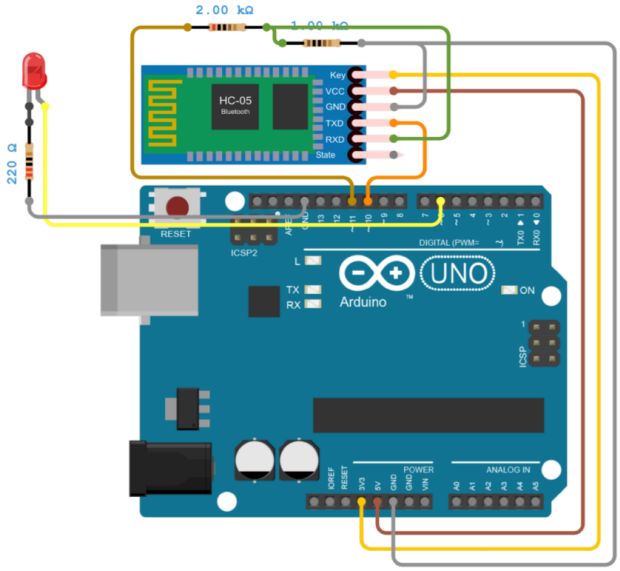


Figure 5: Interface between Arduino UNO and HC-05/HC-06 module

Code

```
#include <SoftwareSerial.h>
SoftwareSerial BT(10, 11); // RX, TX
int led = 6;
void setup() {
  pinMode(led, OUTPUT);
  Serial.begin(9600);
  BT.begin(9600);
  Serial.println("Send '1' to turn ON LED, '0' to turn
OFF.");
}
void loop() {
  if (BT.available()) {
    char cmd = BT.read();
    Serial.print("Received: ");
    Serial.println(cmd);
    if (cmd == '1') {
      digitalWrite(led, HIGH);
      BT.println("LED ON");
      Serial.println("LED turned ON");
    }
    else if (cmd == '0') {
      digitalWrite(led, LOW);
      BT.println("LED OFF");
      Serial.println("LED turned OFF");
    }
    else {
      BT.println("Invalid Command");
    }
  }
}
```

Figure 6: Interface HC-06 and Arduino UNO for bidirectional communication and LED control and confirmation in serial monitor window

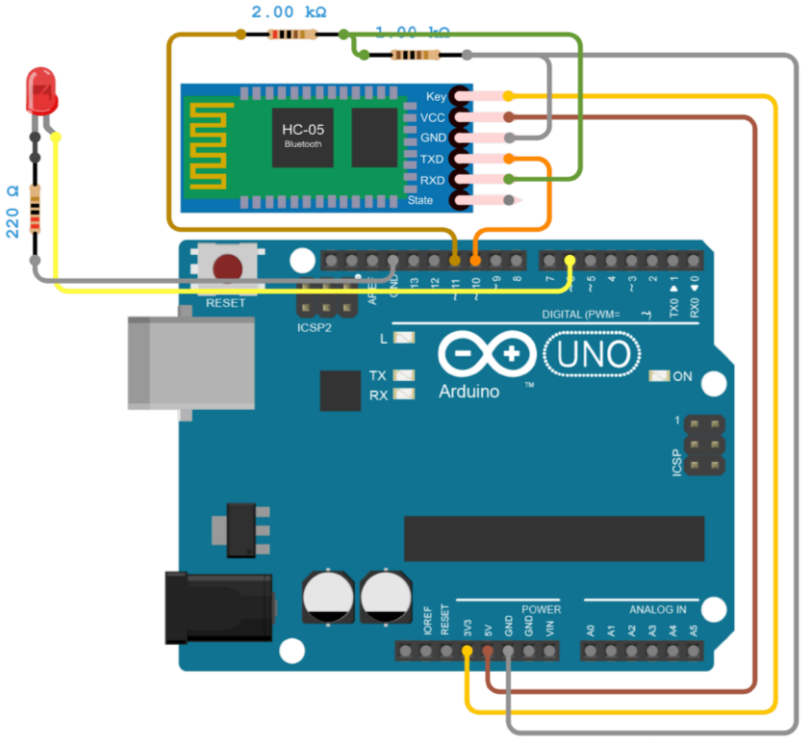
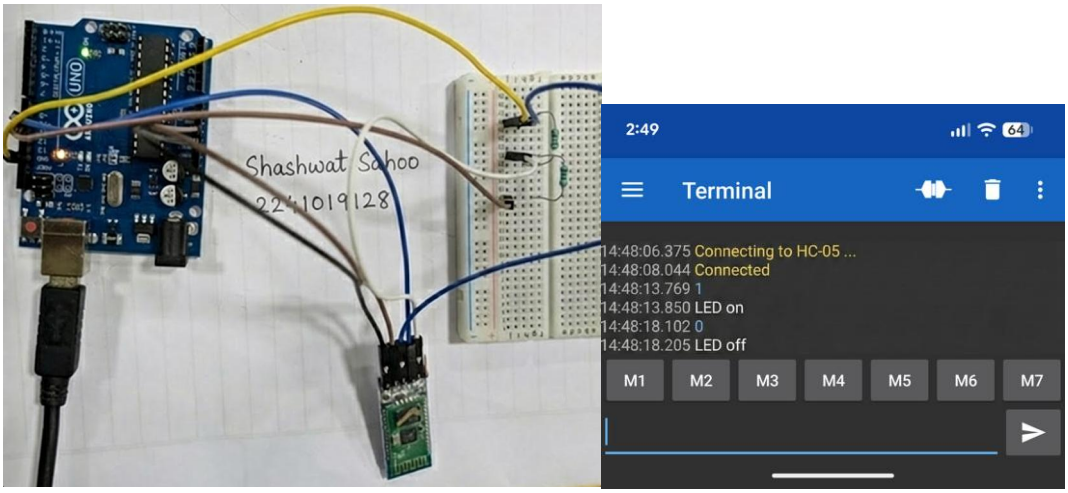


Figure 7: Interface HC-06 and Arduino UNO for bidirectional communication and LED control and confirmation in serial monitor window (Hardware)



Objective 4

To Evaluate communication performance.

