MCTA 3203

MECHATRONIC SYSTEM INTEGRATION

SECTION 1

SEMESTER 2 2024/2025

LECTURER:

SIR WAHJU SEDIONO

SIR ZULKIFLI BIN ZAINAL

LAB REPORT 8:

REMOTE TEMPERATURE MONITORING AND CONTROL

GROUP 2

DATE OF SUBMISSION:

5 MAY 2025

GROUP MEMBERS	MATRIC NUMBERS
AMIRUL IMAN BIN MAT KHIR	2316633
AHMAD IRFAN FAHMI BIN AHMAD USRI	2318631
MUHAMAD NUR HAFIZ BIN ROSLY	2317001
FAKHRULLAH BIN YUZAIRI	2220289

ABSTRACT

This lab report details the implementation of a wireless temperature monitoring system leveraging an Arduino microcontroller, a Bluetooth module, and a Wi-Fi network. The temperature data, acquired using a thermistor, is transmitted via Wi-Fi to a cloud platform for visualization and analysis. A smartphone application communicates with the system via Bluetooth to enable remote control of connected devices, such as a fan or heater, based on the temperature readings. This experiment demonstrates the integration of hardware and software components for seamless data processing and control in a networked environment.

TABLE OF CONTENTS

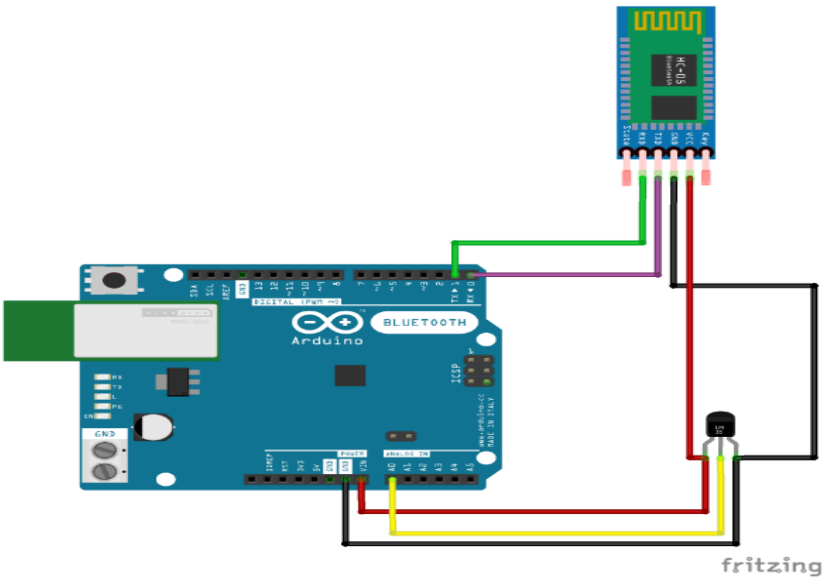
INTRODUCTION

In this lab, we explore the integration of Bluetooth and Wi-Fi data interfacing within a mechatronics system. The primary focus is on the development of a wireless temperature monitoring and control system using Arduino, Wi-Fi connectivity, and a temperature sensor. This setup not only allows real-time data acquisition but also enables remote monitoring and control through a smartphone application or cloud-based services like ThingSpeak. By combining these technologies, the system provides insights into the environmental conditions and enables corrective actions based on data-driven decisions. The experiment highlights the importance of seamless communication between microcontrollers and peripheral devices in modern automation systems. Such systems find applications in smart home environments, industrial automation, and IoT (Internet of Things) ecosystems, showcasing the interplay of sensors, actuators, and data communication technologies. This report discusses the hardware setup, software design, and practical challenges encountered during the integration process.

MATERIALS AND EQUIPMENT:

1. Arduino board with Wi-Fi capability
2. Temperature sensor
3. Bluetooth module
4. Smartphone with Bluetooth support
5. Wi-Fi network and internet access
6. Power supply for the Arduino
7. Breadboard and jumper wires

EXPERIMENTAL SETUP



1. Hardware Setup:

• Connect the temperature sensor (thermistor) to the Arduino.

• Connect the Bluetooth module to the Arduino.

• Connect the Arduino to your Wi-Fi network using the built-in Wi-Fi capabilities.

2. Arduino Programming:

• Write an Arduino sketch that reads temperature data from the sensor.

• Set up Wi-Fi connectivity to send temperature data to a cloud service where you can create a simple dashboard to visualize the data.

3. Bluetooth Programming:

• Write an Arduino sketch to enable Bluetooth communication

4. Remote Monitoring:

• Access ThingSpeak dashboard computer or smartphone to remotely monitor the temperature in real-time via the internet.

