Practical Robotics Projects with Arduino

(CSE 4571)

Lab Assignment No – 08

Bluetooth Communication

Submission Date: _____

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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:

A. Experiment-Specific

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

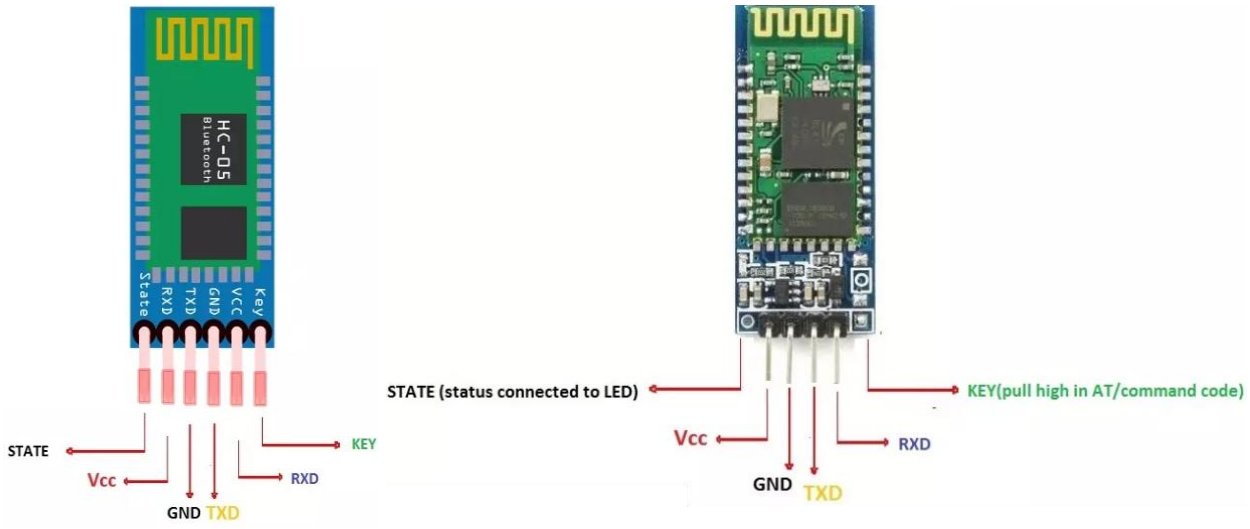


Figure 1: *HC-05/HC-06 module Pinout*

Observation

(Write how you have done the connection between the Bluetooth module and Arduino uno)

- The HC-05/HC-06 Bluetooth module was connected to the Arduino UNO using SoftwareSerial.
- VCC and GND pins of the module were connected to 5V and GND of Arduino respectively.
- The TX pin of the Bluetooth module was connected to the RX pin of Arduino, and the RX pin was connected to the TX pin of Arduino through a voltage divider to protect the module from 5V logic levels.
- This setup enabled serial communication between Arduino and the Bluetooth module.

