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Raspberry Pi & Node-Red

Open-Source Tools for
Local Automation and
Industrial IoT applications

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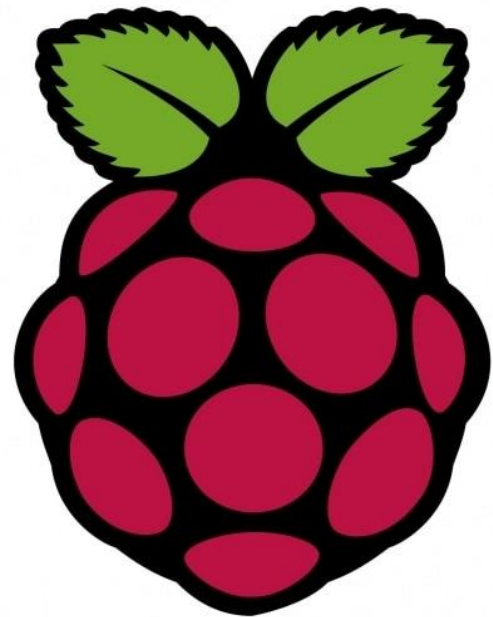
IoT & IIoT

- **IoT** refers to the broader network of connected devices used in everyday life, such as smart home devices, fitness trackers, and consumer electronics. The goal is typically to improve convenience, automation, and user experience.
- **IIoT**, on the other hand, is a subset of IoT specifically geared towards industrial and manufacturing environments. It focuses on enhancing processes, efficiency, safety, and productivity in sectors like manufacturing, logistics, energy, and heavy machinery.



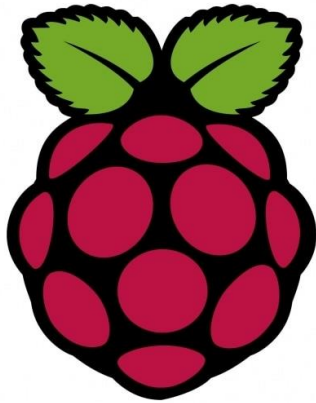
Main Differences

- **Scale and Complexity**
- **Reliability and Safety**
- **Data Management and Analysis**
- **Network and Communication Protocols**



Raspberry Pi

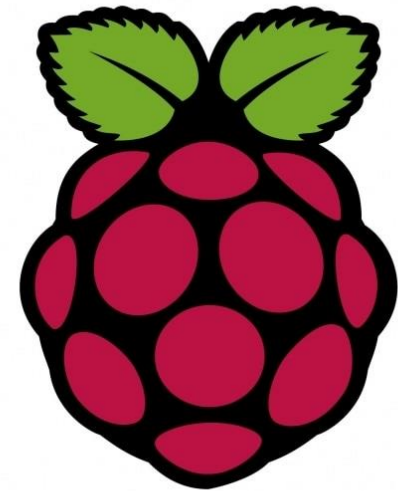
The Raspberry Pi is a small, affordable, single-board computer developed by the Raspberry Pi Foundation.



- It was designed to promote teaching and learning in computer science and programming, particularly in schools and developing countries.
- Low-cost, credit-card-sized computer.
- The Raspberry Pi runs Raspberry Pi OS (Raspbian) but can also run various operating systems (Ubuntu, Windows IoT Core, etc.).
- Extensive compatibility with open-source software, libraries, and tools, making it ideal for developers.
- Supported by a robust community that contributes to extensive documentation, forums, and tutorials.
- Availability of add-ons and HATs (Hardware Attached on Top) for specialized tasks (e.g., ADCs, real-time clocks, industrial interfaces).
- Can be used for a wide range of projects from simple monitoring systems to complex industrial control setups.
- Easily programmable with languages such as Python, Node.js, and C++, allowing rapid prototyping.

