Visualizing Space Data: The EIRSAT-1 Satellite Dashboard Project

Authored by Mila Shukitt

Supervised by Dr. David McKeown

Introduction

EIRSAT-1, Ireland's first satellite, represents a significant milestone in the nation's space research and engineering capabilities. To complement the satellite's mission, this project focused on developing a public-facing dashboard that communicates key telemetry data in a simplified and accessible format. The goal was to create a platform that could effectively engage the general public by simplifying the technical complexities of satellite operations.

Unlike the engineering dashboard used for mission-critical analysis, the public dashboard was designed to present data in a visually intuitive manner. This required analysing and processing highly technical telemetry data, such as system statuses, sensor outputs, and orbital elements, and translating them into meaningful and understandable insights. A notable component of this work involved integrating Two-Line Element (TLE) data. By using Python scripts, the satellite's orbital path was propagated and stored in a database, enabling dynamic visualizations of the satellite's location and movements on the dashboard.

The project highlights the importance of bridging the gap between technical research and public understanding, showcasing the satellite's operations while emphasizing the educational and outreach potential of engineering research.

Methodology

The development of the public-facing dashboard for EIRSAT-1 involved navigating unfamiliar tools, processing complex satellite telemetry data, and designing an intuitive interface for public engagement. The key steps included:

1. Understanding the Tools and Frameworks:
- Grafana was the chosen data visualization software, and my unfamiliarity required significant self-directed learning to master its configuration and customization.
- InfluxDB was used as the database for storing and querying telemetry data, which included learning its query language and database architecture.
- Python was employed for processing Two-Line Element (TLE) data, allowing for the satellite's orbital path to be propagated and visualized dynamically.

2. Data Analysis and Processing:
- Satellite telemetry data, including TLE, system statuses, and environmental readings, was analysed to determine how best to present it in an accessible format.
- Custom Python scripts were written to convert TLE data into real-time satellite location data, which was then stored in the InfluxDB database for visualization.

3. Dashboard Design and Iterative Development:
- Panels were designed in Grafana to simplify complex data into clear and visually engaging metrics, such as system statuses, battery percentage, and satellite position.
- The layout was iteratively refined to balance functionality and aesthetics, ensuring the interface was intuitive for non-technical users.

4. Testing and Refinement:
- The dashboard underwent extensive testing to validate the accuracy of the data, responsiveness of visualizations, and overall usability.
- Feedback was collected to address issues such as data alignment, panel clarity, and user interface improvements.
- This iterative process ensured the final dashboard met both technical and accessibility goals.

Conclusion

The development of the public-facing dashboard for EIRSAT-1 successfully bridged the gap between complex satellite telemetry and public accessibility. By leveraging tools like Grafana, InfluxDB, and Python, the project transformed raw technical data into visually intuitive and engaging panels. The dashboard not only highlights key satellite operations, such as real-time tracking, gamma-ray detection, and system statuses, but also serves as an educational resource to showcase Ireland's first satellite mission.

This project demonstrated the importance of simplifying technical data for broader audiences while maintaining accuracy and functionality. It also emphasized the value of adaptability, as mastering unfamiliar tools and solving integration challenges were central to the dashboard's development.

Looking forward, the methodologies and tools used here could be applied to future satellite missions, further enhancing public engagement with space research. The EIRSAT-1 public dashboard stands as an example of how engineering research can inspire, educate, and connect technical achievements with the broader community.

Results

Fig 1. Completed EIRSAT-1 Dashboard