

## Reflective Journal

Github Link: [Kllle/Lab-04-Conceptual-Design-of-an-IIoT-Sensor-Network-Protocol-Experimentation at Visualizations](#)

### Introduction

This lab was designed to simulate IoT sensors using MQTT, CoAP, and OPC UA communication protocols, alongside visualizing real-time data. It aimed to offer practical experience with these protocols, exploring their unique features and challenges. My goal for this project was to strengthen my understanding of IoT technologies, troubleshoot real-world implementation issues, and enhance my problem-solving skills.

### Personal Contributions

I was solely responsible for every aspect of the project, from script development to debugging. This included:

- Successfully implementing the **MQTT sensor simulation** and ensuring reliable data transmission to the MQTT broker.
- Attempting to develop and test the **CoAP sensor simulation**, though I faced persistent connectivity issues that were not resolved.
- Working on the **OPC UA sensor simulation**, focusing on setting up the server and variables, but ultimately not managing to get it functioning.
- Debugging and improving the **data visualization script**, achieving real-time plotting of data from the MQTT broker.

These tasks required a mix of coding, debugging, and hands-on testing, pushing me to independently navigate a wide range of challenges.

### Learning Outcomes

The project offered substantial learning opportunities, despite not fully resolving some tasks:

1. **MQTT:** I developed a solid understanding of the publish-subscribe model and topics. Debugging issues helped me appreciate the importance of correct broker configurations.
2. **CoAP:** While I couldn't resolve the network error, I learned a lot about URI structures, port configurations, and CoAP's lightweight nature.
3. **OPC UA:** I gained insights into the robustness of OPC UA for modeling complex data hierarchies. While I couldn't get the server functioning, setting up objects and variables provided valuable experience.
4. **General Insights:** This project improved my debugging skills, reinforced the importance of iterative testing, and highlighted the need for careful attention to configuration details.

### Challenges and Solutions

1. **CoAP Sensor Issues:**

- **Challenge:** Persistent `NetworkError` prevented client-server communication.
- **Attempted Solutions:** Reviewed URI configurations, verified ports, and explored diagnostic tools. Though unresolved, these efforts improved my understanding of network troubleshooting.

## 2. **OPC UA Sensor Setup:**

- **Challenge:** I struggled to fully implement the OPC UA server and handle real-time variable updates.
- **Attempted Solutions:** Focused on creating writable variables and simulating data but encountered issues in server functionality. This highlighted the complexity of OPC UA's setup.

## 3. **Visualization Script:**

- **Challenge:** Initially faced blank graphs and a deprecation warning.
- **Solution:** Updating the Paho MQTT library resolved compatibility issues, and debugging ensured data was processed correctly.

## Future Applications

The knowledge and experience gained from this project will be invaluable for future endeavors:

1. **Professional Applications:** The understanding of IoT protocols will support future projects in smart devices, automation, and monitoring systems.
2. **Next Steps for the Project:**
  - Revisiting the **CoAP sensor** and fully addressing the `NetworkError` to complete its functionality.
  - Resolving the issues with the **OPC UA sensor** by exploring further documentation and debugging techniques.
3. **Long-Term Benefits:** This experience has prepared me to tackle complex IoT problems with greater confidence, focusing on adaptability and troubleshooting.

## Conclusion

While I succeeded in implementing some parts of the project, such as MQTT and data visualization, I faced limitations with the CoAP and OPC UA sensors. These setbacks highlighted the challenges of working with diverse protocols but also provided a platform for valuable learning. This project has strengthened my foundational knowledge and inspired me to continue exploring IoT technologies in both academic and professional contexts.