RESULT

This experiment successfully demonstrated a basic system for monitoring and controlling devices based on temperature data using Arduino and Bluetooth communication. The HC-05 module enabled smooth two-way communication between the Arduino and a smartphone application or a Python script. Commands sent from the smartphone app were received and executed by the Arduino, effectively controlling connected devices like a fan or heater.

The Arduino used a thermistor to measure temperature, with the Steinhart-Hart equation converting the readings into accurate temperature values. These values were displayed on the serial monitor and transmitted via Bluetooth to the external interfaces. On the Python side, the script successfully visualized the temperature data in real-time and provided a graphical representation of the temperature trends when the program was stopped.

DISCUSSION

The results showed that Bluetooth communication worked effectively for real-time monitoring and control. The HC-05 module provided reliable data transfer, although occasional delays were noticed when the system handled more data than usual. While this didn't significantly affect the experiment, it could be an issue in more complex applications.

The temperature readings were consistent with expected values, demonstrating that the thermistor and Steinhart-Hart equation worked well together. However, there were slight inaccuracies due to environmental factors like electrical noise and the quality of the resistor used. These issues could lead to small but noticeable variations in the measured temperatures.

The Python script was able to receive and display temperature data without major issues. However, its limited error-handling made it vulnerable to disruptions if invalid data was received. Despite this, the overall system proved its potential for practical use, especially in home automation scenarios. For instance, a fan or heater could be automatically controlled based on temperature data, showing how such a setup could be used for smart home applications.

RECOMMENDATION

1.Upgrade Bluetooth Communication

The HC-05 module worked well but could be replaced with a more advanced module like HC-06 or BLE (Bluetooth Low Energy) for faster and more reliable communication. Adding error-checking in the code would also help maintain data integrity, especially in more demanding setups.

2.Improve Temperature Measurement Accuracy

Calibrating the thermistor with a precise reference resistor would reduce inaccuracies in the readings. Alternatively, switching to a digital sensor like the DS18B20 would provide more consistent and precise measurements while being less affected by noise.

3.Enhance Software Functionality

On the Arduino side, introducing a debounce mechanism could prevent redundant commands and improve responsiveness. The Python script could be refined to include better error-handling, ensuring smoother operation even when unexpected data is encountered.

4.Add Data Logging

Incorporating data logging capabilities, either locally or in the cloud, would allow users to store and analyze historical temperature data. This would be particularly useful for long-term monitoring in fields like environmental studies or industrial processes.

CONCLUSION

This project demonstrated how Arduino and Bluetooth can work together to control devices like a fan or heater based on temperature readings. The system successfully measured temperature, sent data via Bluetooth, and allowed remote control through a smartphone app or Python script, showing its potential for smart home applications.

While the system worked well, there were minor issues like small inaccuracies in temperature readings and occasional communication delays. With better sensors, improved software, and a more user-friendly app, the system could become even more reliable and versatile

Overall, this was a solid starting point, proving that simple, affordable technology can create practical and functional smart systems.

ACKNOWLEDGEMENT

We would like to express our sincere gratitude to sir Zulkilfri Bin Zainal and Sir Wahju Sediono for their guidance and support throughout this project. Our thanks also extend to the lab assistants, for their constructive feedback and assistance,which greatly contributed to the completion of this work.

STUDENT'S DECLARATION

Certificate of Originality and Authenticity

This is to certify that we are **responsible** for the work submitted in this report, that the original work is our own except as specified in the references and acknowledgement, and that the original work contained herein have not been untaken or done by unspecified sources or persons.

We hereby certify that this report has **not been done by only one individual and all of us have contributed to the report.** The length of contribution to the reports by each individual is noted within this certificate.

We also hereby certify that we have **read and understand** the content of the total report and no further improvement on the reports is needed from any of the individual's contributors to the report.

We therefore, agreed unanimously that this report shall be submitted for **marking** and this **final printed report** has been **verified by us.**

Name:Amirul Iman Bin Mat Khir Read /

Matric Number: 2316633 Understand /

Signature: Agree /

Contribution:Title,introduction,equipment setup,acknowledgement

Name:Ahmad Irfan Fahmi Bin Ahmad Usri Read /

Matric Number: 2319531 Understand /

Signature: Agree /
Contribution:Result,Discussion,abstract

Name:Muhamad Nur Hafiz Bin Rosly Read /

Matric Number: 2317001 Understand /

Signature: Agree /
Contribution:Recommendation,methodology

Name: Fakhrulah Bin Yuzairi Read /

Matric Number: 2220289 Understand /

Signature: Agree /
Contribution:Question,Discussion,