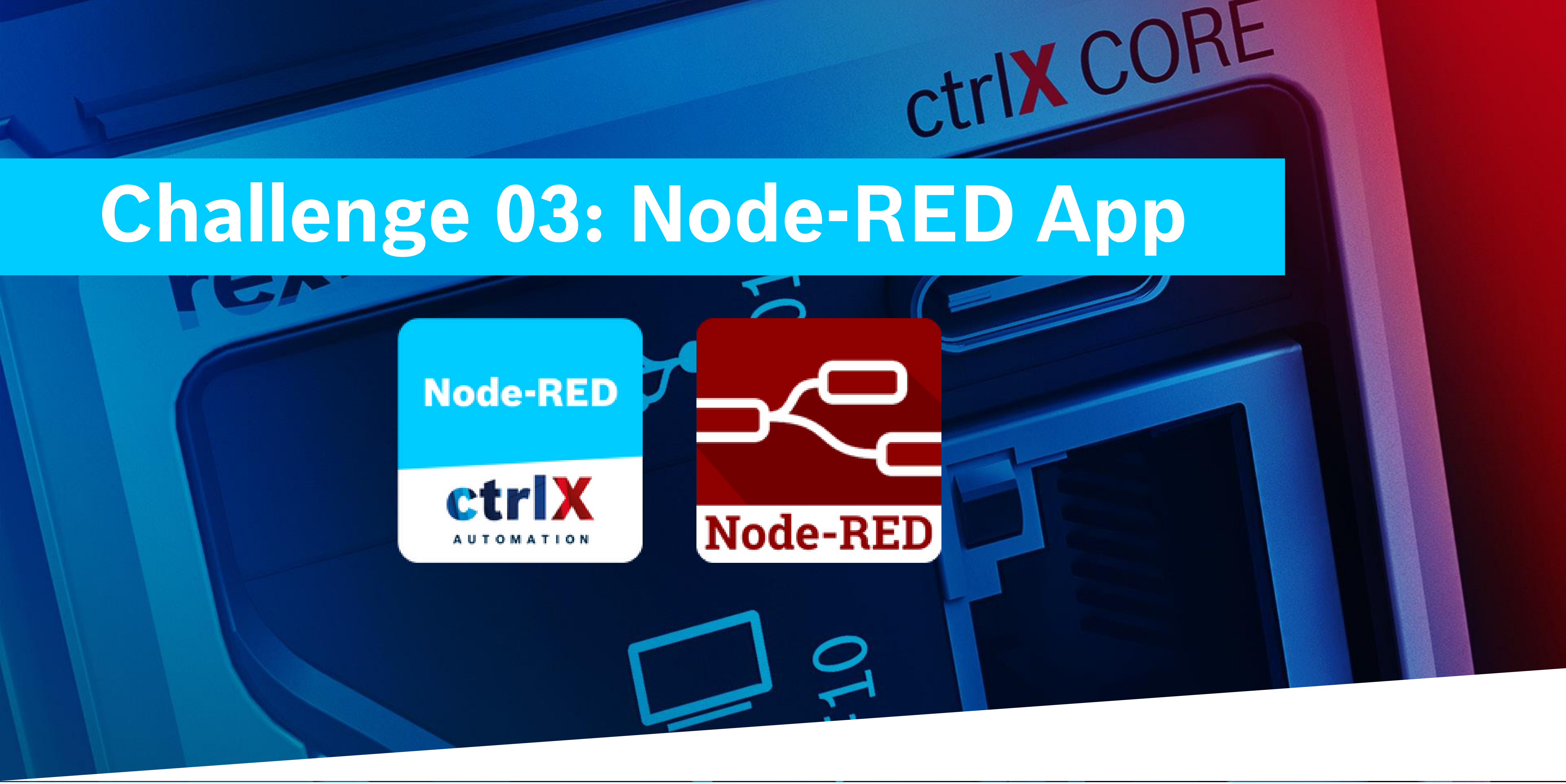
Challenge 03: Node-RED App



Node-RED ctrlX AUTOMATION

Node-RED

Let’s Start!

Let‘s Start!

Inform

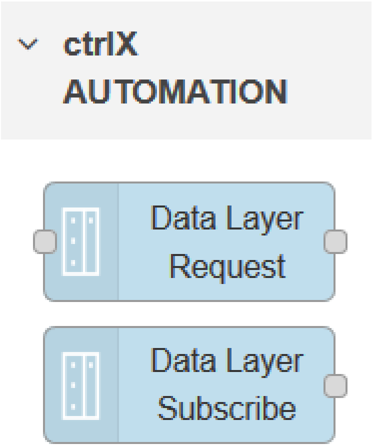
ctrlX AUTOMATION – Node-RED

The Node-RED app is the Node-RED framework adapted for ctrlX AUTOMATION by Bosch Rexroth. The open source tool Node-RED is licensed under the Apache 2.0 license and is a graphic development tool developed by IBM. On the server side, the framework is based on Node.js, while operation takes place via a graphical user interface in the browser. With Node-RED, different nodes for input, output and processing can be connected to one another in a so-called flow. This allows data to be processed as well as various processes or devices to be monitored and controlled.

Information about the ctrlX Node-RED App can be found online:

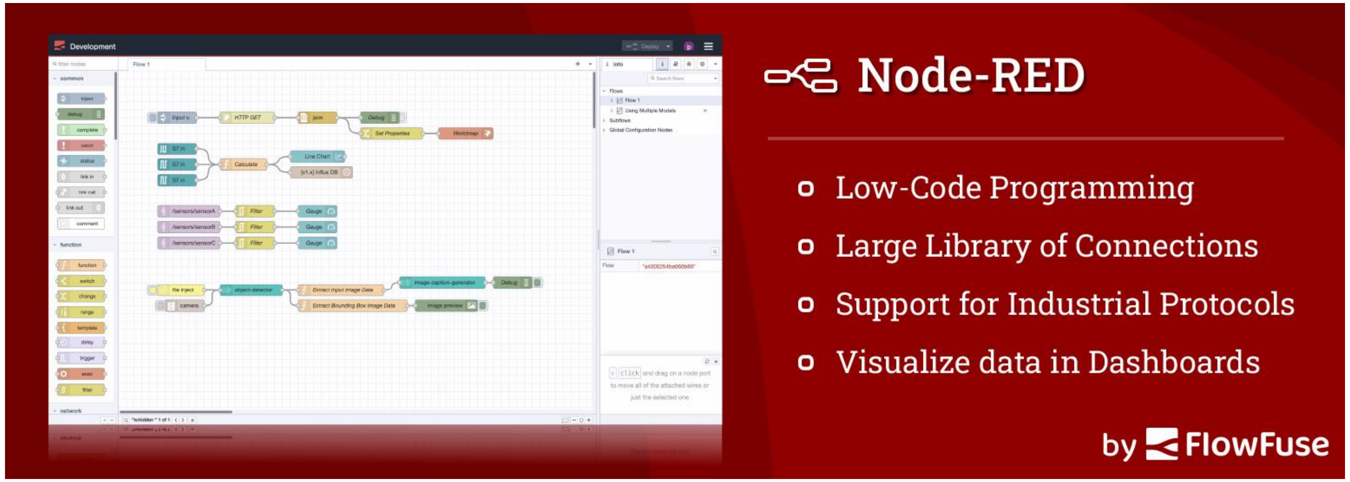
- ctrlX Node-RED App | ctrlX AUTOMATION Community
- ctrlX Node-RED App | Application Manual
- ctrlX Nodes on Github

Node-RED nodes for ctrlX Data Layer



- This package **node-red-contrib-ctrlx-automation** contains nodes to easily connect to ctrlX AUTOMATION devices from Bosch Rexroth.
- Using the nodes you can read from and write to the ctrlX Data Layer.
- **Data Layer Request node**
  - This node can be triggered to execute read, write, browse, create or delete operations within the ctrlX Data Layer.
- **Data Layer Subscribe node**
  - This node allows to subscribe to value changes of an item in the ctrlX Data Layer.

Challenge 03: ctrlX Node-RED App | Introduction


Node-RED
Low-Code Programming
Large Library of Connections
Support for Industrial Protocols
Visualize data in Dashboards
by FlowFuse

Introduction to Node-RED

Node-RED is a low-code graphical/ visual development environment that connects data from many different types of services, including industrial sensors, PLCs, enterprise services, and more. Developers create Node-RED applications by dragging and dropping nodes onto a canvas that creates flows of events for the data. In the industrial world, Node-RED is often deployed on PLCs, like ctrlX CORE, to analyze, filter and integrate the data before sending it to the cloud.