Circuit / Schematic Diagram

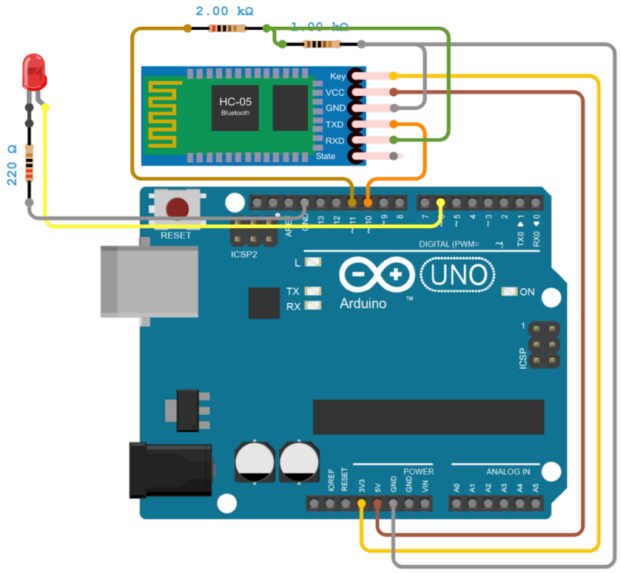
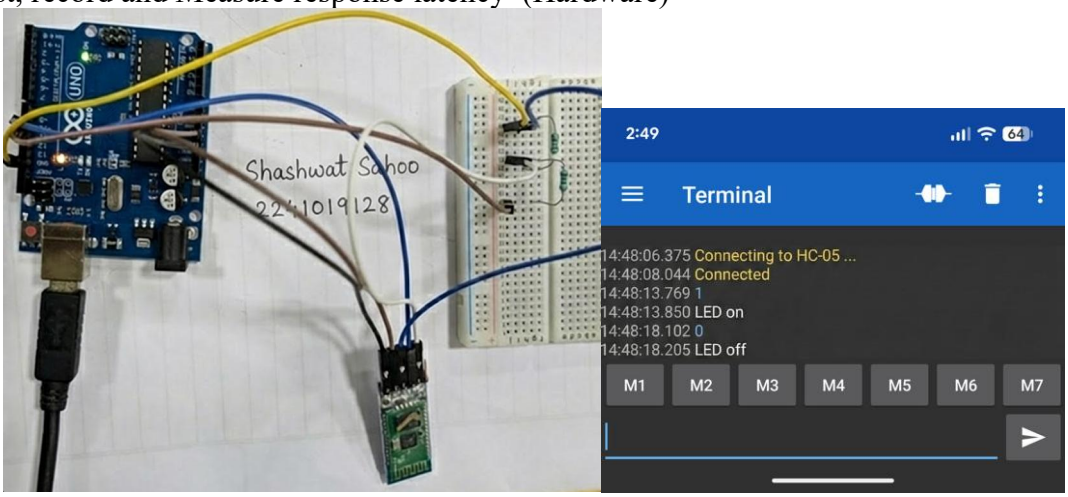


Figure 8: Establish connection with the Serial Monitor and Mobile Phone

Code

```
#include <SoftwareSerial.h>
SoftwareSerial BT(10, 11); // RX, TX
int led = 6;
void setup() {
  pinMode(led, OUTPUT);
  Serial.begin(9600);
  BT.begin(9600);
  Serial.println("Send '1' to turn ON LED, '0' to turn
OFF.");
}
void loop() {
  if (BT.available()) {
    char cmd = BT.read();
    Serial.print("Received: ");
    Serial.println(cmd);
    if (cmd == '1') {
      digitalWrite(led, HIGH);
      BT.println("LED ON");
      Serial.println("LED turned ON");
    }
    else if (cmd == '0') {
      digitalWrite(led, LOW);
      BT.println("LED OFF");
      Serial.println("LED turned OFF");
    }
    else {
      BT.println("Invalid Command");
    }
  }
}
```

Figure 9: Test, record and Measure response latency (Hardware)



Conclusion

Precautions

Post Experiment Questionnaire:

1) How did you establish bidirectional communication between Arduino and a smartphone?
2) Describe the steps to control an LED using Bluetooth commands.
3) What was the maximum reliable communication range achieved during the experiment?
4) How did you implement forwarding between Serial Monitor and Bluetooth?
5) What challenges did you face while pairing the HC-05/HC-06 module?
6) Explain how the Arduino code processes different commands (1 = ON, 0 = OFF).
7) How would you modify the setup to control multiple LEDs with different commands?
8) Compare the observed LED behavior when using Serial Monitor vs. smartphone commands.

Answers to Post-Lab Questions

(Signature of the Faculty)	**(Signature of the Student)**
	Name:
Date:	**Registration No.:**
	Branch:
	Section