Laboratory Report

Experiment 8: IIOT, Node-Red, MQTT & Mobile App

Programme: Mechatronics Engineering
Mechatronics Control and Automation Lab (MCTA 3104)
Section 2
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Objectives

- To explore Node-RED as a programming tool for connecting hardware devices, APIs and online services.
- To investigate the integration of IIoT (Industrial Internet of Things) into systems through Node-REDCAND plc (Programmable Logic Controller).

Equipment and Components

1. IIOT Simulator 2070, IOT Sata Sdn Bhd

— It mimics the operation of industrial automation systems, demonstrating how PLCs interact with these systems in practical scenarios. Additionally, it integrates with Node-RED to enable visualization of data from simulated processes, design control interfaces, and build automation logic.

2. Computer with Node-RED

— Node-RED is an open-source development platform based on JavaScript, designed for IoT system development. It features a visual interface for building data flows and streamlining integration with advanced systems such as SQL servers and cloud platforms. Its Dashboard provides tools for real-time data visualization and supports rapid prototyping using protocols like MQTT and database interactions. Paired with the IIOT Simulator 2070, Node-RED effectively connects with PLCs, enabling real-time monitoring, control, and automation. This integration enhances PLC functionality and adaptability without requiring complex programming.

## Process Flow

Part A: Make PLC Diagram in TIA PORTAL

1. Connection between TIA portal and PLC hardware (SIMATIC IOT2000 PLC) is set up.

2. Click on PLC → Properties →General → Ethernet addresses → IP protocol. Select "Set IP address in the project", and then insert the IP address of the PLC hardware.

3. Click on PLC → Properties →General → protection → Connection mechanisms → Tick "permit access with PUT/GET…".

4. In project tree, →Under program blocks → add new block → choose Function block → 'OK'

5. Click on Block_1[FB1] →properties → Under general →Attributes → Uncheck "Optimizes block access"

6. Create a simple LAD Program in FB1

7. Open "Main [OB1]" → Drag "Block_1[FB1]" into network "Main [OB1]" → popup "call options" appear, just click "OK"

8. Save & upload the complete program (Hardware & Software) to CPU

Task 1: Built this following circuit in PLC and see the whether IIOT Simulator will be activated when the button is pressed.
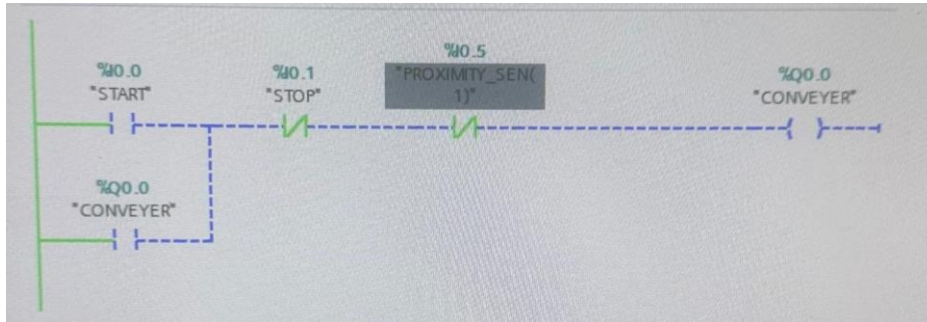
Task 2: Built this circuit and see the timing of the data send.
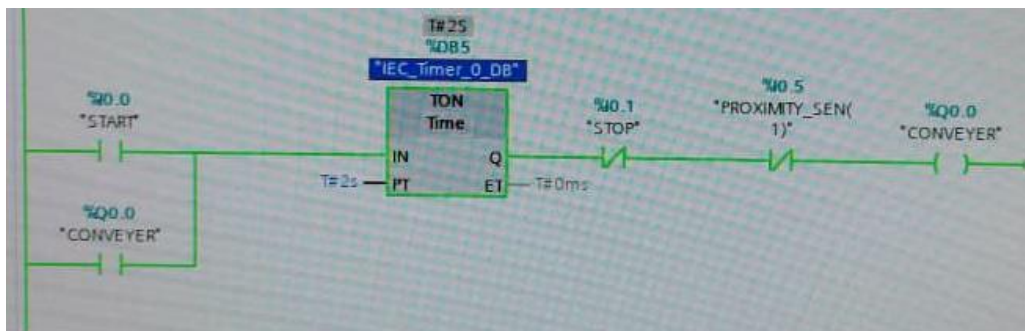

