Industrial Data Communications - KON435E
Final Project

Due Date and Time: 17.01.2023 - 23.59

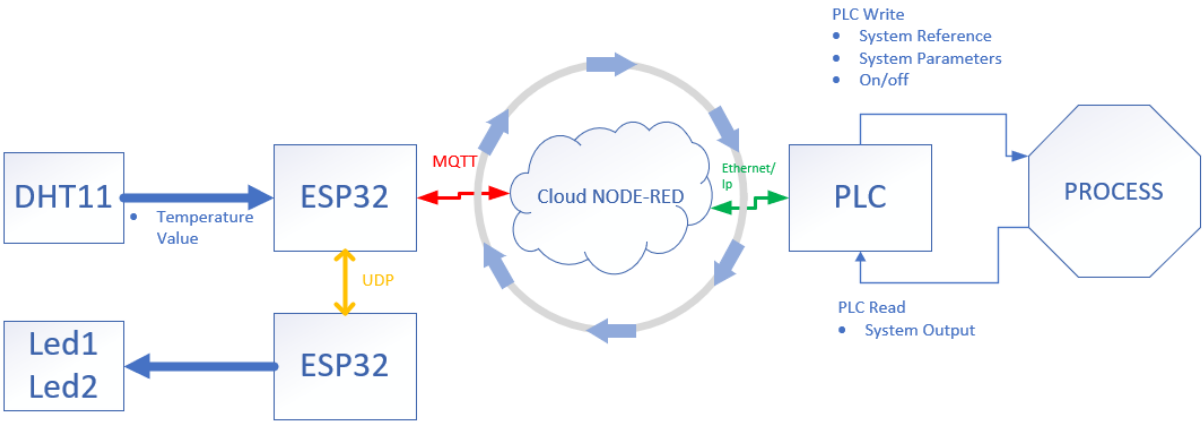

Figure 1: System Description

1 Description of the Project

Aim of the project is to build a industrial SCADA and data analyze system with Allen-Bradley Controllogix PLC, Node-Red and ESP32s.

There are two servers on internet and their addresses are 160.75.154.100 -101. Node-Red (PORT 1880) and MQTT broker (PORT 1884) is running on the servers.

The servers are connected to a PLC from local network which runs an embedded process. The process contains a second order system with changeable system parameters. The system parameters will be specified for each group. The process is as seen in the figure 2.

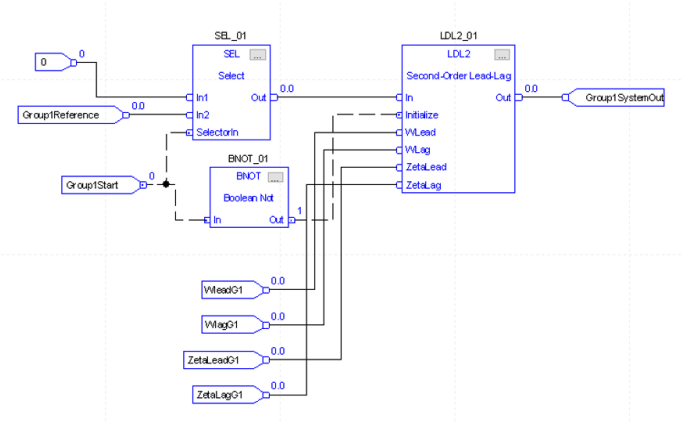

Figure 2: 2nd order system process that is embedded in the PLC

An ESP32 system which will contain 2 ESP32's, 1 DHT11 temperature sensor and 2 leds need to be established. ESP32s will communicate with each other via UDP protocol while one of them will communicate with Node-Red servers via MQTT protocol.

Establish MQTT communication between Server and ESPs. MQTT broker addresses are 160.75.154.100-101, port 1884, username: kon435, password:963258741. Measure the communication delays in terms of milliseconds. (There are functions in Node-Red you can install them via Manage Palette) Compare the responses coming back from MQTT.

1st ESP32 will publish DHT11 temperature and humidity values. It will also subscribe to system's output value in order to calculate error between DHT11 temperature value and system's output.

2nd ESP32 will get the system's output data from the 1st ESP32 with UDP protocol. It will trigger the 1st led if the system is working and will trigger the 2nd led if the system's output is bigger than the DHT11 temperature value.

The PLC datas will be read and written from Node-Red. "*eth-ip in*" and "*eth-ip out*" nodes can be used for data reading and writing. The PLC adress is 172.16.2.171. Node-Red will be programmed to start the system for once at every hour and collect data for 15 minutes. The system is also need to be able to be started and stopped at anytime. The process has to work in cycles. System reference will be equal to the DHT11 room temperature.

The error between DHT11 temperature (system input) and the system's output and the efficiency need to be calculated for 15 minutes in node-red. It need to be done for every cycle.

All commands, signals, datas and calculations need to be visualized in Node-Red dashboard.

2 PLC Tags

Every group have 7 tags to read and write. *Start* tag is the starting command of the system and it is boolean. *System reference* is the input of the system in REAL data type and it need to be equal to the instant DHT11 temperature value. *SystemOut* is the output data of the system in REAL data type. *System parameters* are as seen in the equation 1.

$$H(s) = \frac{\frac{s^2}{w_{lead}^2} + \frac{2\zeta_{lead}s}{w_{lead}} + 1}{\frac{s^2}{w_{lag}^2} + \frac{2\zeta_{lag}s}{w_{lag}} + 1} \tag{1}$$

The specified tags for each group are shared with the excel document which is attached to the homework.

3 Important Tips

Teams 1-8 will be using 160.75.154.100. There will be separated flows for each group.

Teams 8-15 will be using 160.75.154.101. There will be separated flows for each group.

Notice that each group should have their own code and due to different IPs and networks your delays should be different.

It is also suggested for each group to take screenshots of Node-Red and export the flow code in every step.

A detailed and carefully prepared report is required.