Technical Capabilities

- **Processing Power:** Modern Raspberry Pi models feature quad-core ARM processors with clock speeds up to 1.8 GHz (e.g., Raspberry Pi 4). Adequate RAM options, ranging from 1 GB to 8 GB, allowing multitasking and smooth operation for automation tasks.
- **Connectivity:** Equipped with multiple USB ports, Ethernet, Wi-Fi, and Bluetooth for connectivity. GPIO (General Purpose Input/Output) pins enable integration with sensors, relays, and industrial devices.
- **Expandability:** Support for SD card storage, enabling easy upgrades and system backups. USB and HDMI ports provide integration capabilities with other industrial equipment or monitors for real-time monitoring.
- **Low Power Consumption:** Consumes significantly less power compared to traditional PCs or PLCs, making it ideal for continuous operation in industrial environments.



Raspberry Pi 1 Model B+



Raspberry Pi 1 Model A+



Raspberry Pi 2 Model B



Raspberry Pi 3 Model B



Raspberry Pi 3 Model A+



Raspberry Pi 3 Model B+



Raspberry Pi 4 Model B



Raspberry Pi Zero 1.3



Raspberry Pi Zero W



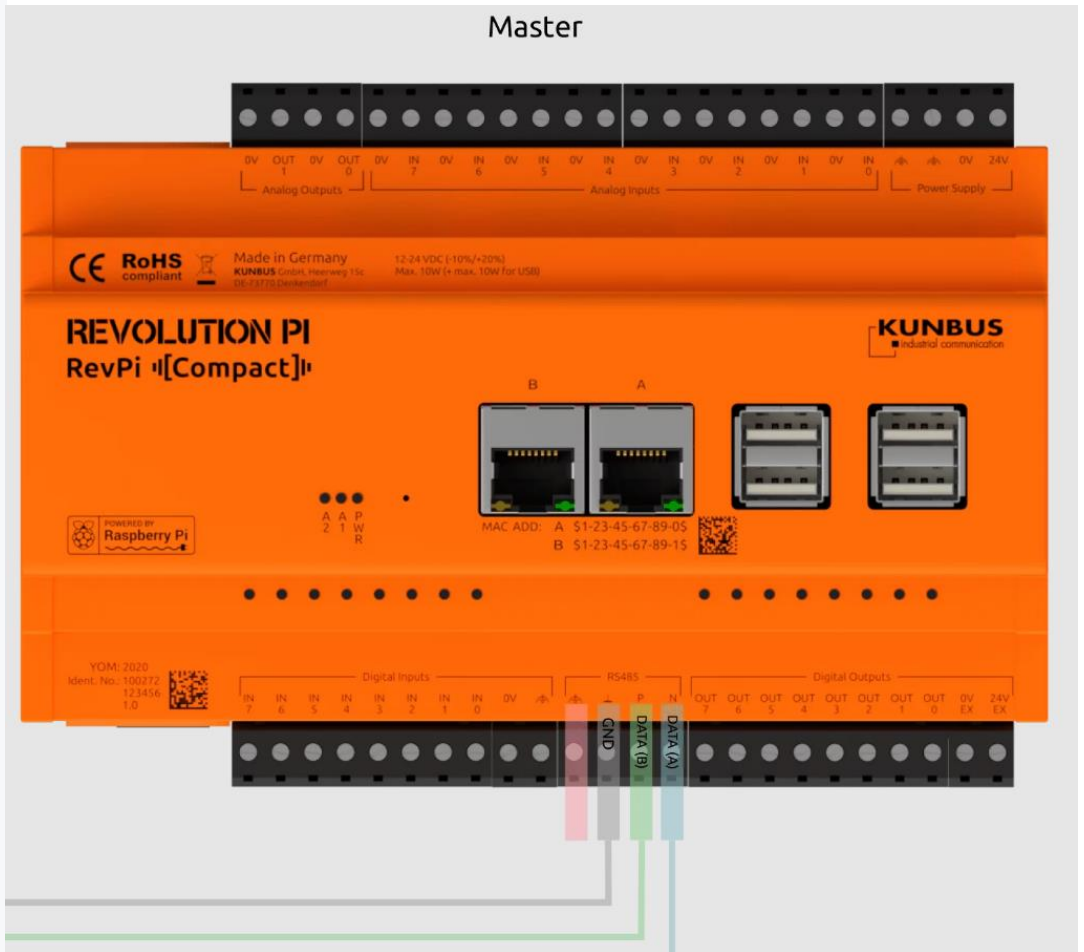
Raspberry Pi Zero 2 W



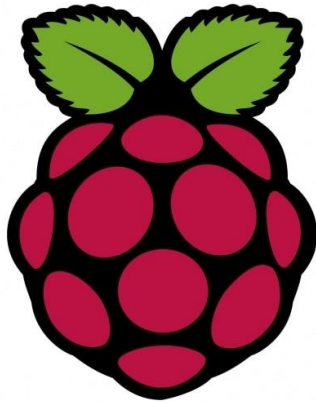
Raspberry Pi 5



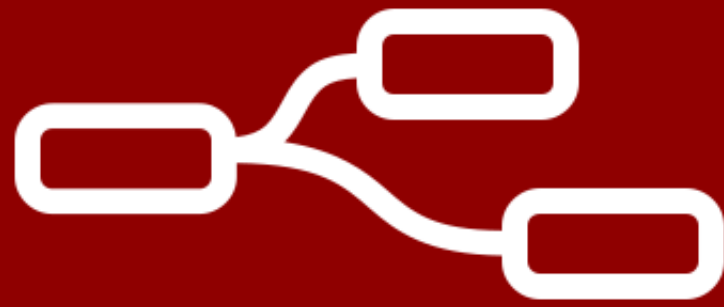
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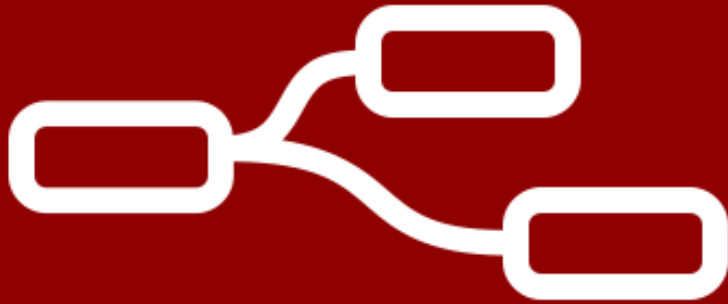
RPi vs PLCs: Why is it good?



- **Cost-Effectiveness**
 - Low cost
 - Small to medium scale operations
 - **Flexibility and Versatility**
 - No proprietary hardware/software like most PLCs
 - AIO: data acquisition, control logic & communication
 - **Ease of Programming and Integration**
 - Compatible with widely known programming languages and development environments, making it accessible for developers with general coding skills.
 - Can be integrated (Node-RED, Python scripts, etc.)
 - **Customizable Solutions**
 - Modular: from simple monitoring to advanced automation w custom logic/interface
 - Adaptive: Iterative design & rapid prototyping for new projects
 - **Open-Source Advantages**
 - No licensing costs, promotes innovative solutions
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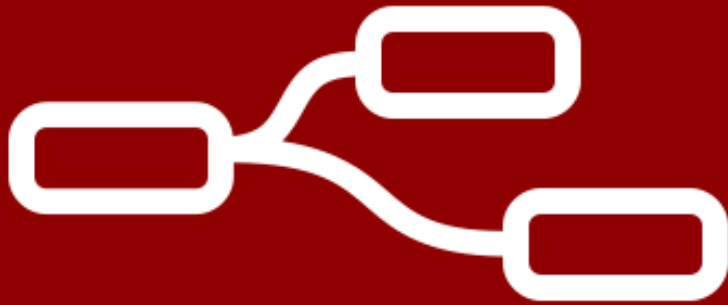
Node-RED