Objective 2

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

Circuit / Schematic Diagram

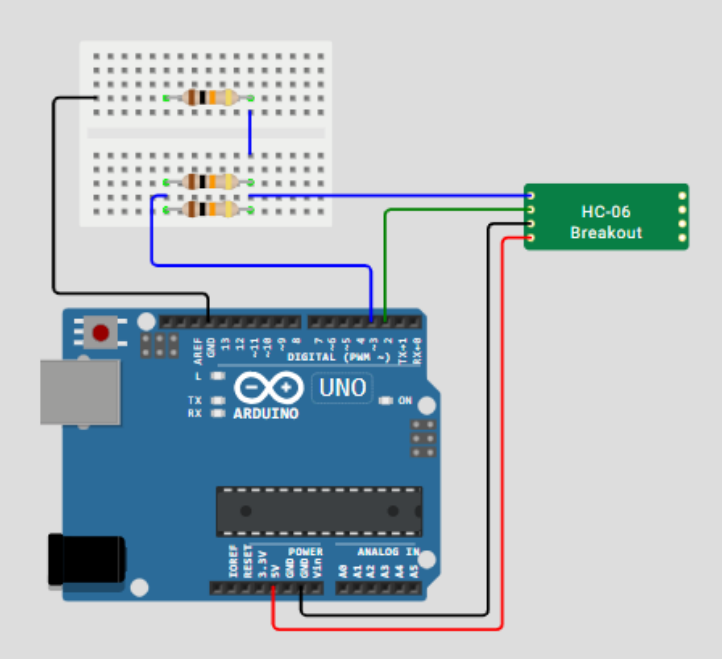


Figure 2: *Interface between Arduino UNO and HC-05/HC-06 module*

Code

```
#include <SoftwareSerial.h>

SoftwareSerial bt(2, 3); // RX, TX
void setup() {
  Serial.begin(9600);
  bt.begin(9600);
  Serial.println("Bluetooth Ready");
}

void loop() {
  if (bt.available()) {
    char data = bt.read();
    Serial.write(data);
  }
  if (Serial.available()) {
    bt.write(Serial.read());
  }
}
```