Why it's very popular for factory automation application?

- It's visual programming environment makes it possible for non-software developers to build real applications.
- A large library of nodes and flows makes it trivial to connect different types of analog and digital services, including industrial protocols (OPC-UA, Modbus, MQTT), databases, weather services, etc.
- Add and use of global and local variable, with and without input and output assignment

Challenge 03: ctrlX Node-RED App | Introduction

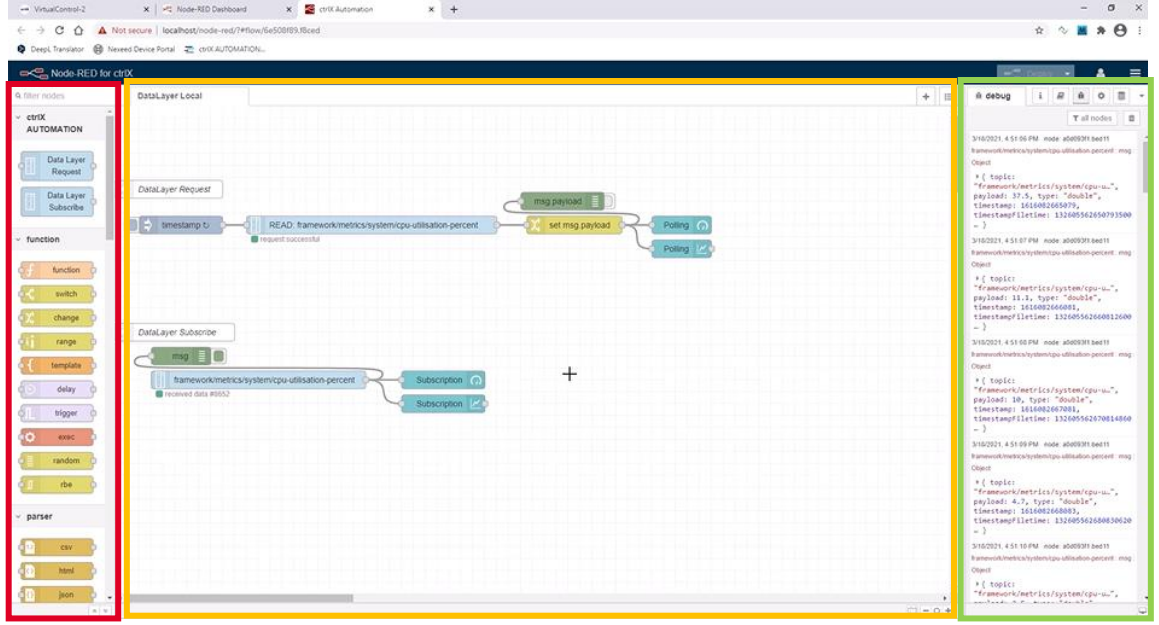
Introduction to Node-RED

Node-RED Interface

- Node-RED consists of two (2) window elements:

1. Node-RED Flow Editor

- The Flow Editor is the Node-RED user interface in which the user can create and configure flows.



```
3/16/2021, 4:51:06 PM  node: a0d093f1.bed11
framework/metrics/system/cpu-utilisation-percent : msg :
Object
▸{ topic:
"framework/metrics/system/cpu-u…",
payload: 37.5, type: "double",
timestamp: 1616082665079,
timestampFiletime: 132605562650793500
… }
3/16/2021, 4:51:07 PM  node: a0d093f1.bed11
framework/metrics/system/cpu-utilisation-percent : msg :
Object
▸{ topic:
"framework/metrics/system/cpu-u…",
payload: 11.1, type: "double",
timestamp: 1616082666081,
timestampFiletime: 132605562660812600
… }
3/16/2021, 4:51:08 PM  node: a0d093f1.bed11
framework/metrics/system/cpu-utilisation-percent : msg :
Object
▸{ topic:
"framework/metrics/system/cpu-u…",
payload: 10, type: "double",
timestamp: 1616082667081,
timestampFiletime: 132605562670814860
… }
3/16/2021, 4:51:09 PM  node: a0d093f1.bed11
framework/metrics/system/cpu-utilisation-percent : msg :
Object
▸{ topic:
"framework/metrics/system/cpu-u…",
payload: 4.7, type: "double",
timestamp: 1616082668083,
timestampFiletime: 132605562680830620
… }
3/16/2021, 4:51:10 PM  node: a0d093f1.bed11
framework/metrics/system/cpu-utilisation-percent : msg :
Object
▸{ topic:
"framework/metrics/system/cpu-u…",
```

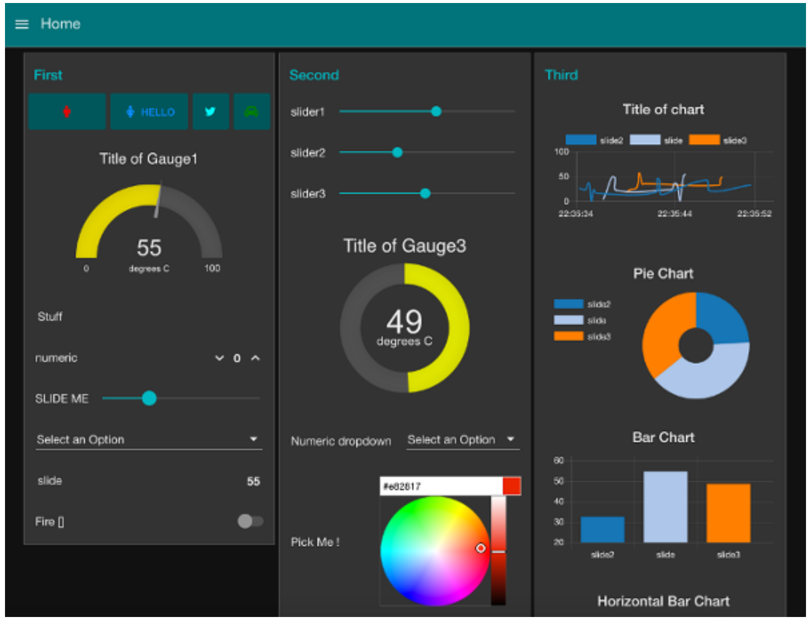
Node panel

Sheets panel

Info panel / Debug panel (tabs)