Node-RED

Node-RED

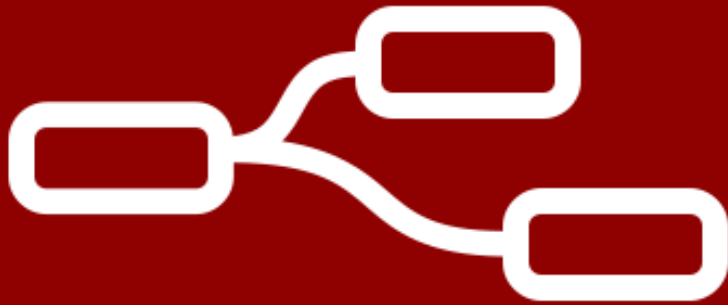
- Node-RED is a flow-based development tool designed for wiring together devices, APIs, and online services. It uses a visual interface that allows users to create flows by dragging and connecting nodes, simplifying the process of programming.
- Message-driven architecture: each node represents a discrete function or operation, processing messages that pass through them. Nodes can include inputs (such as sensors or MQTT topics), processing logic (functions or filters), and outputs (such as actuators or databases). This model allows for asynchronous operation, enabling multiple processes to run simultaneously, which is particularly useful in automation systems.
- Includes a variety of built-in nodes for tasks such as HTTP requests, MQTT communication, database interactions, and more.



Node-RED

Node-RED

- Flows created in Node-RED can be easily deployed and run on Raspberry Pi, cloud platforms, or other servers.
- Supports various industrial protocols essential for automation, such as Modbus, MQTT, OPC UA, and RS485.
- This compatibility helps bridge the gap between modern IoT solutions and existing industrial infrastructure.



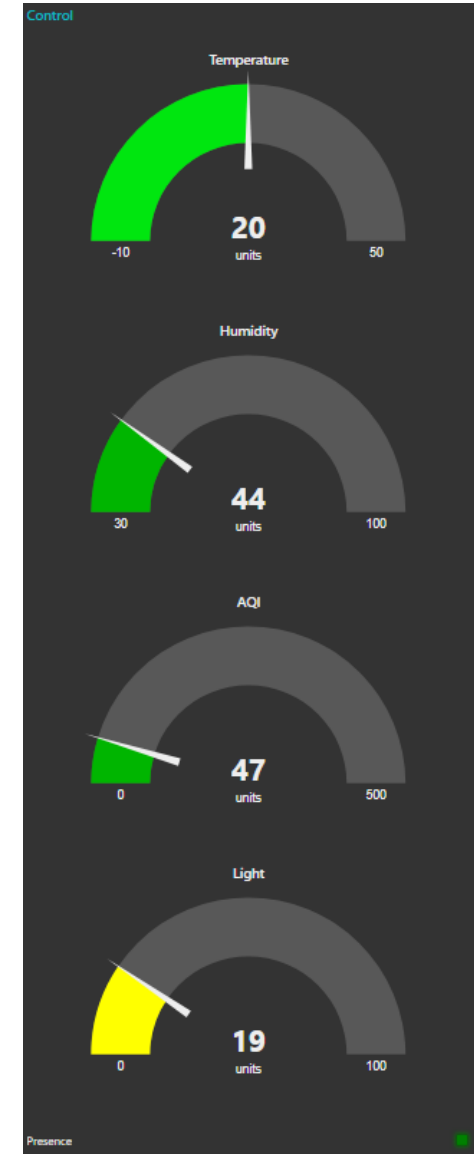
Node-RED

Why is it good?