Observation

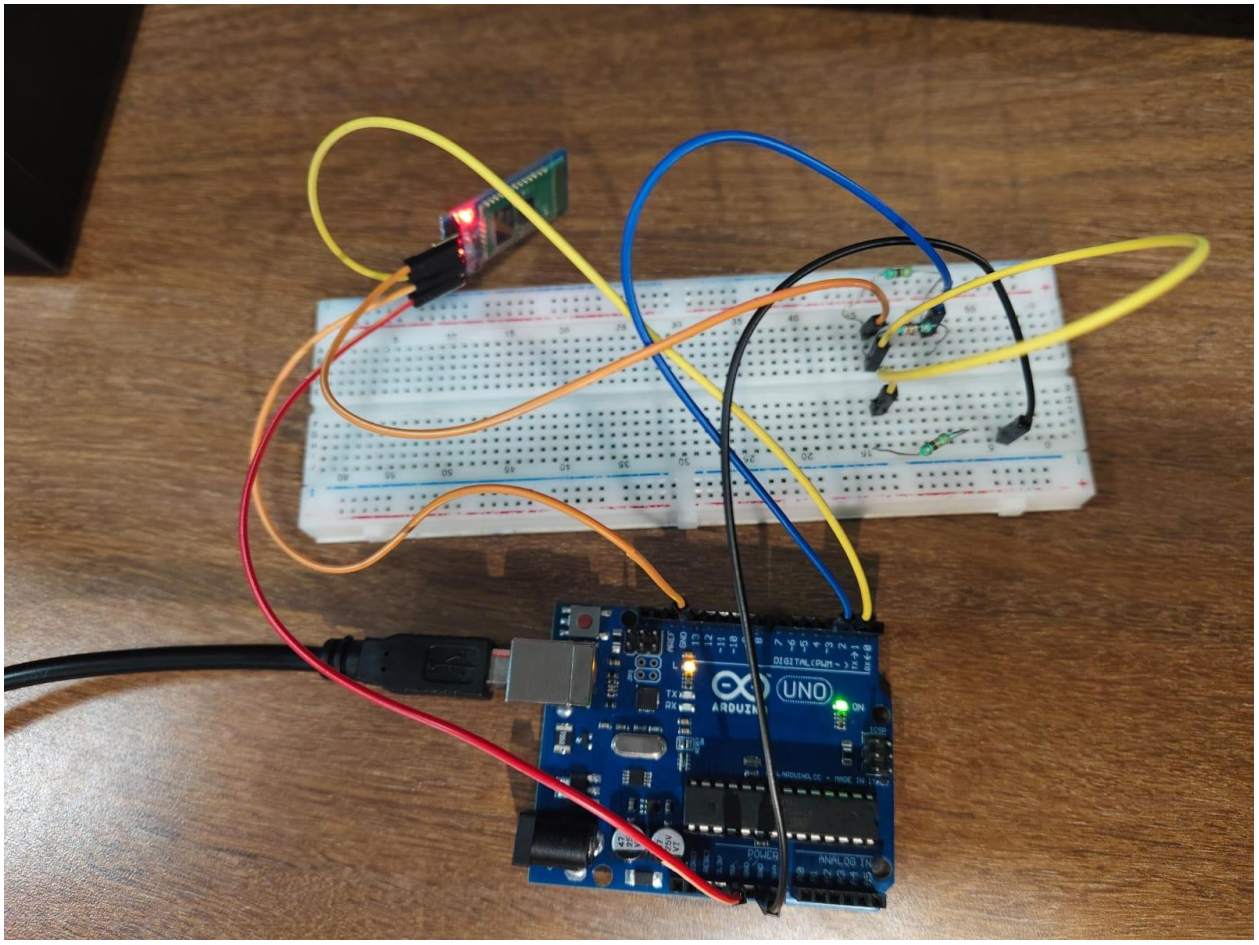


Figure 5: *Interface of Arduino UNO with HC-05/HC-06 module (Hardware)*

Objective 3

To implement bidirectional communication and LED control.

