Solar Energy Monitoring System

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1 Introduction

The Solar Energy Monitoring System is a real-time embedded project designed to collect, process, and display simulated solar energy production data and real weather data. The system utilizes a Raspberry Pi with a Sense HAT to gather real-world data like temperature and humidity data, while energy production data is simulated. Data transmission is handled using MQTT, with storage in Firebase. A frontend interface will visualize the collected data for user analysis. The project is designed to be modular, allowing for easy expansion and integration of additional sensors or features.

2 Main Components and Their Purposes

- **Raspberry Pi with Sense HAT:** Collects real-world data like temperature and humidity data.
- **Simulated Solar Energy Data:** Generates artificial energy production data to mimic a real solar panel system.
- **Linux C RT Component:** Implements real-time processing features that cannot be handled by Raspberry Pi's OS.
- **Local MQTT Broker:** Facilitates real-time communication between devices and data services.
- **Firebase Cloud Database:** Stores collected data for further analysis and visualization.
- **Frontend Interface:** Displays real-time and historical data to users via a web or mobile application.

3 Communication Design

- **Data Collection:** The Raspberry Pi collects real-world weather data and generates simulated energy production data.
- **MQTT Communication:**

  - The Raspberry Pi publishes sensor data to predefined MQTT topics.
  - The Linux C RT component subscribes to MQTT topics for real-time processing.
  - The frontend subscribes to MQTT topics or retrieves data from Firebase for visualization.

- **Cloud Integration:** The collected data is stored in Firebase, allowing real-time access from multiple clients.
- **Frontend Display:** The user interface retrieves and visualizes data from Firebase, ensuring real-time monitoring.

4 Expected Outcome

- A functional prototype capable of monitoring and displaying real and simulated data.
- A user-friendly interface for real-time and historical data analysis.
- Compliance with project requirements, including a real-time component.

5 Conclusion

This project integrates embedded systems, IoT protocols, real-time processing, and cloud services to provide an efficient and scalable solar energy monitoring solution.