Table of Contents

List of Figures

Solutions

1 Overview

The increased growth of Internet of Things (IoT) devices has made it necessary for the creation of easily understandable and informative interfaces. For this project, I decided to add visualization as a part of the IoT Hub. While previous implementations offered the feature of viewing live consumption for any outlet, this enhancement allows for visualizations of both current and past usage patterns using interactive charts. The intention is to enable the user to improve their understanding of usage patterns, allow them to discover anomalies, and make better-informed device management decisions.

Its implementation required both server-side and client-side changes to be made. The server-side was modified to support storage and retrieval of time-series power levels, while the client-side was optimized to display that data in an understandable and insightful way. This integration thus presents a unified user experience that allows one to view real-time variations and analyze past trends for individual plugs or relevant groups.

2 Design and Implementation

2.1 Design Choices

- Visualization library: For line charts generation, a widely used JavaScript chart library like Apache ECharts or Chart.js was selected, due to its suitability for making visualizations of both real-time and past data for web applications.
- Data Model: The backend system was updated to store recent power readings for every outlet, thus enabling access via a RESTful API endpoint.
- Front-end Integration: The web interface gets the latest power reading for the respective plug or group and continuously updates the graph in real-time as new readings are collected.
- User Experience: The interface shows consistency from past projects, maintaining the familiar paradigm of plug and group selection but adding a dynamic chart area inside it.

2.2 System setup and Configuration

- Ensure the IoT simulator and backend server are running as in previous projects.
- The backend must be configured to store and serve time-series power data.
- The frontend must be served from the public directory and have access to the backend's new API endpoints for power history.
- No additional dependencies are required beyond the chosen charting library, which is included via CDN or npm as appropriate.

3 User Stories

User story 1: Instant Visualization of Power Data

As an end-user, I want to see a live line graph showing power readings for each outlet so that I can observe patterns of power usage over a given time frame.
This report underscores the importance of timely feedback and trend monitoring. By creating avenues for immediate visualization of electricity usage, customers are facilitated to quickly discover abnormal usage, ensure correct equipment operation, and improve their own understanding of their usage patterns.

User Narrative 2: Obtaining Historical Data Relating to Plugs

As a consumer, I would want the ability to see past usage history for a given plug so that I can analyze usage patterns over a specific time frame.
The story revolves around the analysis of historical data. By enabling users to access and analyze historical data, the system improves energy audits, troubleshooting, and long-term efficiency optimization.

4 Testing Procedures

Procedure for Experiment 1: Real-Time Visualization

- Start the IoT simulator and backend server.
- Access the web interface using a web browser.
- Select a connector from the list provided on the left.
- Study the line graph on the right, which is aimed at refreshing each second to provide new power readings.
- Activate the electrical outlet by switching it between the on and off states; confirm that the visual indication correctly reflects these changes without hesitation.
- Confirm that the chart axes are labeled (Power in Watts vs. Time) and that the data points correspond to the plug's state.

Screenshot Example:

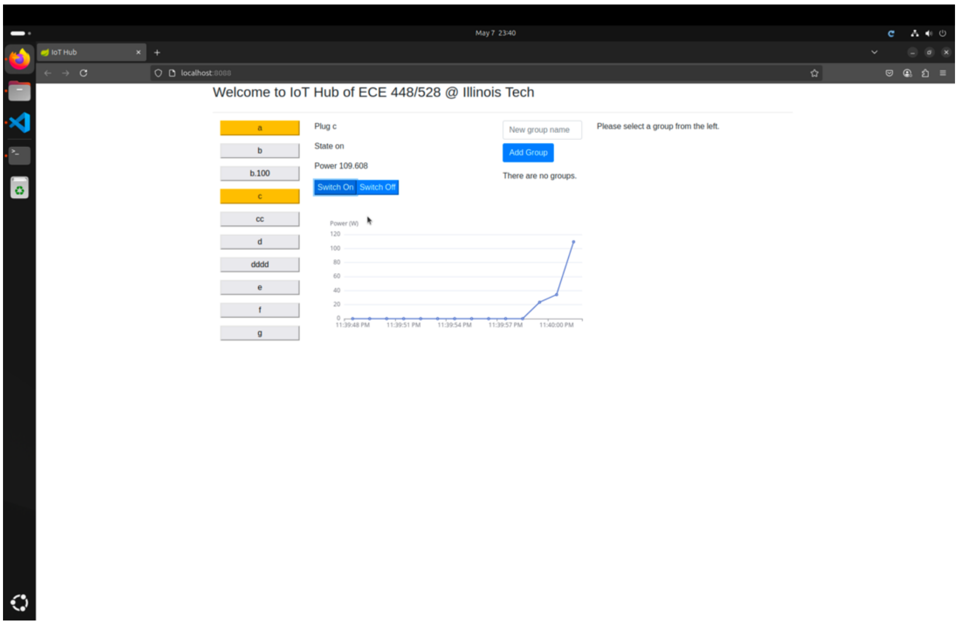

Figure 1: Graph of Plug c.

A graph of plug 'c' illustrates a considerable surge of power after being activated.

Methodological Strategy 2: Accessibility of Historical Data Historicization

- When the system is running, select a plug and let it record some power data for a few minutes.
- Use the interface to view past data, for example, by entering a specific time range or browsing through the graphically presented representation.
- Ensure that the graph adapts accordingly to portray the chosen time interval, accurately displaying historical power measurement data.
- Switch between the different plugs to ensure that each graph accurately reflects the relevant historical data corresponding to the selected plug.

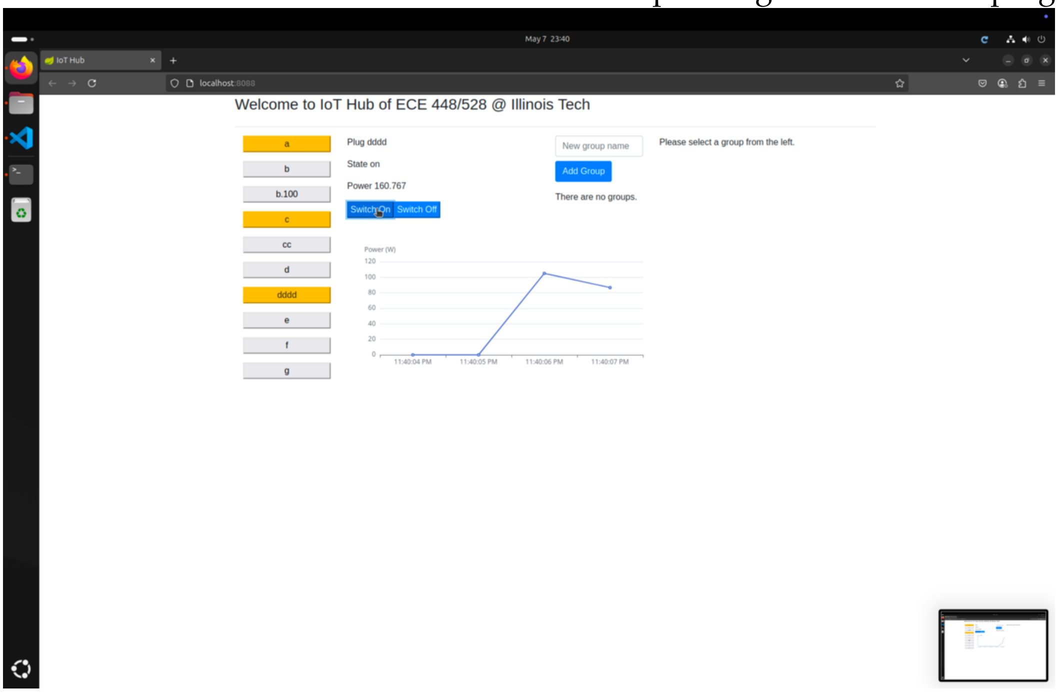

Figure 2: dddd plug fluctuates with Switch ON and Switch OFF.

