Practical 9

Study of Node-red programming tool.

Node-RED is a flow-based programming tool ideal for visually wiring together devices, APIs, and online services.

1. Overview of Node-RED

- Developed by IBM, Node-RED is built on **Node.js** and uses a visual editor for creating flow-based applications.
- It allows users to connect hardware devices, cloud-based services, and APIs in a browser-based flow editor, using "nodes" that represent individual functions or devices.

2. Node-RED Interface and Basic Components

- **Workspace**: The central area where you design flows.
- **Nodes**: The building blocks of a flow. Nodes are categorized by function, such as input, output, function, or network nodes.
- **Palette**: Contains nodes you can drag and drop onto the workspace.
- **Sidebar**: Provides details, configurations, and context for selected nodes.

3. Common Nodes in Node-RED

- **Inject Node**: Used to initiate a flow. You can configure it to inject messages at intervals or manually.
- **Debug Node**: Displays data in the debug sidebar, which is invaluable for troubleshooting.
- **Function Node**: Allows for custom JavaScript code to modify or create messages.
- **HTTP Request Node**: Sends HTTP requests, which is useful for REST API calls.
- **Dashboard Nodes**: Create interactive web dashboards for visualizations and user controls.

4. Flow Creation and Deployment

- **Creating Flows**: Flows are created by connecting nodes with “wires.” Data (payload) moves along these wires, processed by each node it encounters.
- **Deploying Flows**: After setting up nodes, click “Deploy” to make the flow live and enable interactions or automations.

5. Real-World Use Cases of Node-RED

- **IoT and Smart Home Automation**: Easily connect sensors and actuators, control devices like lights or fans, and gather data from sensors.
- **Data Visualization**: Integrate with databases and visualization tools to create real-time dashboards.
- **API Integrations**: Use Node-RED as an intermediary between APIs for applications like weather data integration, cloud services, or messaging.
- **Machine Learning and AI**: Integrate machine learning models to make real-time predictions based on sensor data.

6. Programming in Node-RED

- Node-RED flows are primarily set up visually, but JavaScript can be used in **Function Nodes** to add more complex logic.
- **Example: Basic Flow Using JavaScript**
  - **Function Node Code**:

```
javascript

msg.payload = msg.payload * 2; // Modifies payload data
return msg;
```

- **JSON**: Often used for structuring data sent between nodes or displayed in debug.

7. Extending Node-RED with Custom Nodes and Libraries

- **Node-RED Library**: Add additional nodes through the Node-RED library or npm. Custom nodes can extend functionality (e.g., weather nodes, messaging, machine learning).
- **Dashboard Extension**: Nodes like node-red-dashboard enable creating custom web dashboards.

8. Integration with Other Technologies

- **MQTT**: Node-RED works well with MQTT for real-time data in IoT projects.
- **Raspberry Pi GPIO**: Use GPIO nodes to control and monitor Pi hardware pins.
- **Databases**: Connect to databases like MySQL, MongoDB, or InfluxDB for data storage and retrieval.

Node-RED's combination of visual simplicity and powerful JavaScript customization makes it a flexible tool for projects in IoT, automation, and more! Let me know if you want more details on any specific area.

Installing Node-RED is straightforward and can be done on various platforms like Windows, macOS, Linux, and directly on Raspberry Pi.

1. Install Node-RED on Raspberry Pi

Node-RED is commonly used with Raspberry Pi for IoT and automation projects, and it can be installed with a simple script.

1. **Open the Terminal**.
2. **Run the Installation Script** (this will install Node-RED, Node.js, npm, and other dependencies):

   bash <(curl -sL https://raw.githubusercontent.com/node-red/linux-installers/master/deb/update-nodejs-and-nodered)

3. **Run Node-RED**:
   - Once installed, start Node-RED by typing:

     node-red

   - Access the Node-RED editor at http://<your-pi-ip>:1880.
4. **Set up Autostart on Boot**:
   - Enable Node-RED to start on boot by running:

     sudo systemctl enable nodered.service

2. Install Node-RED on Windows and macOS

For Windows and macOS, Node-RED requires Node.js to be installed first.

1. **Install Node.js**:
   - Download the latest version of Node.js from https://nodejs.org.
   - Run the installer and follow the setup instructions.
2. **Install Node-RED Using npm**:
   - Open a command prompt or terminal and run the following command:

     npm install -g --unsafe-perm node-red

3. **Run Node-RED**:
   - Start Node-RED by entering:

     node-red

   - Open the editor by visiting http://127.0.0.1:1880 in your web browser.

3. Install Node-RED on Linux (Debian/Ubuntu)

Node-RED can be installed on any Linux system that supports Node.js.

1. **Open a Terminal**.
2. **Install Node.js and npm** (if not already installed):

   sudo apt update
   sudo apt install nodejs npm

3. **Install Node-RED**:

   sudo npm install -g --unsafe-perm node-red

4. **Run Node-RED**:
   - Start Node-RED with:

     bash
     Copy code
     node-red

   - Access it at http://127.0.0.1:1880.

4. Running Node-RED as a Service

On Linux systems, it can be useful to run Node-RED as a background service.

sudo systemctl enable nodered.service
sudo systemctl start nodered.service

This will start Node-RED whenever the system boots up.

After installation, Node-RED will be accessible on http://localhost:1880 (or your device's IP). You can start creating flows immediately and customize Node-RED by installing additional nodes as needed.