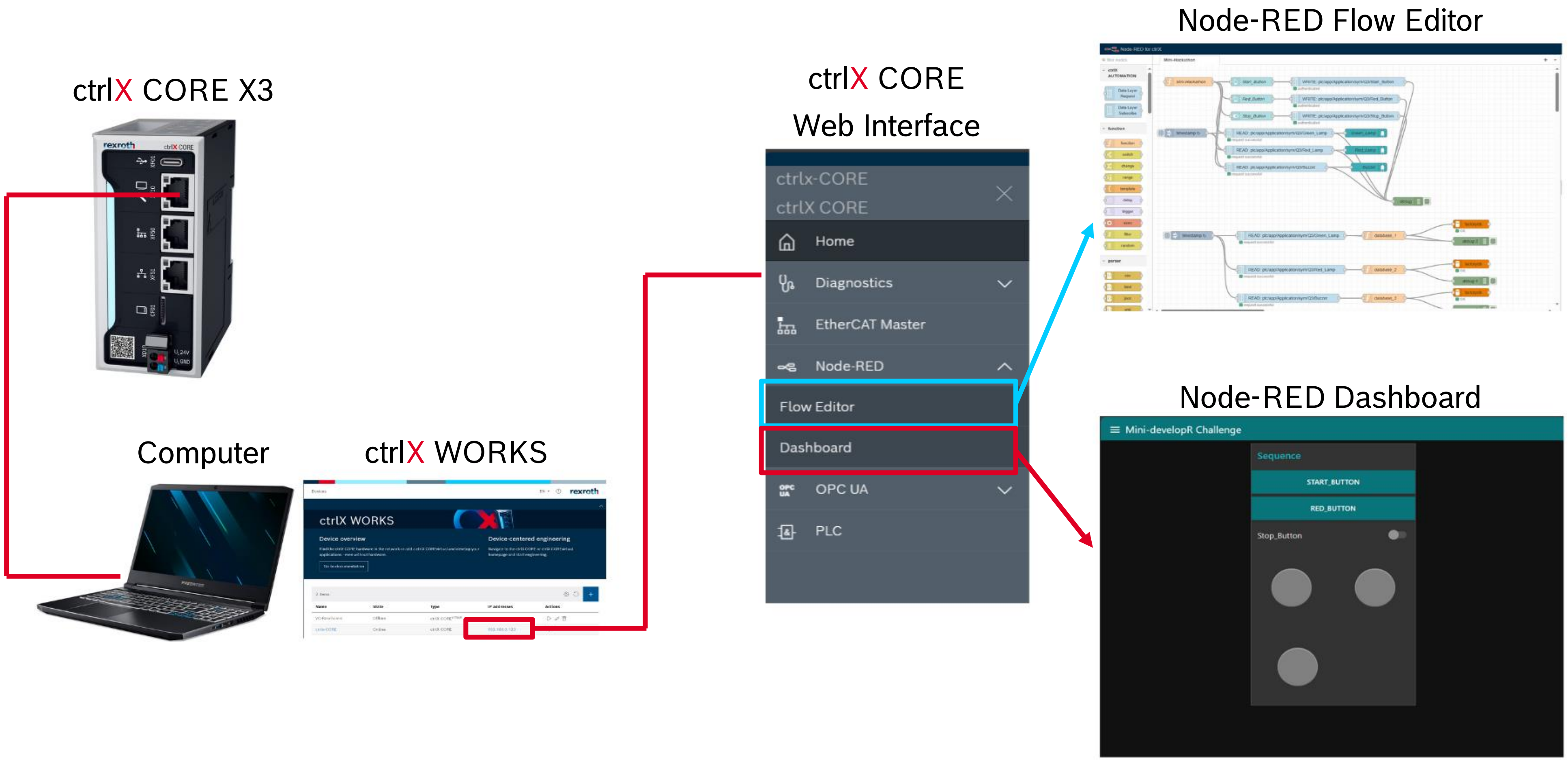
2. Node-RED Dashboard

- The Dashboard is a configurable interface to display and control objects and live data (buttons, controllers, trend displays, etc.).



rexroth
A Bosch Company

Challenge 03: ctrlX Node-RED App | Setting up Node-RED App

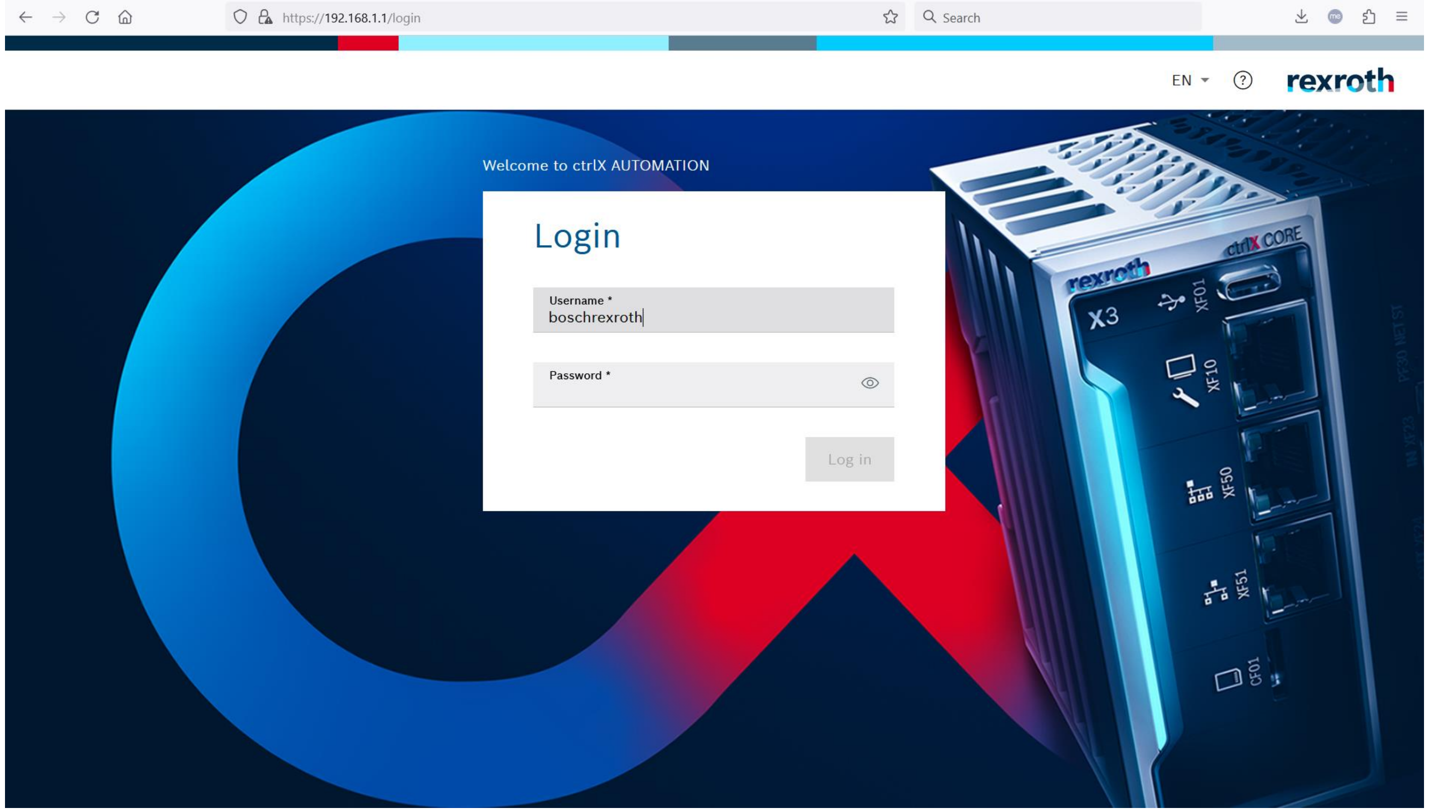


Challenge 03: ctrlX Node-RED App | Setting up Node-RED App

Steps

1. Login into the ctrlX web-based user interface. Enter the Login details (Username: boschrexroth, Password: B0schrexroth).

ctrlX Web-Based User Interface – Login Page



https://192.168.1.1/login

Welcome to ctrlX AUTOMATION

Login

Username *
boschrexroth

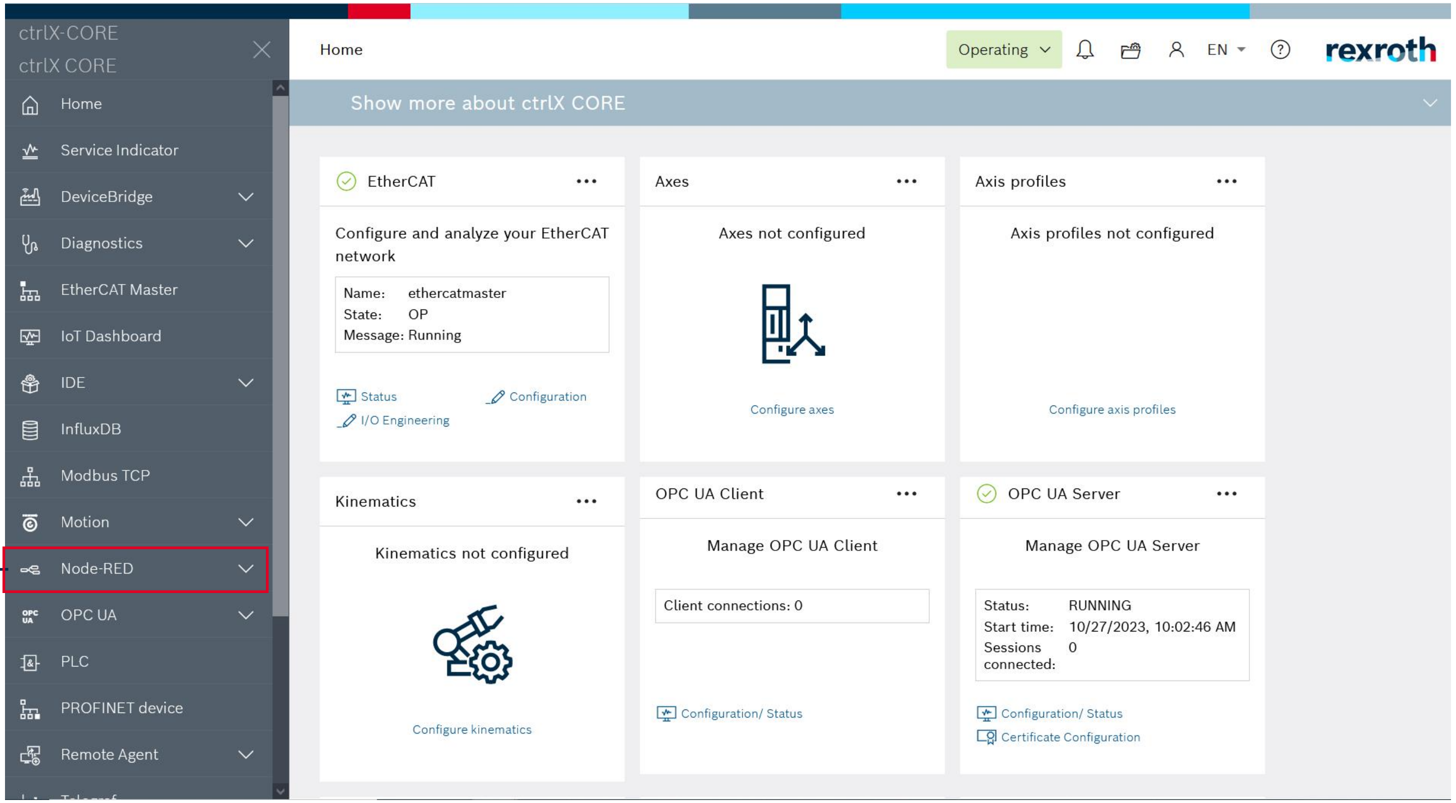
Password *

Challenge 03: ctrlX Node-RED App | Setting up Node-RED App

Steps

2. After successfully logging in, navigate to the Node-RED App from the Home Page of the ctrlX CORE Web Based User Interface.