- **Easy to use**
- **Debugging and Monitoring**
- **Easy deployment and highly scalable**
- **Flow Control and Logic**
- **Compatibility with Protocols**
- **Remote Communication and Control**
- **Collaboration and Community Contributions**

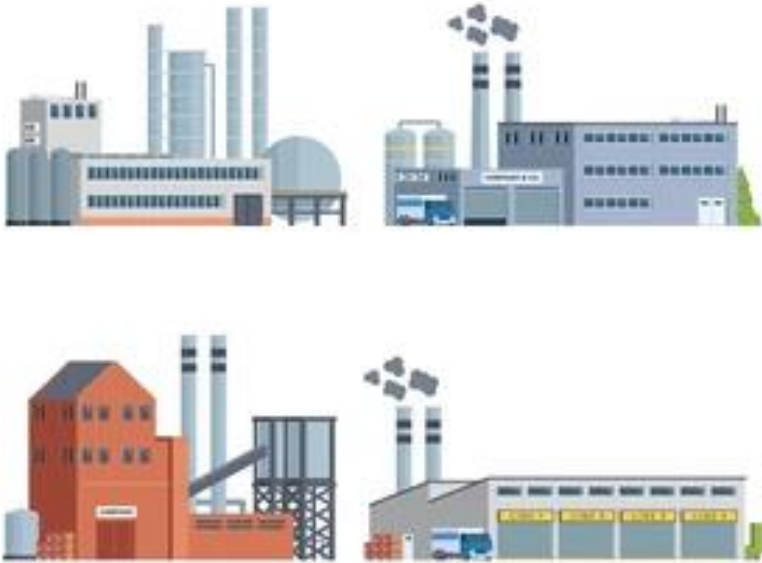
Household Monitoring Dashboard Example

- Temperature, Humidity, Air Quality Index, Light and Presence
- Solution for Domotics or Building Automation projects