Circuit / Schematic Diagram

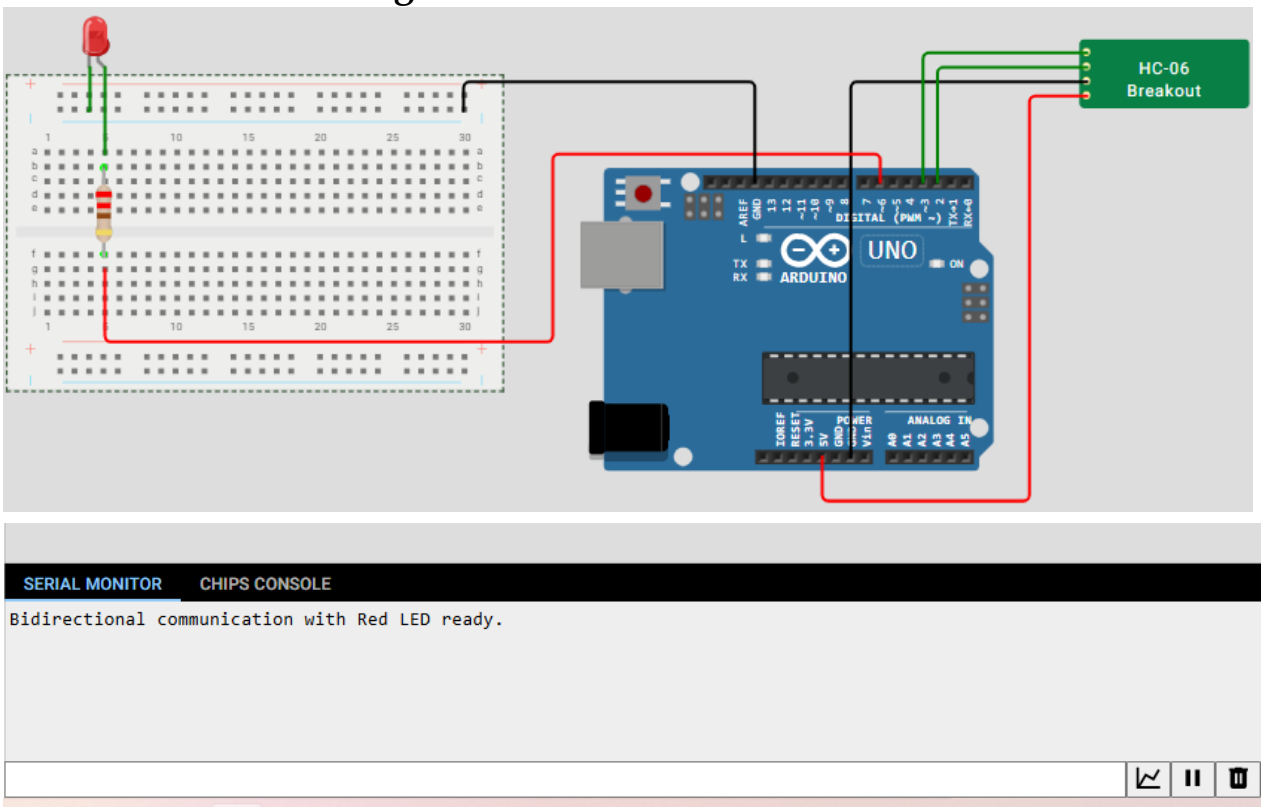


Figure 6: *Interface HC-06 and Arduino UNO for bidirectional communication and LED control and confirmation in serial monitor window*

Code

```
#include <SoftwareSerial.h>

SoftwareSerial bt(2, 3);
int ledPin = 6;

void setup() {
  pinMode(ledPin, OUTPUT);
  Serial.begin(9600);
  bt.begin(9600);
  bt.println("Bidirectional communication with LED ready");
}

void loop() {
  if (bt.available()) {
    char cmd = bt.read();
```

```
    if (cmd == '1') {
      digitalWrite(ledPin, HIGH);
      bt.println("LED ON");
    }
    else if (cmd == '0') {
      digitalWrite(ledPin, LOW);
      bt.println("LED OFF");
    }
  }
}
```

