OVERVIEW

The Smart HVAC Monitoring System was designed and implemented as a cloud-based architecture to monitor and visualize indoor environmental conditions using virtual sensors. Built using Node-RED on the FlowFuse platform, the system leverages cloud-native tools and MQTT-based communication to ensure real-time data flow and responsive dashboard interaction.

The system integrated three key virtual sensors from MyDevices.com — **Temperature**, **Humidity**, and **Motion Detection** — to simulate a real-world IoT environment for HVAC monitoring. These sensors publish data via a public MQTT broker under the topic devices/Spandroit-HVACI4ET, which is subscribed to within the Node-RED flow for processing. The modular nature of Node-RED allows seamless routing and transformation of the incoming sensor data before it is passed to a user-facing dashboard.

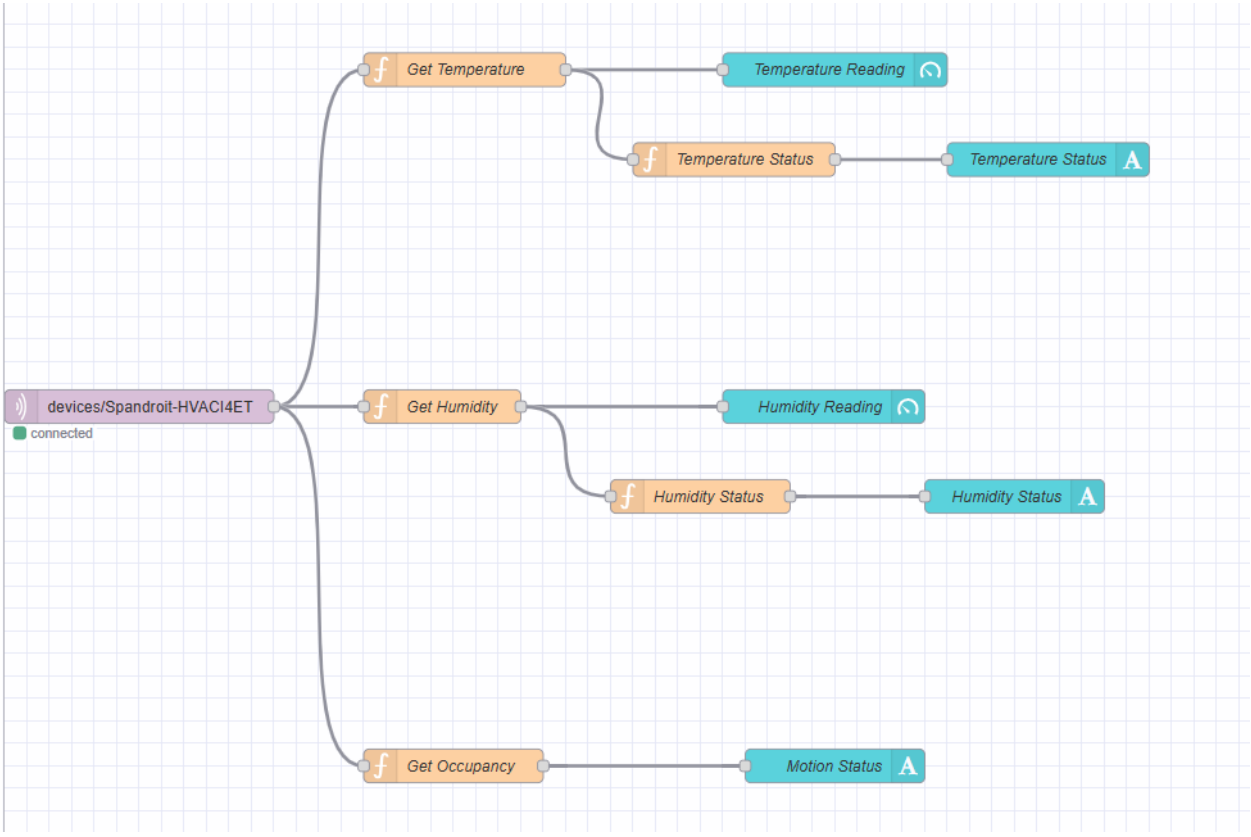

Fig. 1: Implementation of Cloud Architecture

The Dashboard, built using Node-RED Dashboard 2.0 nodes, provided real-time insights into ambient temperature and humidity through dynamic gauges with defined threshold segments. A

motion sensor widget was also included to indicate occupancy status using intuitive emoji-enhanced status messages. External weather data was integrated from the OpenWeatherMap API, enriching the system with current outdoor conditions to provide contextual awareness for future HVAC automation.