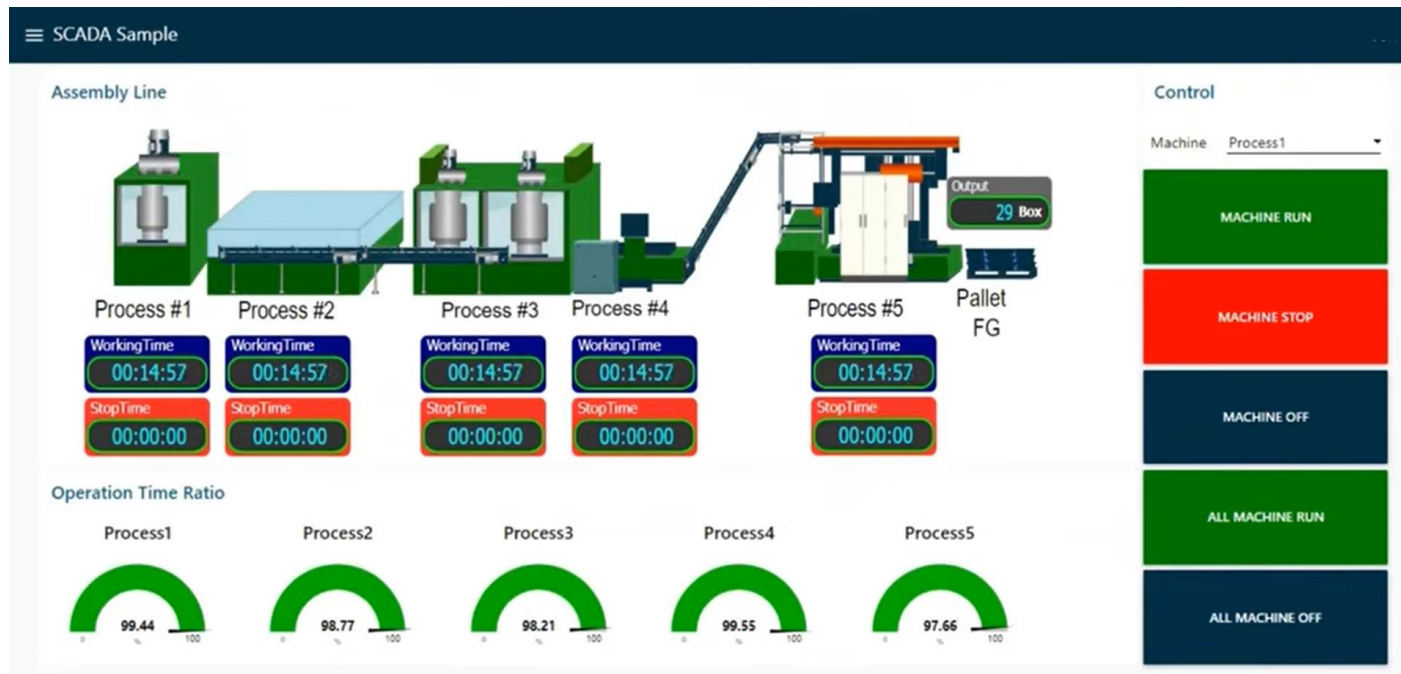


Industrial Monitoring Scaling

- **Reuse of Logic:** The same fundamental logic used for reading air quality data from a few sensors in a small project can be adapted to handle data from multiple sensors in an industrial setting. This modularity allows for easy expansion without rewriting code from scratch.
- **Incremental Implementation:** start with smaller projects and gradually scale up.