Observation

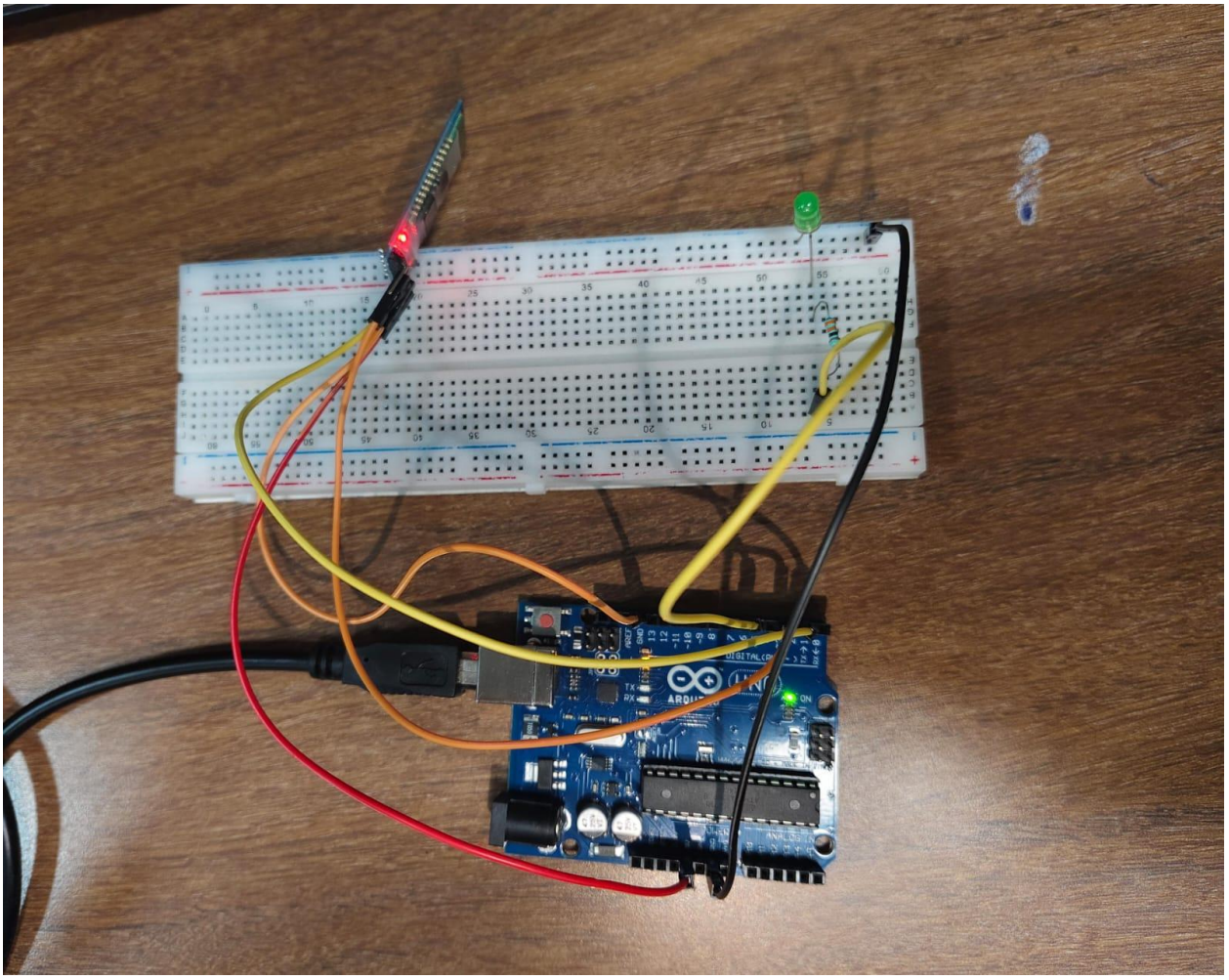
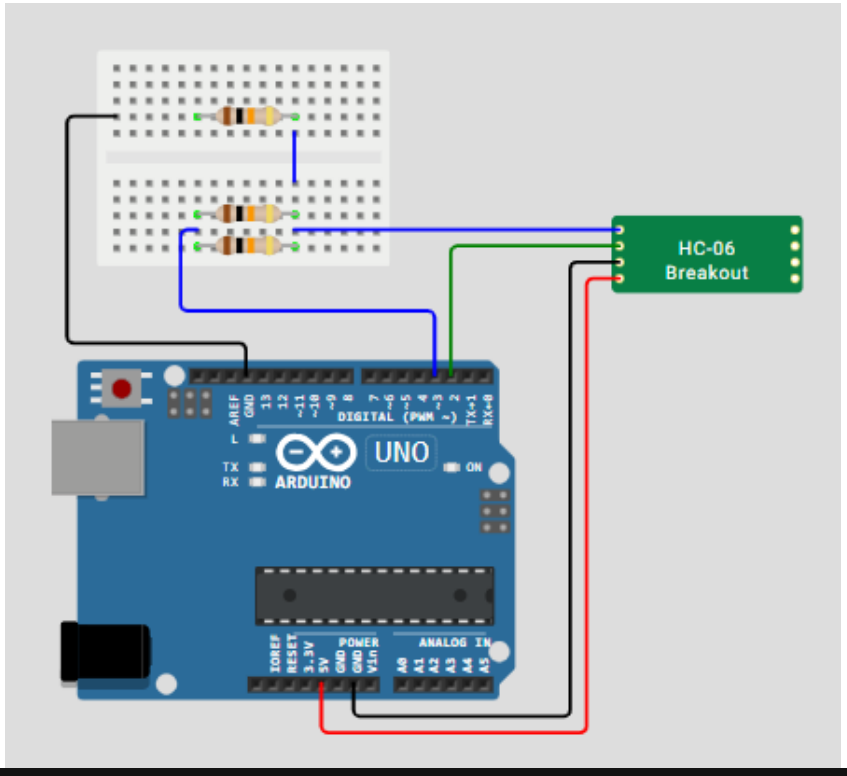


Figure 7: *Interface HC-06 and Arduino UNO for bidirectional communication and LED control and confirmation in serial monitor window (Hardware)*