Part B: Open Node-Red

1. Install Node.js from the official Node.js website

2. Check if the installation is done by typing the following to the command prompt(cmd):
   "node --version && npm –version"

3. Install Node-red by typing the following to the cmd:
   "npm install -g --unsafe-perm node-red"

4. Run Node-red by typing the following to the cmd:
   "node-red"

5. Access Node-RED in Browser by entering ethernet or Wi-Fi IP address of IOT2000
   (Default ethernet IP address of IOT2000 is http://192.168.200.1:1880)

Part C: IIOT (Controlling PLC through Node-Red)

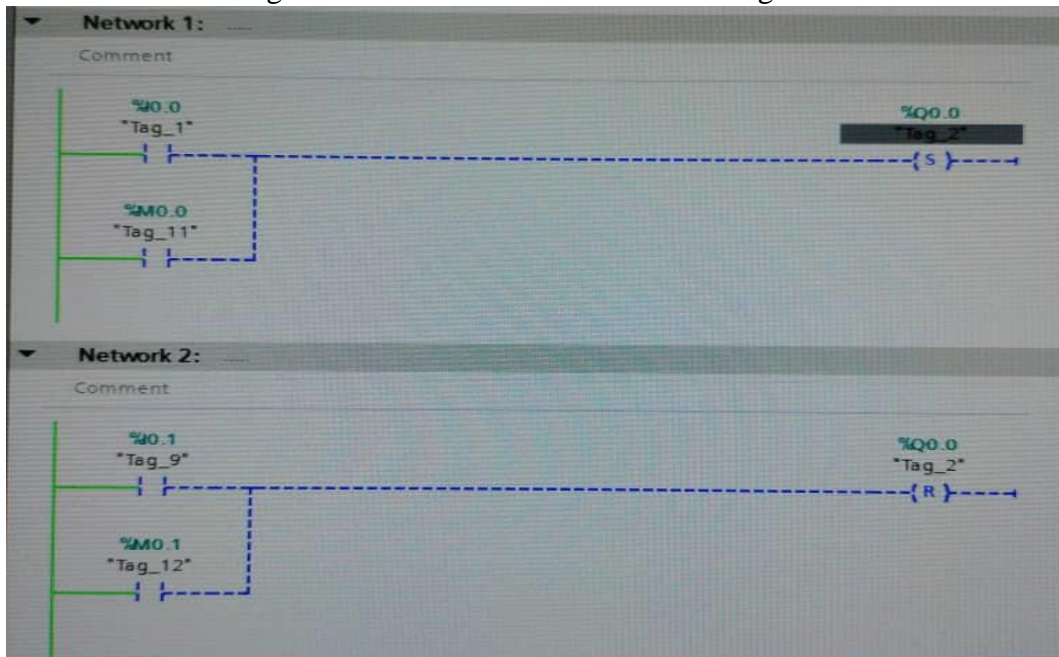1. Create the following flow in Node-Red:
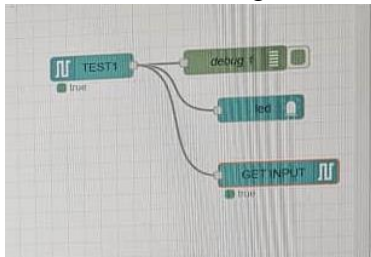
2. Configure each of the nodes respectively.
3. Deploy the flow.