ctrlX Web-Based User Interface – Home Page



EtherCAT

Configure and analyze your EtherCAT network

Name: ethercatmaster
State: OP
Message: Running

Status · Configuration · I/O Engineering

Axes

Axes not configured

Configure axes

Axis profiles

Axis profiles not configured

Configure axis profiles

Kinematics

Kinematics not configured

Configure kinematics

OPC UA Client

Manage OPC UA Client

Client connections: 0

Configuration/ Status

OPC UA Server

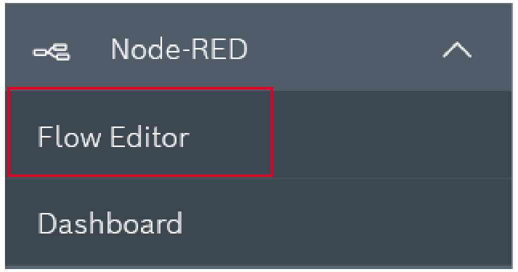
Manage OPC UA Server

Status: RUNNING
Start time: 10/27/2023, 10:02:46 AM
Sessions connected: 0

Configuration/ Status · Certificate Configuration

1. Click on the Node-RED App

2. Click on Flow Editor



Challenge 03: ctrlX Node-RED App | Setting up Node-RED App

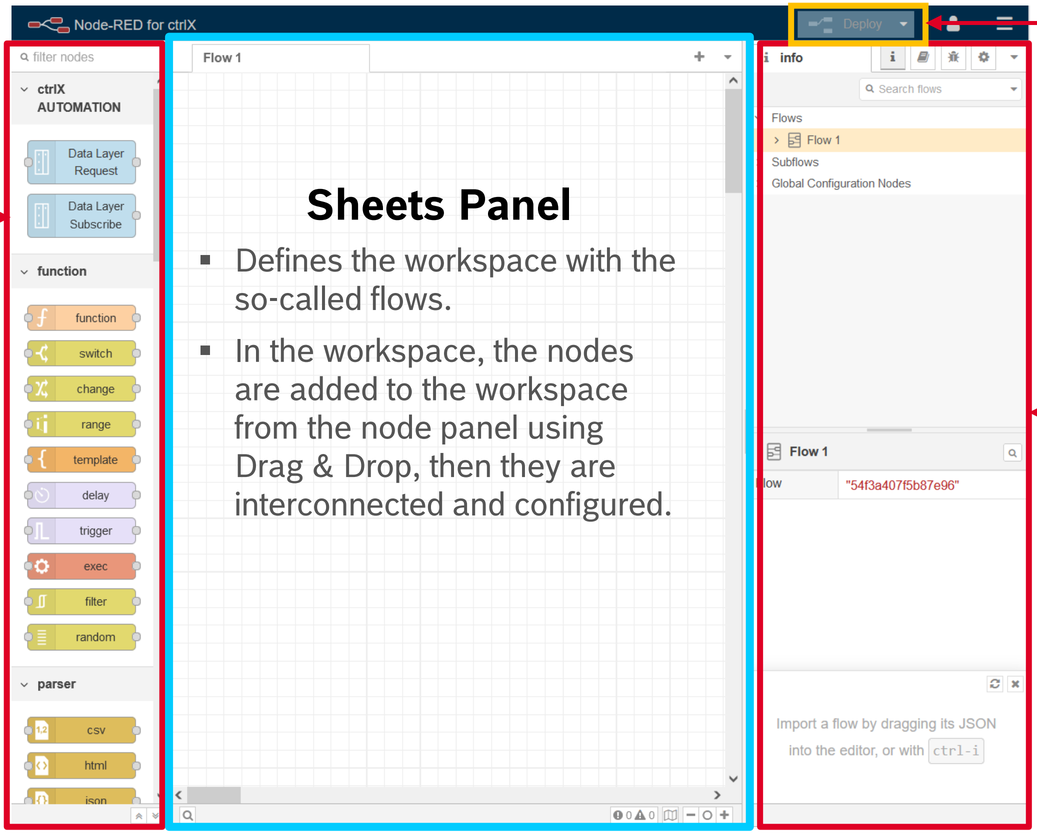
Steps

3. The Node-RED Flow Editor will open in a new tab in the web browser.

ctrlX Node-RED Interface – Flow Editor

Node Panel

- Lists all installed or available nodes.
- The nodes are divided into functional categories such as input and output and can be extended using the package manager.



Import a flow by dragging its JSON into the editor, or with ctrl-i

Sheets Panel

- Defines the workspace with the so-called flows.
- In the workspace, the nodes are added to the workspace from the node panel using Drag & Drop, then they are interconnected and configured.

Deploy Button

- The Deploy button is used when a flow has been constructed and causes the flow to be deployed onto the Node-RED system and executed.
- A successfull deploy will indicate

Successfully deployed

Info panel / Debug panel (tabs)

- The info box and the debug box to the right side are divided into tabs.
- The information area ℹ info shows the description of a selected node.
- The debug area debug lists the debug node output or internal errors.

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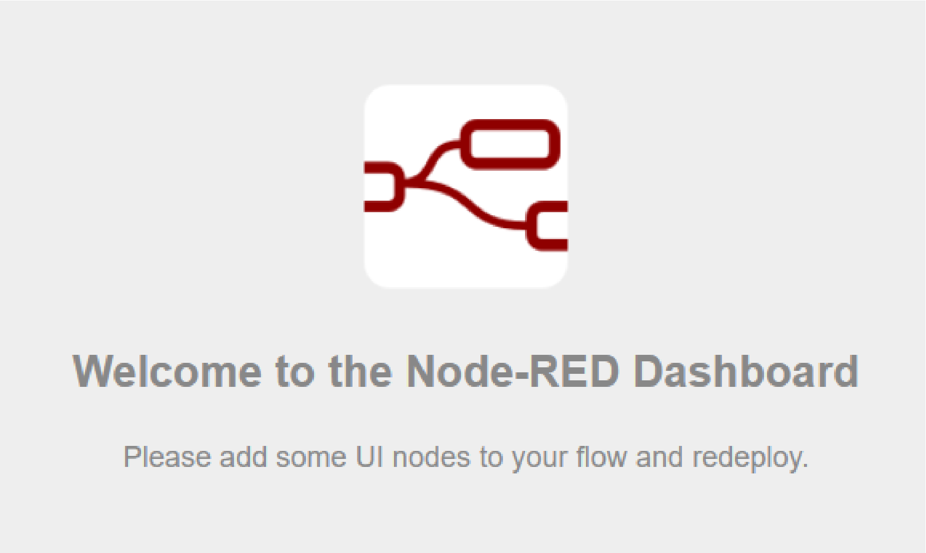
Challenge 03: ctrlX Node-RED App | Setting up Node-RED App