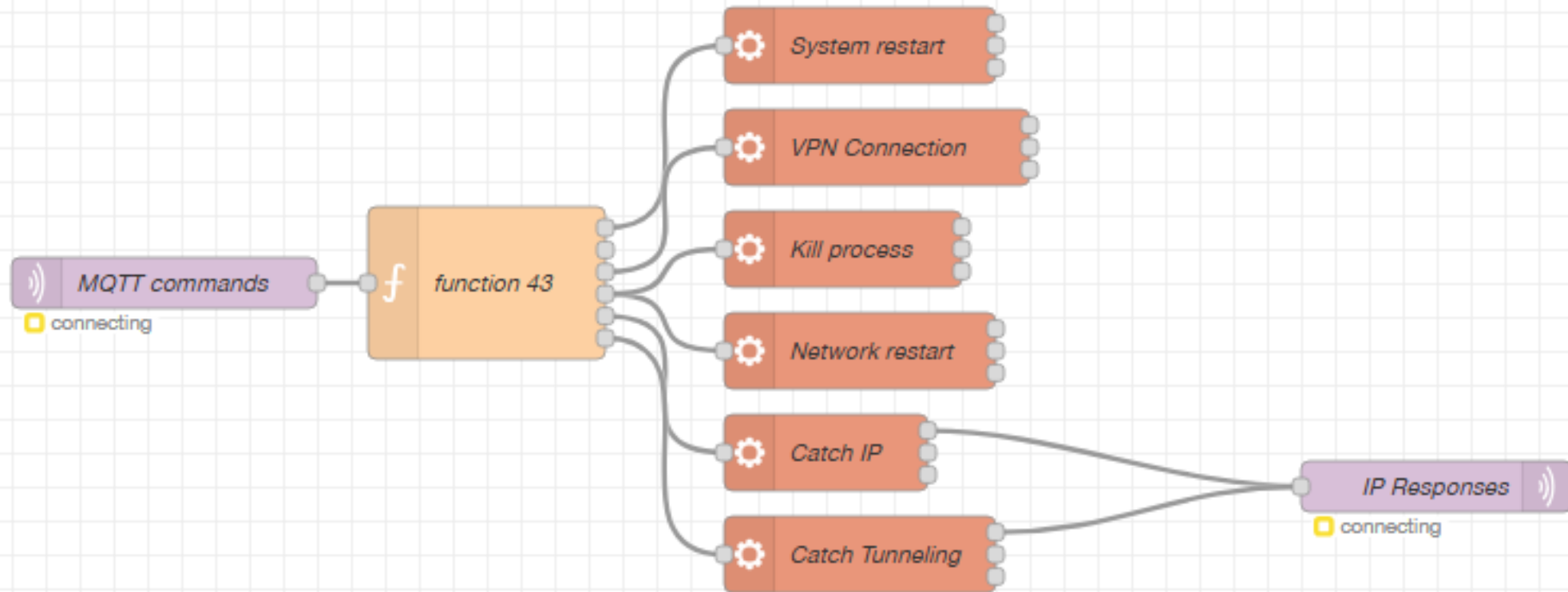
Industrial Monitoring Scaling



<https://www.youtube.com/watch?v=8d3fbDEnuFo> (Yaser Ali Husen channel)

- **SCADA-like Interface:** in addition to Node-RED's native dashboards, by using the plugin **node-red-contrib-ui-svg**, you can create custom dashboards with a SCADA system style, making them more familiar for automation users.

Remote Control Example

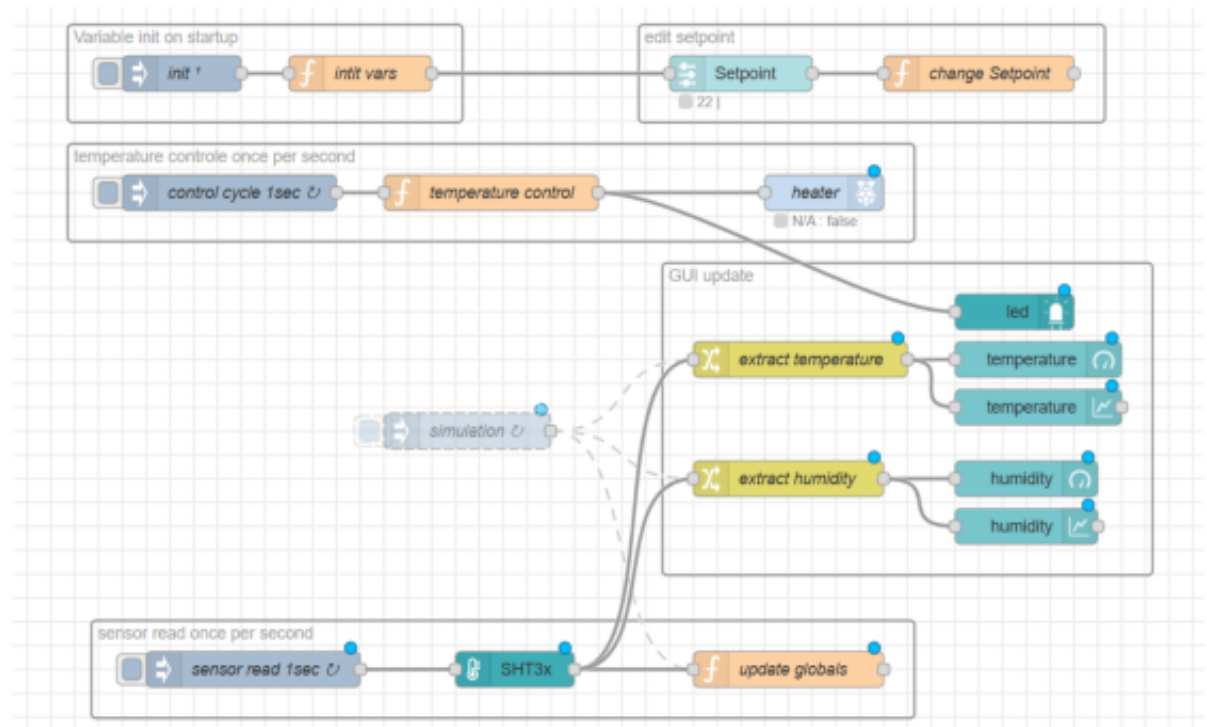


Temperature Control with hysteresis

GUI



Flow





**Thanks For
Watching!**

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