Objective 4

To Evaluate communication performance

Circuit / Schematic Diagram



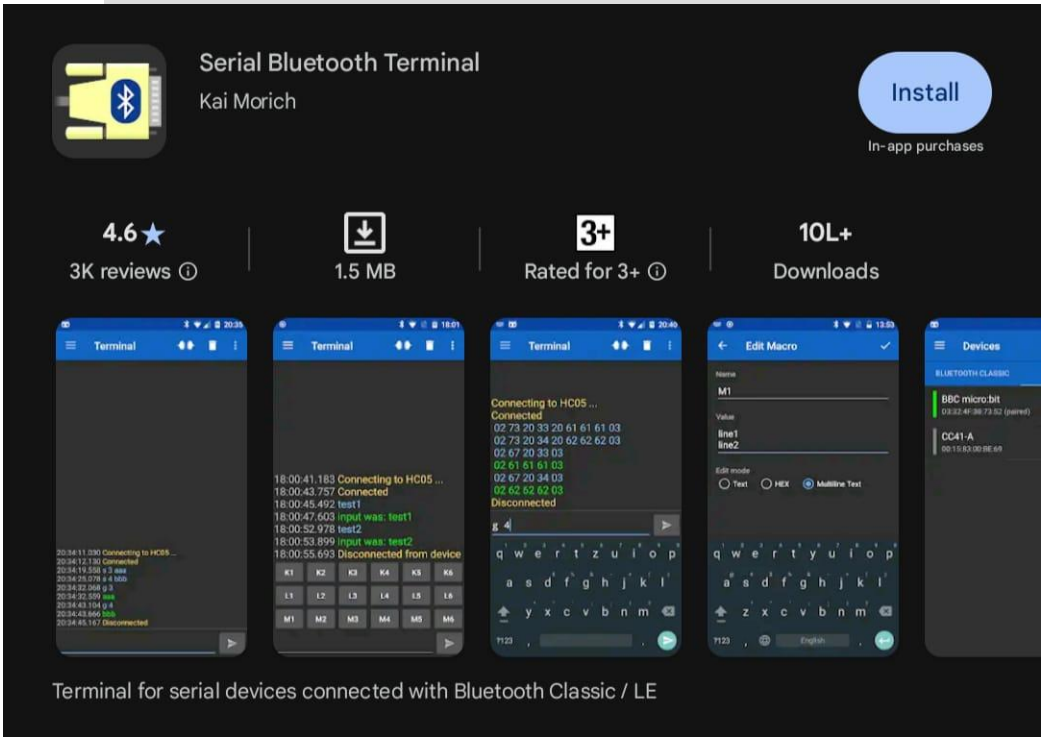


Figure 8: Establish connection with the Serial Monitor and Mobile Phone

Code

```
#include <SoftwareSerial.h>

// SoftwareSerial pins for HC-05 / HC-06
SoftwareSerial bt(2, 3); // RX, TX

void setup() {
  Serial.begin(9600);   // Serial Monitor
  bt.begin(9600);       // Bluetooth module baud rate

  Serial.println("Bluetooth Performance Test Started");
  bt.println("Bluetooth Performance Test Started");
}

void loop() {
  // Data from Bluetooth to Serial Monitor
  if (bt.available()) {
    char data = bt.read();
    Serial.print("Received from Bluetooth: ");
    Serial.println(data);

    // Send acknowledgment back
    bt.print("ACK: ");
```

```
    bt.println(data);
  }

  // Data from Serial Monitor to Bluetooth
  if (Serial.available()) {
    char data = Serial.read();
    bt.print("From Serial: ");
    bt.println(data);
  }
}
```