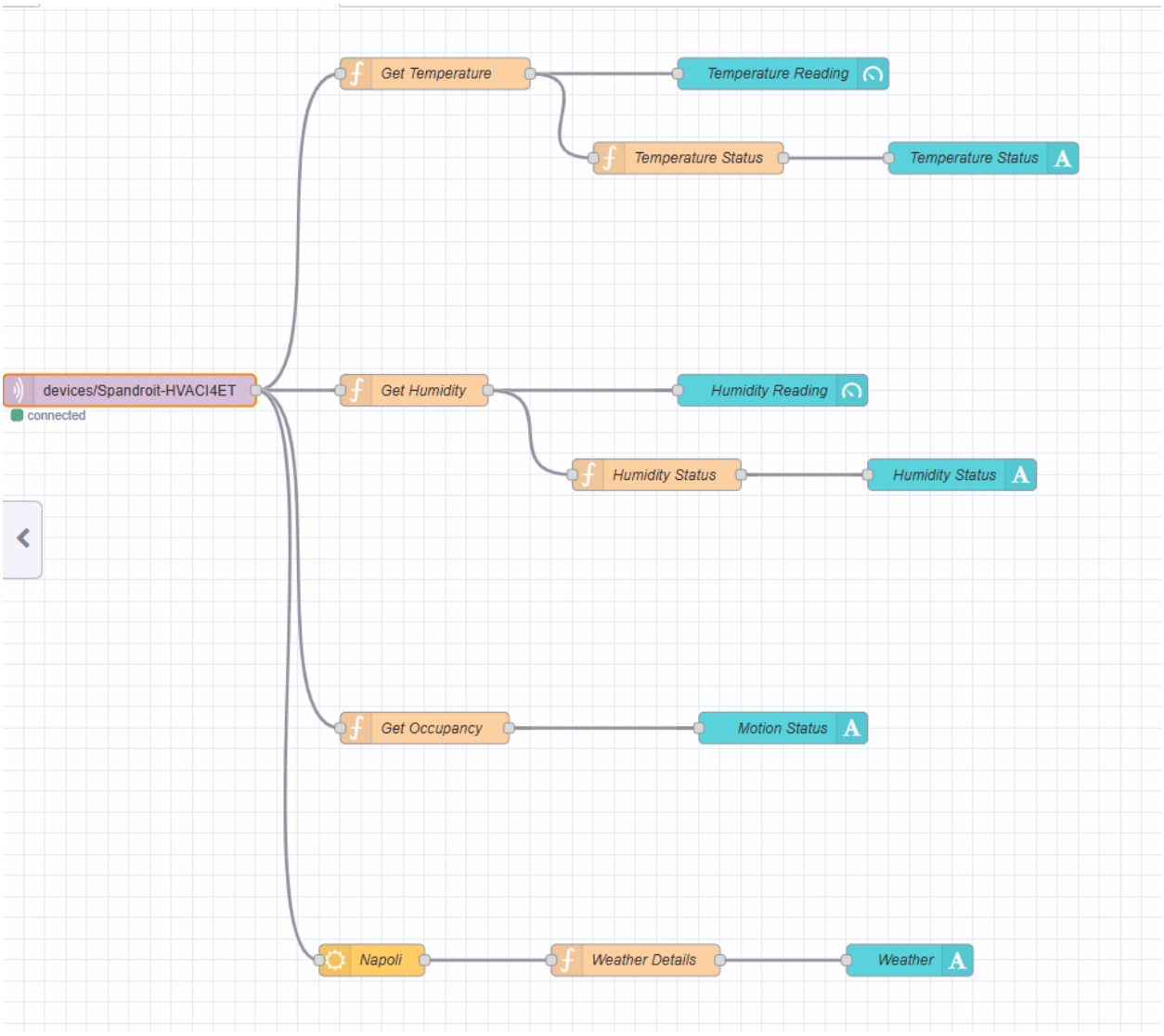

Fig. 2: Integration of Weather Map

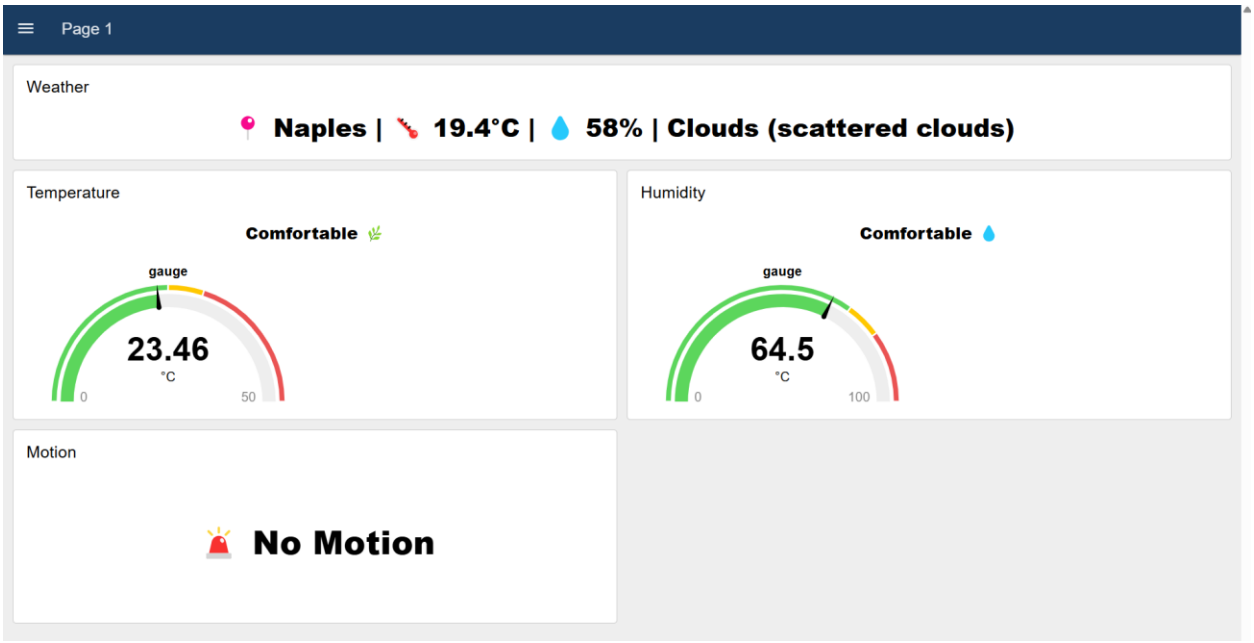

Fig. 3: Dashboard 2.0

By combining cloud-based tools, MQTT integration, and simulated IoT sensors, this system effectively demonstrates a scalable and intelligent approach to smart building monitoring and lays the groundwork for potential real-world deployment using physical hardware.