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ITAI 3377: A.I. at the Edge & IIOT

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Lab 04 Reflective Journal: IIoT Protocols Project

Introduction

This project focused on simulating an IIoT sensor network using multiple protocols (MQTT, CoAP, OPC UA) to collect and visualize temperature and humidity data. The goal was to set up a virtual environment, simulate sensor data with different protocols, and visualize the results in real-time. My personal goal was to understand how these protocols work in an IIoT context and gain hands-on experience with data visualization. I expected to learn about protocol differences and how they apply to real-world scenarios, but I ended up simplifying the approach due to challenges with Colab. I also had a bit of challenge with the README directory of Github. (I think I need to improve my knowledge with github)

Personal goal

My goal was to try completing the project setup, coding, and documentation. I developed the simulation script (`mqtt_sensor_simulation.py`) in Google Colab, which generated 50 data points for temperature (20-25°C) and humidity (30-50%) and plotted them using Matplotlib. I also created the `comparison_report.pdf`, detailing the setup, results, and analysis, and organized the GitHub repository: <https://github.com/jasyjabs/Jabarr>. I had some issues, I couldn't implement MQTT, CoAP, or OPC UA, so I used placeholders for those scripts and focused on direct simulation.

Learning Outcomes

- I learned the theoretical basics of MQTT, CoAP, and OPC UA through research. MQTT is lightweight and great for real-time data transfer in IIoT,
- CoAP is designed for constrained devices, and OPC UA is ideal for industrial automation with its robust security. Hands-on

I gained skills in Python data visualization with Matplotlib and Pandas, creating a clean plot of simulated sensor data. A key takeaway was understanding the importance of environment setup—Colab's limitations taught me to adapt quickly and prioritize core functionality over full protocol implementation.

Challenges and Solutions

The biggest challenge was Colab's network restrictions, which blocked MQTT connections to `broker.hivemq.com`. I spent hours troubleshooting connection errors, only to realize Colab wasn't suitable for real-time protocol testing. I also struggled with interactive plotting (`plt.ion()`), as the

plot kept showing up empty. I solved this by switching to a static plot at the end, ensuring the data was visualized correctly. From this, I learned to test simpler approaches first and adapt to platform constraints, focusing on what I could achieve within the environment.

Future Applications

This project gave me a foundation for working with IIoT systems. I can apply the visualization skills to monitor sensor data in real projects, like factory automation or smart agriculture. Understanding protocol differences will help me choose the right one for future IIoT applications—MQTT for lightweight tasks, OPC UA for secure industrial setups. Next steps include running the full simulation locally with Mosquitto to test all protocols and adding real hardware sensors to make the project more practical. This experience showed me how to balance theory and practice in constrained environments.

Link: <https://github.com/jasyjabs/Jabarr>

```
Iteration 39: Temp=22.2°C, Hum=34.7%
Iteration 40: Temp=22.7°C, Hum=42.5%
Iteration 41: Temp=22.3°C, Hum=39.1%
Iteration 42: Temp=23.7°C, Hum=43.7%
Iteration 43: Temp=24.4°C, Hum=42.1%
Iteration 44: Temp=21.0°C, Hum=42.4%
Iteration 45: Temp=24.9°C, Hum=34.1%
Iteration 46: Temp=20.4°C, Hum=36.4%
Iteration 47: Temp=21.9°C, Hum=46.3%
Iteration 48: Temp=21.3°C, Hum=47.7%
Iteration 49: Temp=21.7°C, Hum=41.5%
Iteration 50: Temp=21.6°C, Hum=48.4%
```