Steps

4. From Step 2, click on Node-RED Dashboard. The Node-RED Dashboard will open in a new tab in the web browser.

ctrlX Node-RED Interface – Dashboard

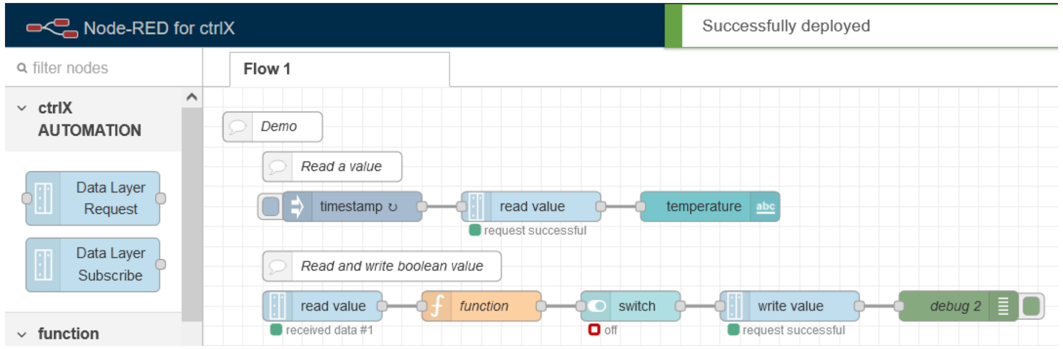
- In an empty workspace in the flow, you will view an empty Node-RED Dashboard:

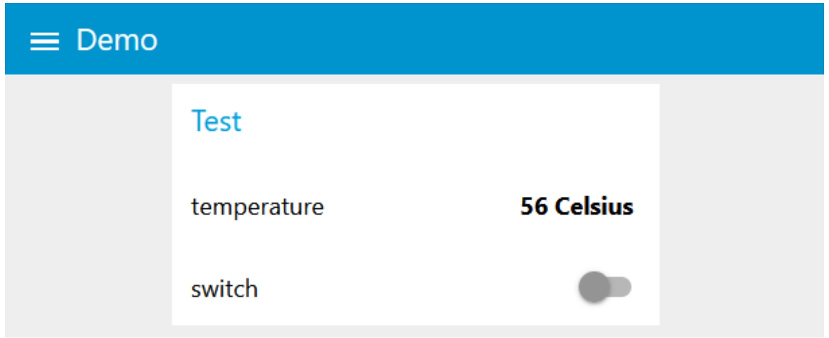


Welcome to the Node-RED Dashboard

Please add some UI nodes to your flow and redeploy.

- After you have added and configured nodes in the flow and successfully deployed your flow, your Node-RED Dashboard will display objects such as buttons/ switch and live data for visualization.





Demo

Test

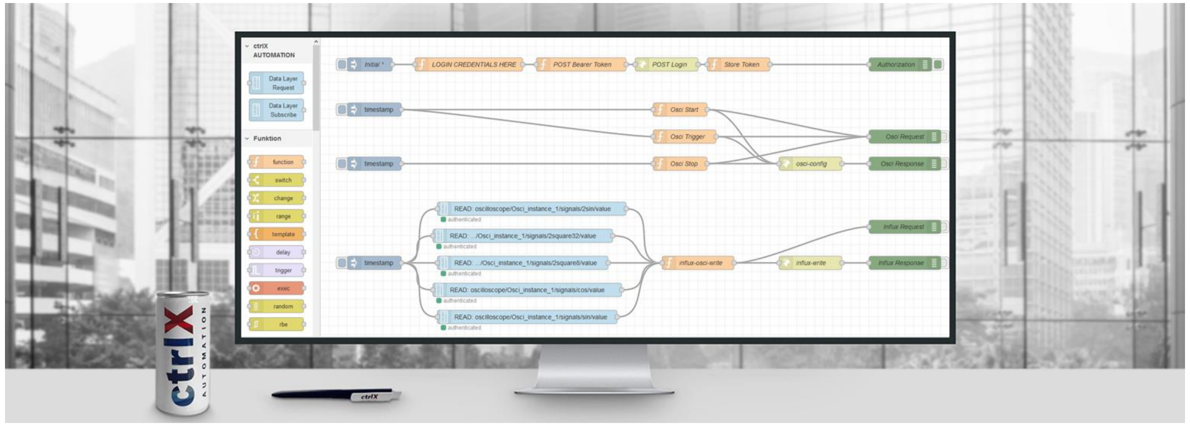
temperature 56 Celsius

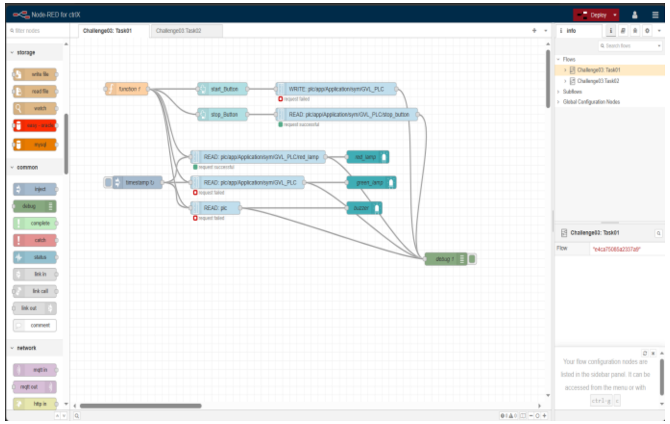
switch

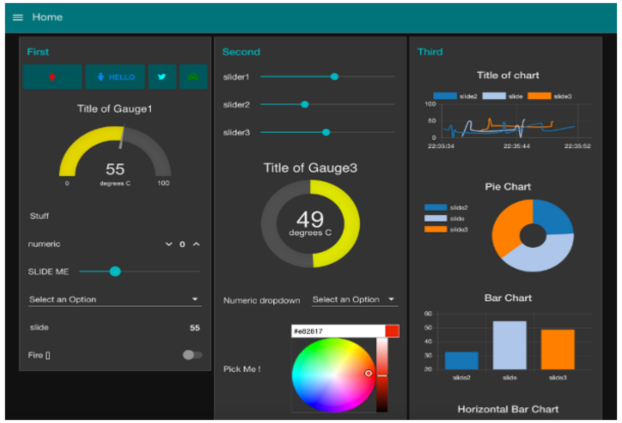
Challenge 03: Node-RED App

Task 01

Challenge 03: ctrlX Node-RED App | Task 01







Description

From OPC UA App Challenge Task 2, you have completed the monitoring and controlling of a system, but the User Interface / User Experience (UI/ UX) element is missing. Now you are given the task to create a User Interface (UI) using Node-RED to monitor and control the system. When the system is either on or off, you should be able to monitor and modify the status of the inputs and outputs of the PLC directly from the ctrlX Node-RED UI.

Task

This task will test your ability and understanding on Node-RED and its working principles. Solve the problems presented in the Node-RED Flow Editor to accomplish this task.

Challenge 03: ctrlX Node-RED App | Task 01

Safety instructions for the project exercise

In order to ensure the operational capability and to identify the possible hazards of machines and systems, the safety regulations must be observed before and during the order execution.

The ctrlX CORE may only be operated in technically perfect condition. The intended use, performance data and operating conditions may not be changed. No protective devices/components may be deactivated.

In case of emergency, failure or other irregularities:

- Before connecting or disconnecting any electrical components, ensure that the power to the ctrlX CORE unit and associated equipment is turned off.

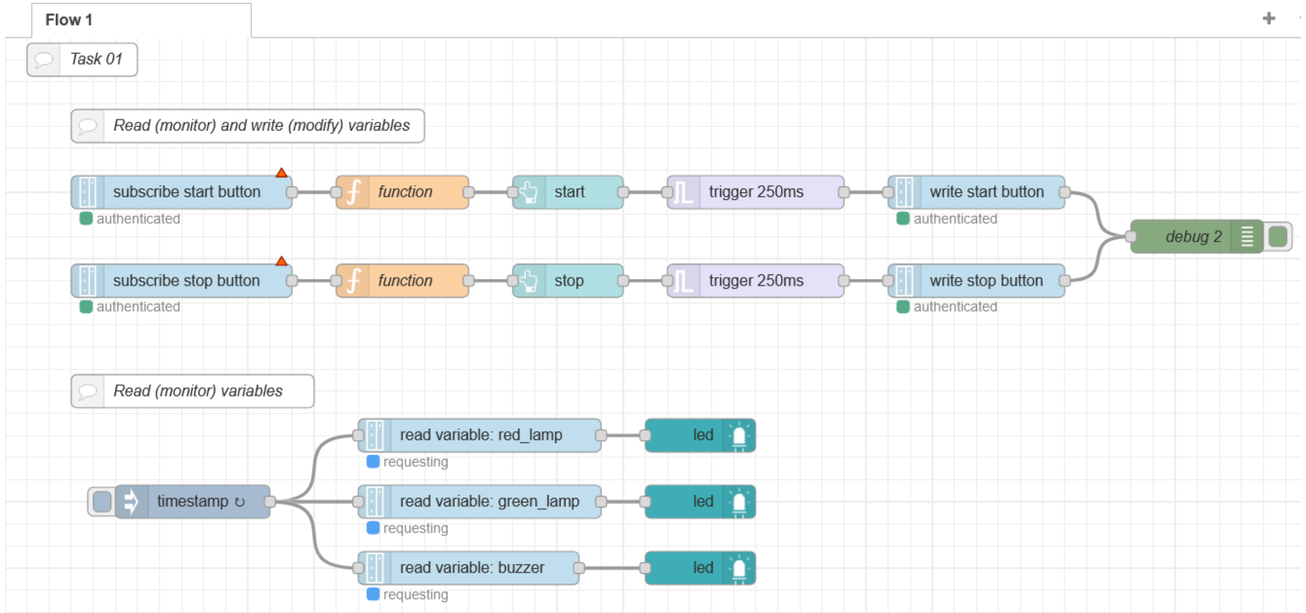
Challenge 03: ctrlX Node-RED App | Task 01