Observation

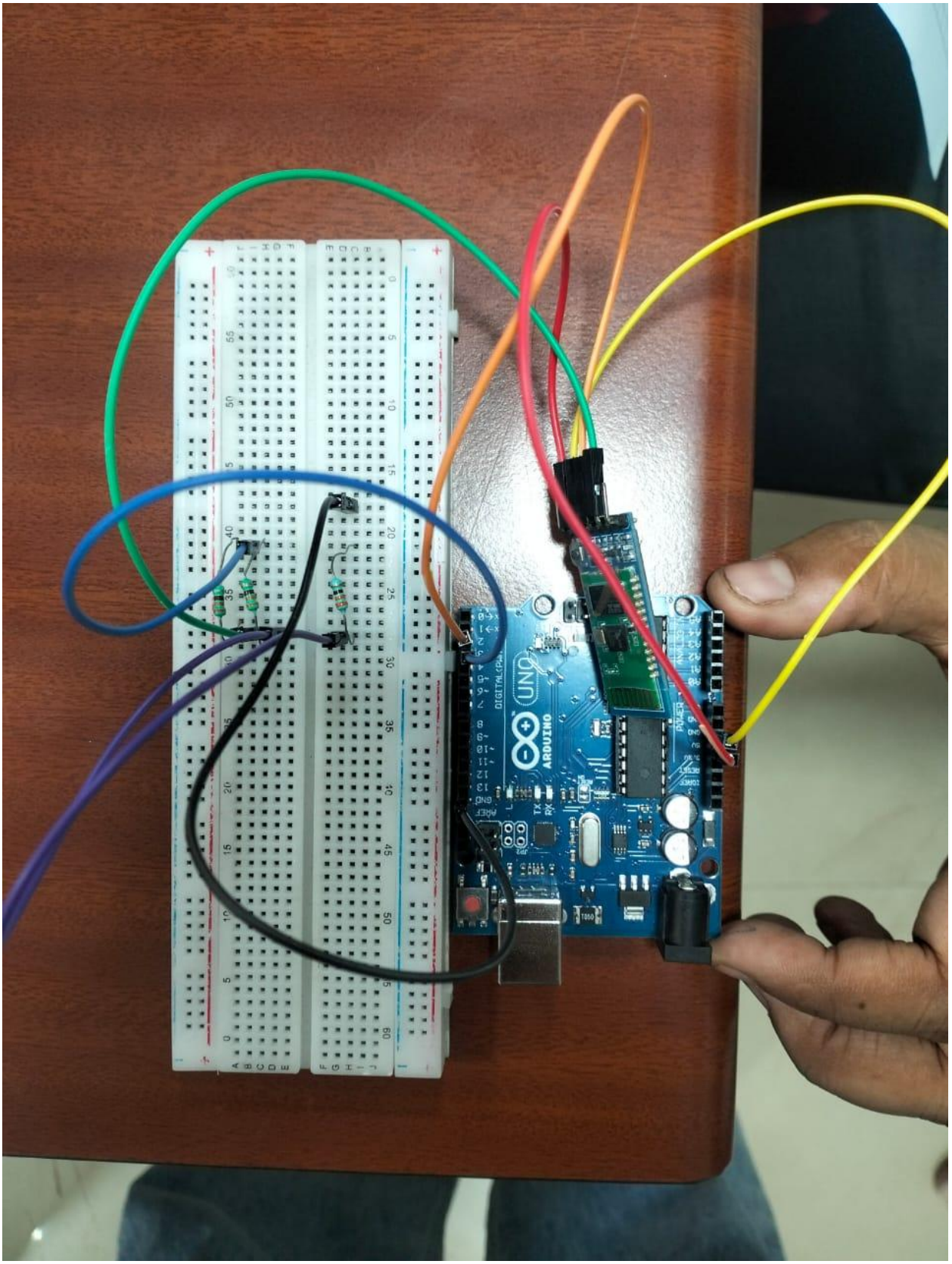


Figure 9: Test, record and Measure response latency (Hardware)

Conclusion:

Precautions:

Post Experiment Questionnaire:

1. What AT command is used to change the name of the Bluetooth module ?
2. What AT command is used to change the pairing command pin ?
3. How do you check if the Bluetooth module is paired with your phone ?
4. What happens if RX and TX wires are connected wrongly ?
5. Why is software serial preferred for Bluetooth communication in Arduino project ?
6. How did you establish bidirectional communication between Arduino and a smartphone?
7. Describe the steps to control an LED using Bluetooth commands.
8. What was the maximum reliable communication range achieved during the experiment?
9. How did you implement forwarding between Serial Monitor and Bluetooth?
10. What challenges did you face while pairing the HC-05/HC-06 module?
11. Compare the observed LED behavior when using Serial Monitor vs. smartphone commands.

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