Task 3: Built this following circuit and see the whether PLC will be activated when Node-red is pressed.
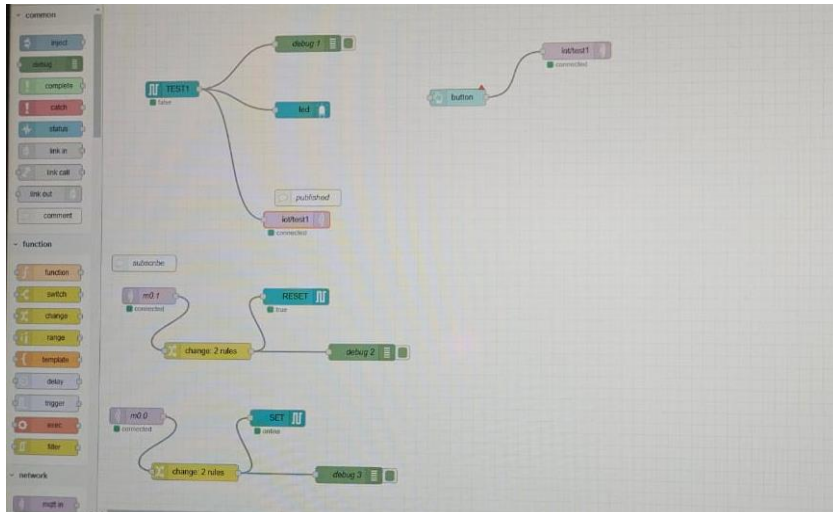

Part D: Controlling Node-Red through mobile phone (Task 4)

1. Build this ladder diagram in PLC: Set and Reset ladder diagram


2. Create this following in Node-Red:

3. Install an IIOT MQTT Panel app in a mobile phone.
4. In the app, make sure the IP Address matches the IIOT Simulator used.
5. Pick a toggle swich in the app, set the payload to 2 so that it will have two options whether 'true' or 'false'.
6. Select 1 LED as and output.
7. Lastly, make sure all the setting in the app matches the setting in the Node-Red.