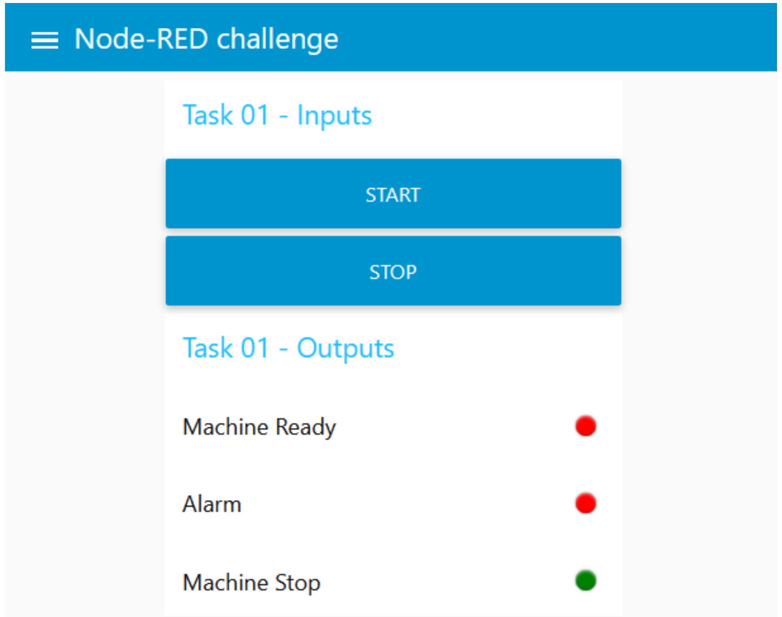
Steps

For Task 1, you need to solve the issues that exists in “**Flow 1**” in the Node-RED Flow Editor to make it work.

Solve the issues in the Node-RED Flow

- The required nodes have been added to the workspace of the flow for this task
- In the Flow Editor, the flow is not working and requires your help to solve it. You should see some error messages in the Debug Panel
- In the Dashboard, when you clicked on the **START** or **STOP** button, no changes in the behavior of the LEDs





Challenge 03: ctrlX Node-RED App | Task 01

Steps

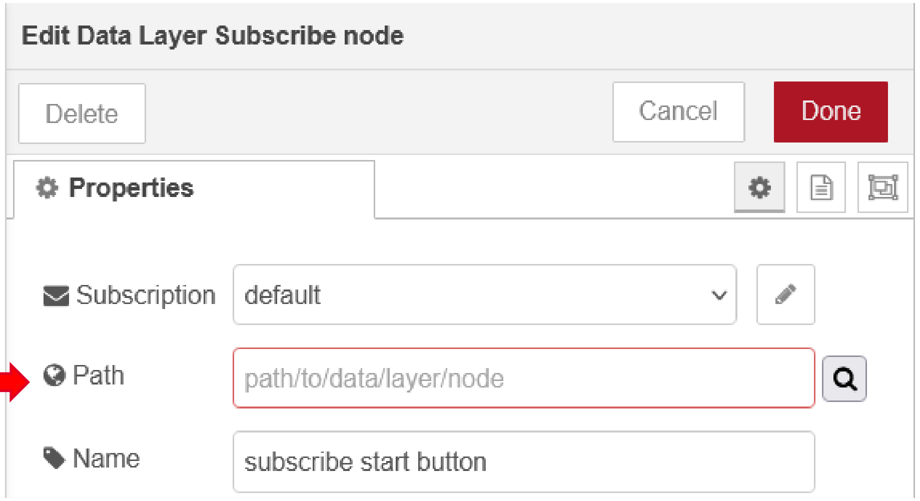
For Task 1, you need to solve the issues that exists in “**Flow 1**” in the Node-RED Flow Editor to make it work. Follow the steps below:

Edit the ctrlX Data Layer Subscribe Node [Inputs]

1. Double-click the “**subscribe start button**” Data Layer Subscribe node to edit

- Observe that the **Path** to the variable is missing
- To find the variable, click on the magnifying glass icon 🔍
- Navigate to the **GVL_PLC** target path in the ctrlX Data Layer
- Search for the variable: **start_button_opc**
- Click the Done Done button

Insert the target path here!



Edit Data Layer Subscribe node

Subscription: default

Path: path/to/data/layer/node

Name: subscribe start button

Challenge 03: ctrlX Node-RED App | Task 01

Steps

For Task 1, you need to solve the issues that exists in “**Flow 1**” in the Node-RED Flow Editor to make it work. Follow the steps below:

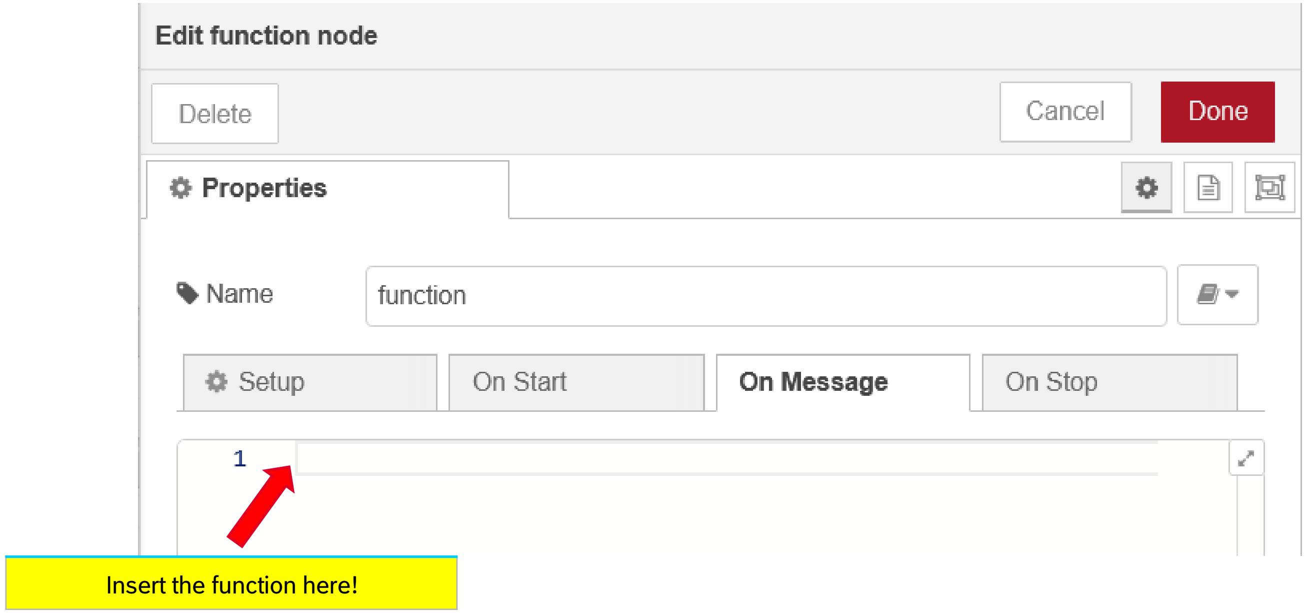
Edit the Function Node [Inputs]

2. Double-click the “**function**” node connected/ linked to the “**subscribe start button**” to edit

- Observe that the code in the “**On Message**” tab is empty
- Insert the code in the function:

```
var newMsg = {}
newMsg.payload =
{
       "type":"bool8",
       "value":msg.payload
}
return newMsg;
```

- Click the Done Done button



Edit function node

Name: function

Insert the function here!