5 Screenshots

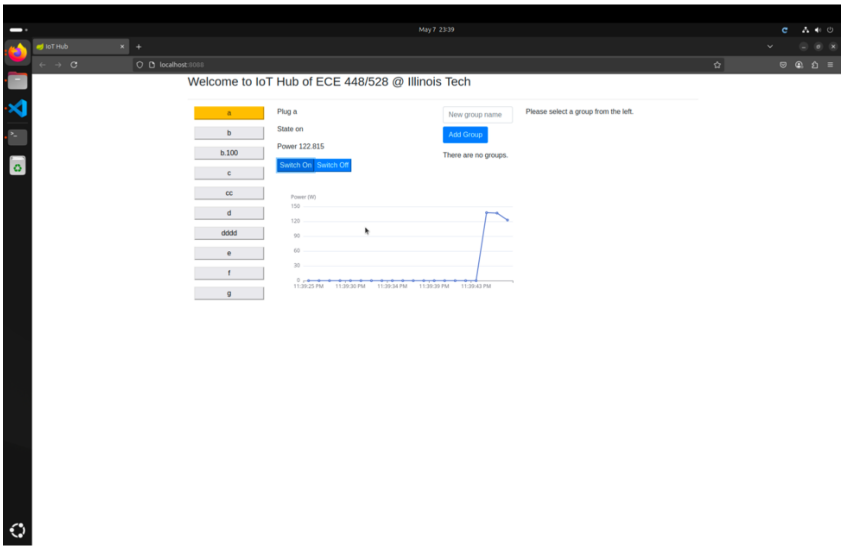

Figure 3: Plug a ON.

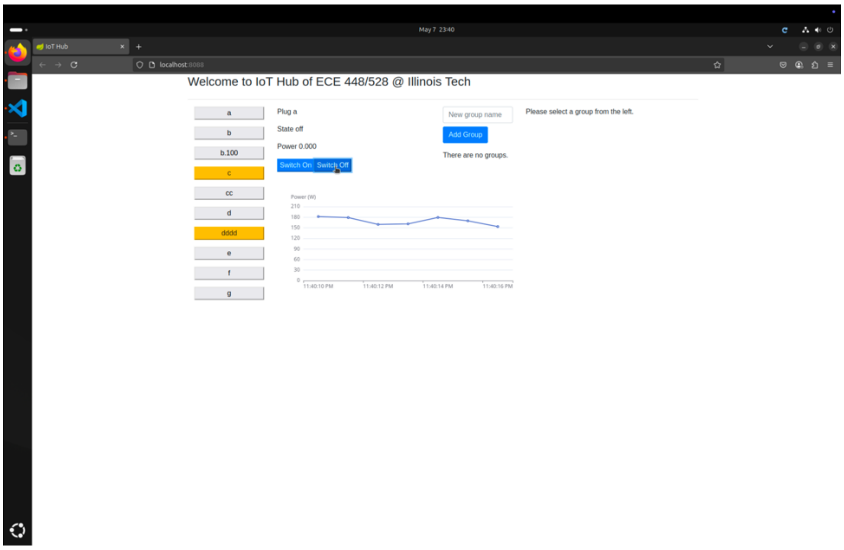

Figure 4: Plug a OFF.

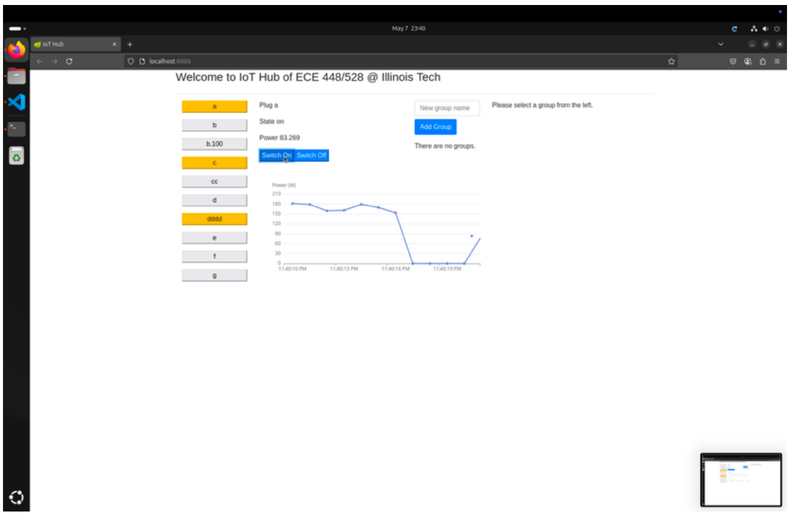

Figure 5: Plug a ON again.

6 Conclusion

The incorporation of data visualization adds great value to both the usability and informational value of the IoT Hub. By providing insight into electricity usage trends across historical and modern timeframes, users are in a position to make well-informed, data-driven choices about their energy usage. This solution follows recognized best practices in software engineering, and the test criteria, backed by provided screenshots, validate that all requirements and use cases have been fulfilled to the letter.