Results

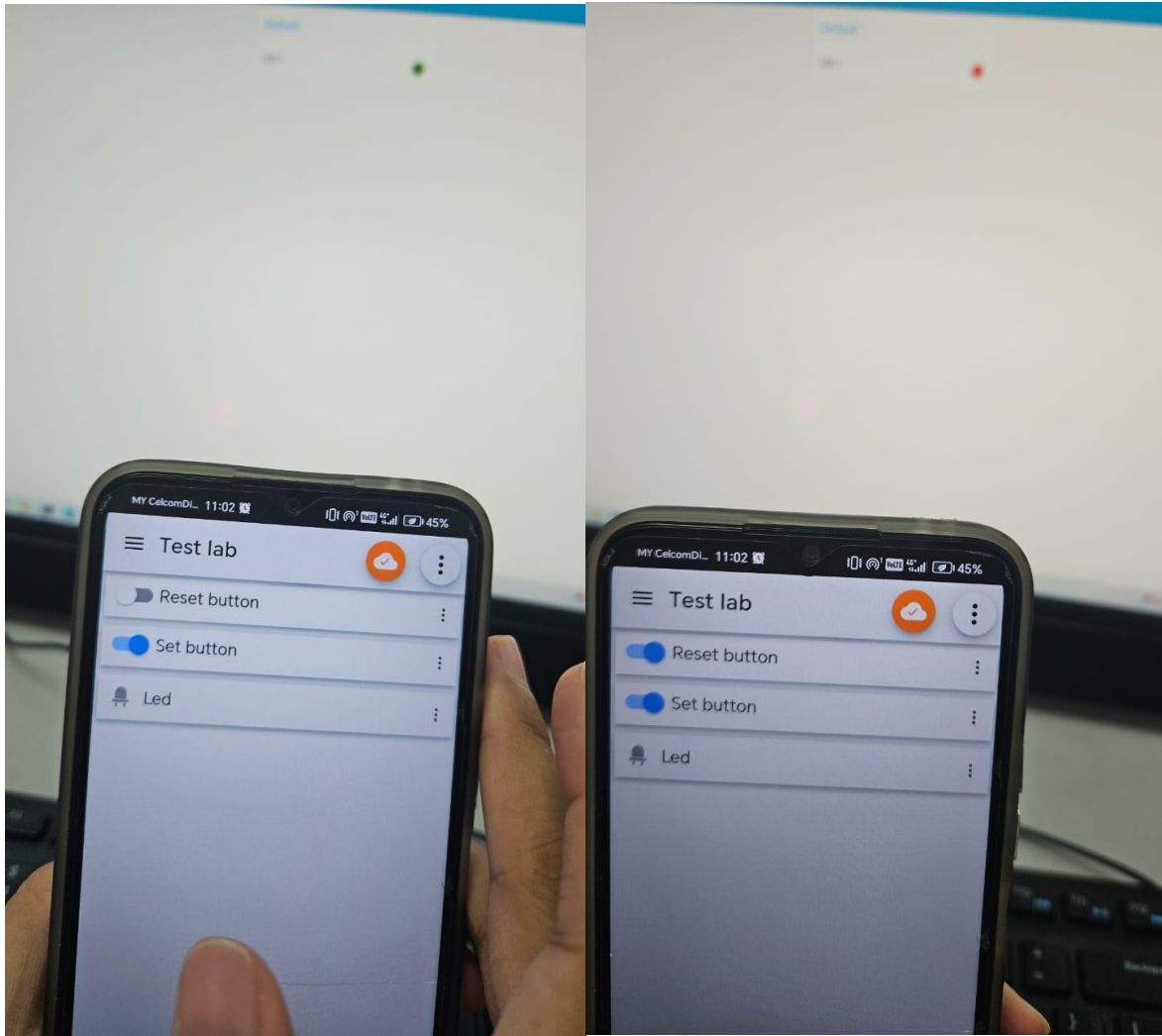**Task 1:** when pressing either the I0.0 or I0.1, the O0.0 will lit up.
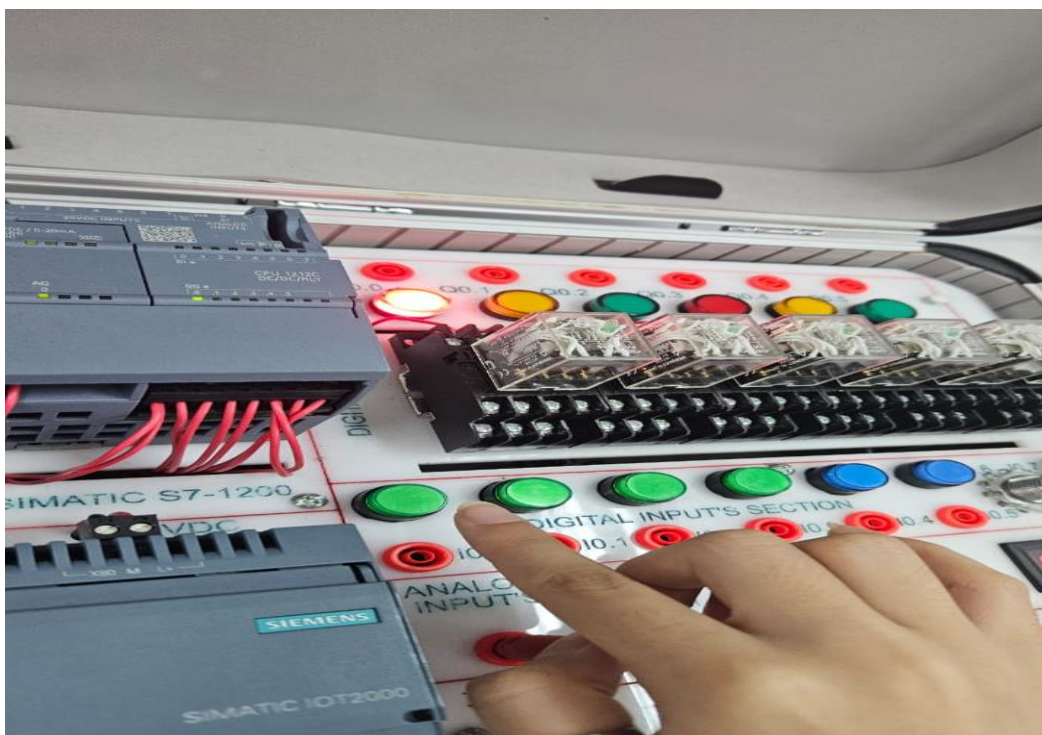
Task 2: When we put 100 milli second delay, there is a delay for the O0.0 to lit up.
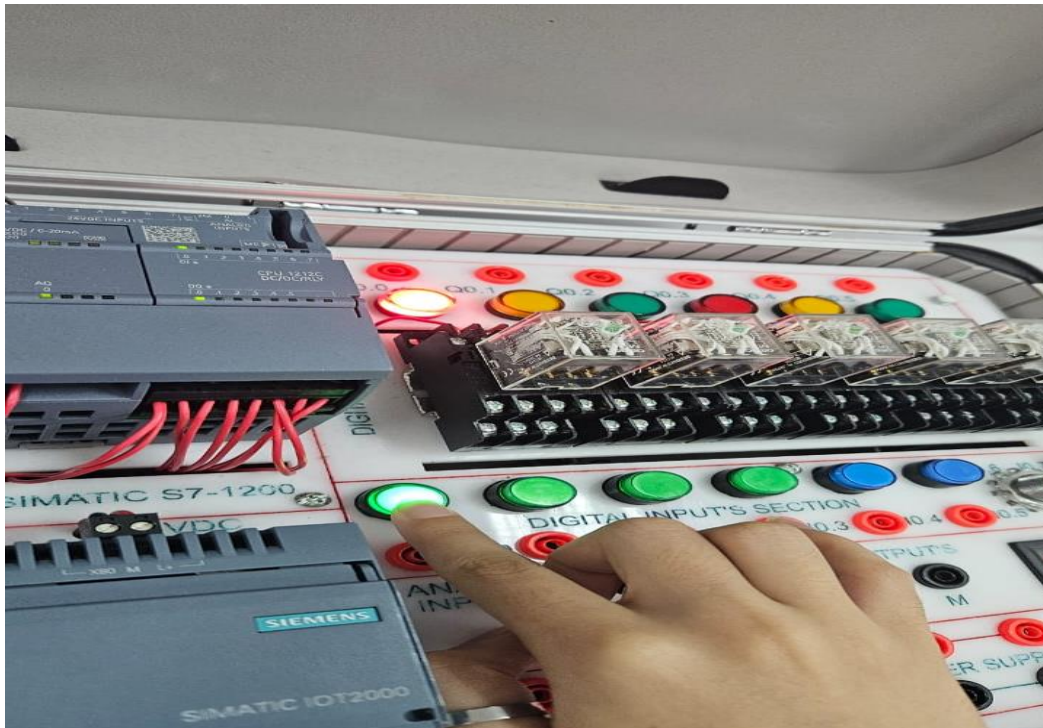
Task 3: We manage to activate and connect the PLC with Node-Red. We are able to see the output in the PLC and also in Node-Red.

Task 4: We are able to control the Node-Red through our mobile phone.

Summary

In this report, we successfully explored how the Industrial Internet of Things (IIoT) can be integrated with Programmable Logic Controllers (PLCs) using Node-RED. The experiments demonstrated practical applications of IIoT in automation. In Task 1, pressing a button activated the IIoT simulator, confirming the functionality of the PLC circuit. Task 2 showed that introducing a 100-millisecond delay resulted in a matching output delay, verifying accurate timing in data transmission. In Task 3, Node-RED was seamlessly connected to the PLC, enabling real-time monitoring and control. Finally, Task 4 demonstrated remote control of Node-RED through a mobile app, highlighting the system's flexibility and ease of use.

Overall, combining Node-RED, PLCs, and the IIoT simulator provided an effective way to design and control automated systems. These tools simplify automation processes, making them more efficient and adaptable to various applications.

References

- **Siemens TIA Portal Manual. Guided the setup of the PLC hardware and software**
- **MQTT Protocol Documentation.** *Used for setting up communication between Node-RED and the mobile app*.

Appendices

The IIoT Simulator IP Adress