Challenge 03: ctrlX Node-RED App | Task 01

Steps

For Task 1, you need to solve the issues that exists in “**Flow 1**” in the Node-RED Flow Editor to make it work. Follow the steps below:

Edit the Trigger Node [Inputs]

3. Double-click the “**trigger**” node to edit

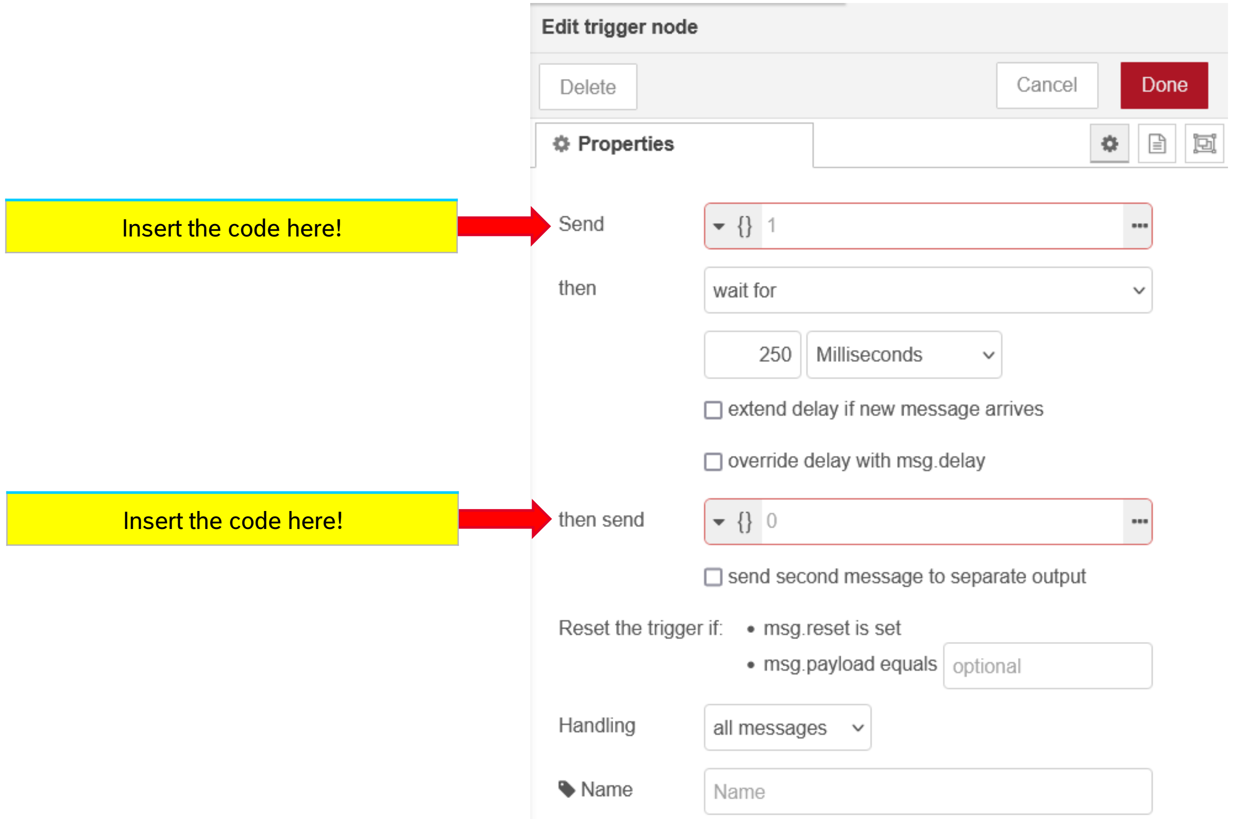
- Observe that the “**Send**” field is empty
- Insert the code in the field:

```
{
        "value": true,
        "type":"bool8"
}
```

- Next, observe that the “**then send**” field is empty
- Insert the code in the field:

```
{
        "value": false,
        "type":"bool8"
}
```

- Click the Done Done button



Insert the code here!

Insert the code here!

Edit trigger node

Send: {} 1

then: wait for

250 Milliseconds

□ extend delay if new message arrives

□ override delay with msg.delay

then send: {} 0

□ send second message to separate output

Reset the trigger if:
- msg.reset is set
- msg.payload equals optional

Handling: all messages

Name: Name

Challenge 03: ctrlX Node-RED App | Task 01

Steps

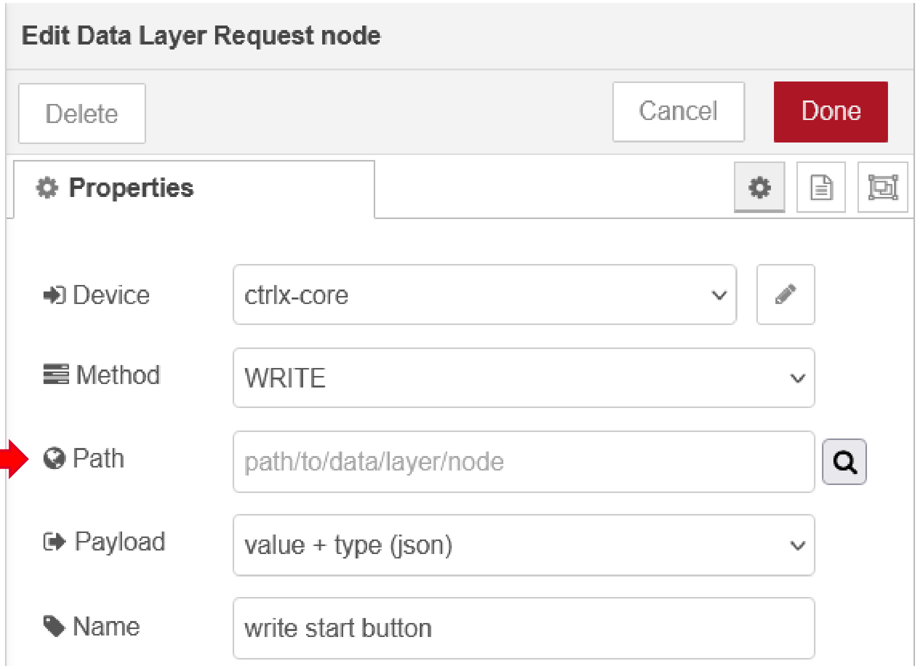
For Task 1, you need to solve the issues that exists in “**Flow 1**” in the Node-RED Flow Editor to make it work. Follow the steps below:

Edit the ctrlX Data Layer Request Node [Inputs]

4. Double-click the “**write start button**” Data Layer Request node to edit

- Observe that the **Path** to the variable is missing
- To find the variable, click on the magnifying glass icon 🔍
- Navigate to the **GVL_PLC** target path in the ctrlX Data Layer
- Search for the variable: **start_button_opc**
- Click the Done Done button

Insert the target path here!



Edit Data Layer Request node

Device: ctrlx-core

Method: WRITE

Path: path/to/data/layer/node

Payload: value + type (json)

Name: write start button

Challenge 03: ctrlX Node-RED App | Task 01

Steps

For Task 1, you need to solve the issues that exists in "**Flow 1**" in the Node-RED Flow Editor to make it work. Follow the steps below:

Do it yourself

5. Edit the "**subscribe stop button**" ctrlX Data Layer Subscribe node
6. Edit the "**function**" node
7. Edit the "**trigger**" node
8. Edit the "**write stop button**" ctrlX Data Layer Request node

Challenge 03: ctrlX Node-RED App | Task 01

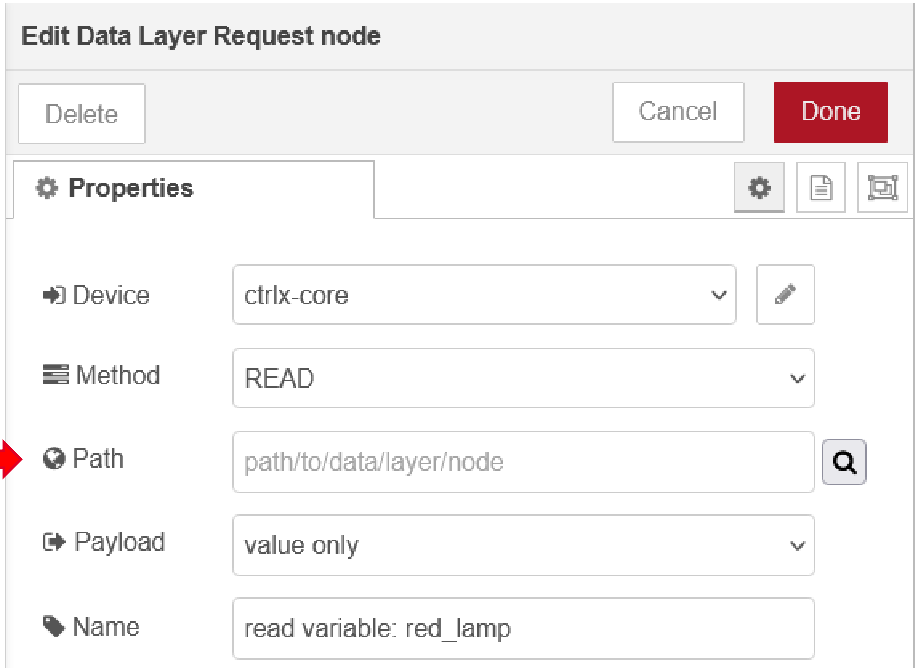
Steps

For Task 1, you need to solve the issues that exists in “**Flow 1**” in the Node-RED Flow Editor to make it work. Follow the steps below:

Edit the ctrlX Data Layer Request Node [Outputs]

9. Double-click the “**read variable: red_lamp**” Data Layer Request node to edit

- Observe that the **Path** to the variable is missing
- To find the variable, click on the magnifying glass icon 🔍
- Navigate to the **GVL_PLC** target path in the ctrlX Data Layer
- Search for the variable: **red_lamp**
- Click Done Done



Edit Data Layer Request node

Device: ctrlx-core

Method: READ

Path: path/to/data/layer/node

Payload: value only

Name: read variable: red_lamp

Insert the target path here!

Challenge 03: ctrlX Node-RED App | Task 01

Steps

For Task 1, you need to solve the issues that exists in “**Flow 1**” in the Node-RED Flow Editor to make it work. Follow the steps below:

Do it yourself

10. Edit the “**read variable: green_lamp**” Data Layer Request node
11. Edit the “**read variable: buzzer**” Data Layer Request node

Challenge 03: ctrlX Node-RED App | Task 01

Steps

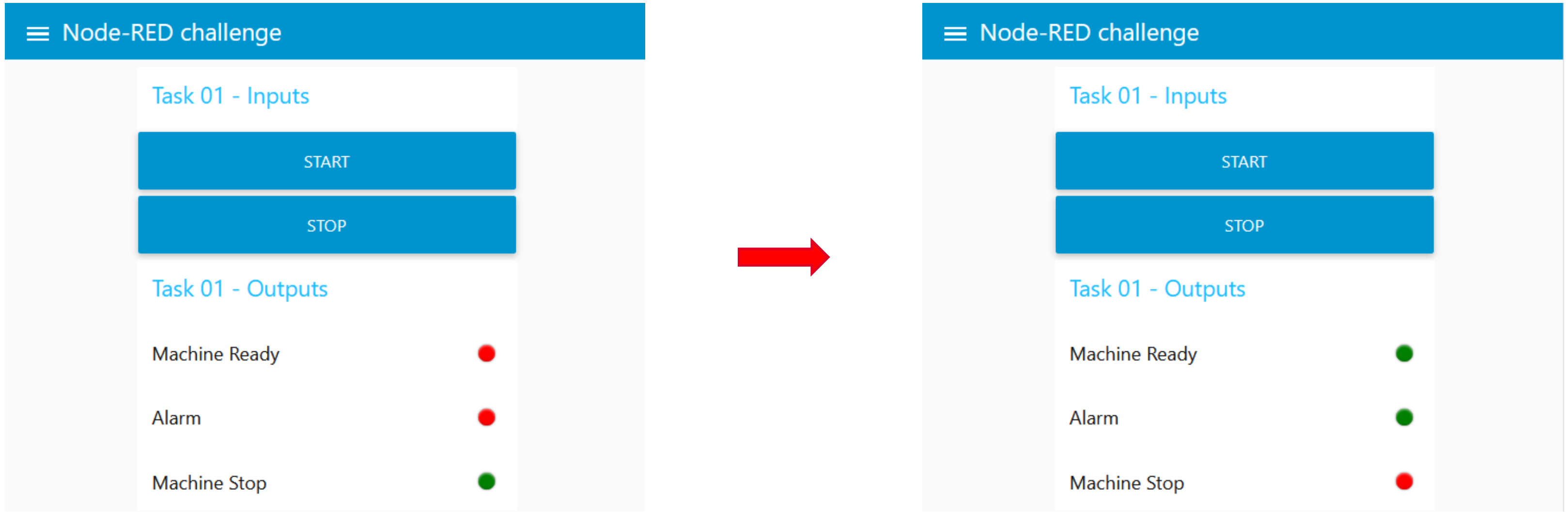
Once you have completed the node configurations and ready to deploy your Node-RED Flow, follow the steps below:

Deploy your Node-RED flow

- Click on the **"Deploy"** Deploy ▾ button to deploy and execute the Flow onto the Node-RED system

- Observe that after a successful deploy, you will get the notification Successfully deployed

- Open the Node-RED Dashboard and test your solution by clicking on the buttons. You should observe the changes in the Outputs behavior



Challenge 03: ctrlX Node-RED App | Task 01

Steps

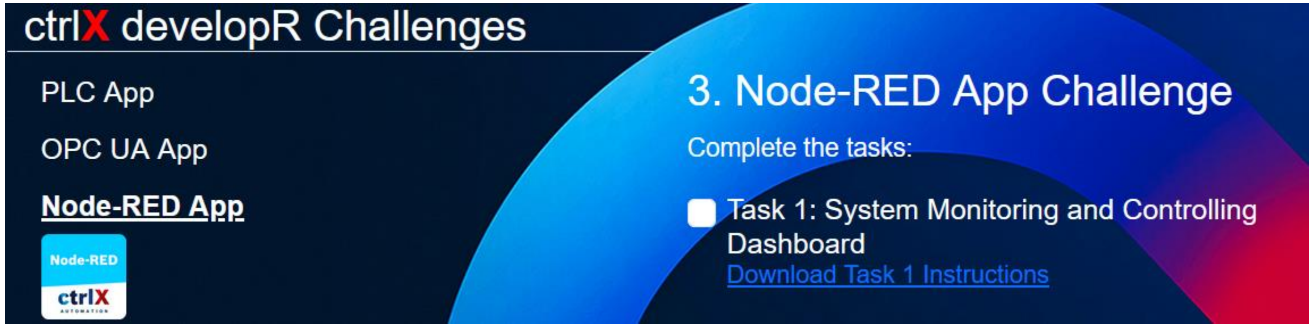
Once you have completed Task 1, follow the steps below.

How to complete Task 1 Node-RED App

- You can test your solution against the Task description
- Once it satisfies the task requirements, confirm that you have completed the task by informing the available instructor for verification
- In the ctrlX developR challenge website, under the Node-RED App challenge section, tick [✓] the Task 1 checkbox

Congratulations on completing Task 1!

Proceed to Task 2!



ctrlX developR Challenges

PLC App

OPC UA App

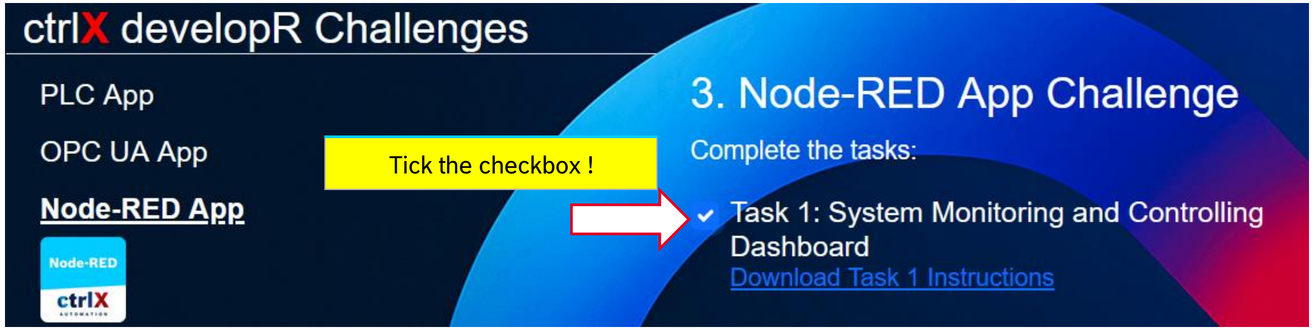
Node-RED App

3. Node-RED App Challenge

Complete the tasks:

□ Task 1: System Monitoring and Controlling Dashboard

Download Task 1 Instructions



ctrlX developR Challenges

PLC App

OPC UA App

Node-RED App

3. Node-RED App Challenge

Complete the tasks:

Tick the checkbox !

✓ Task 1: System Monitoring and Controlling Dashboard

Download Task 1 Instructions