



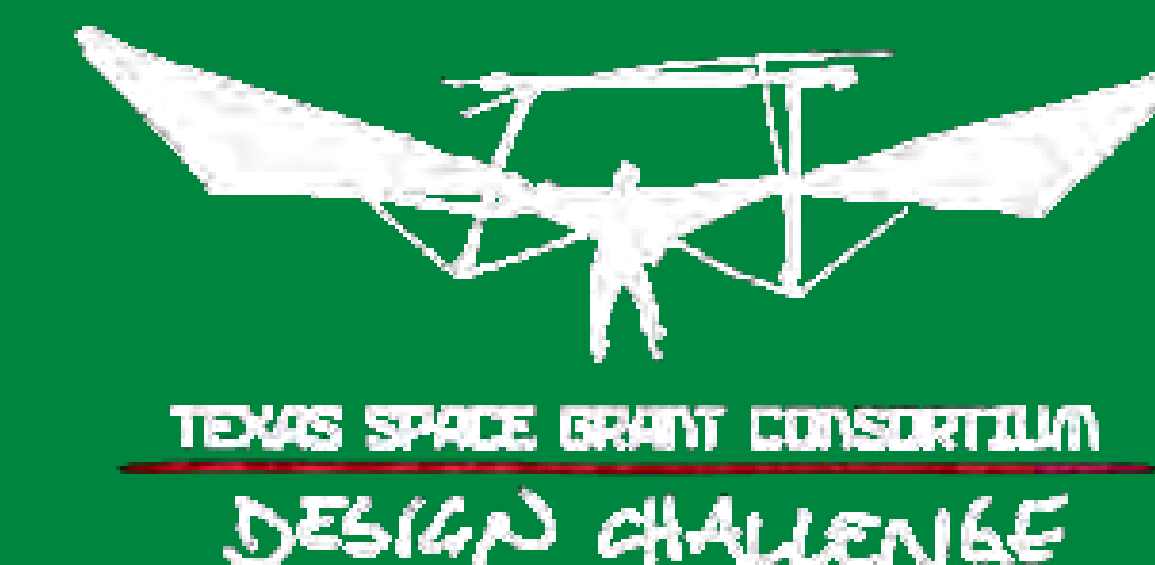
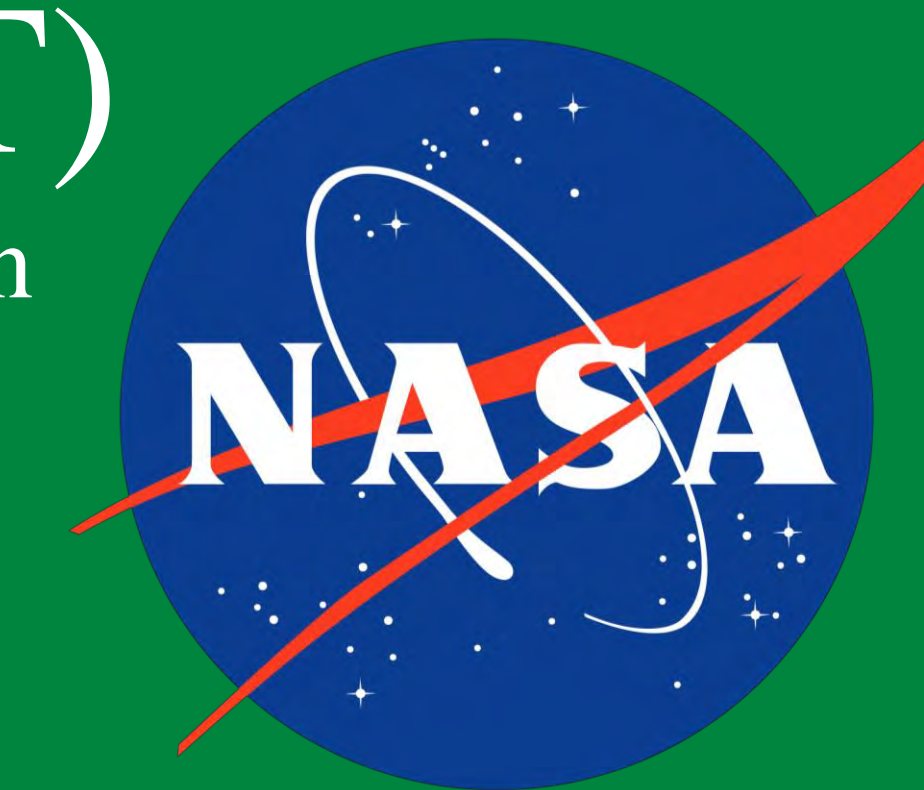
Private Cloud With Wireless Internet of Things (IoT)

Team Denton Space Eagles: Mark Younker, Ricardo Garza, Shangda Li, Yicheng Feng, Micah Warren

Team email: teamdse@myunt.onmicrosoft.com

Advisors: Robin Pottathuparambil, PhD and Chatwin Lansdowne

Department of Computer Science and Engineering, University of North Texas



Background

- NASA periodically samples sensors for operational and experimental use, but collection and analysis of sensor data is difficult due to high latency over the connection to Earth.
- With the wide variety and accessibility of different IoT platforms, that can collect and analyze sensor data on an on-board private cloud, there is an opportunity to eliminate the high latency problem with one of these platforms.

Objective

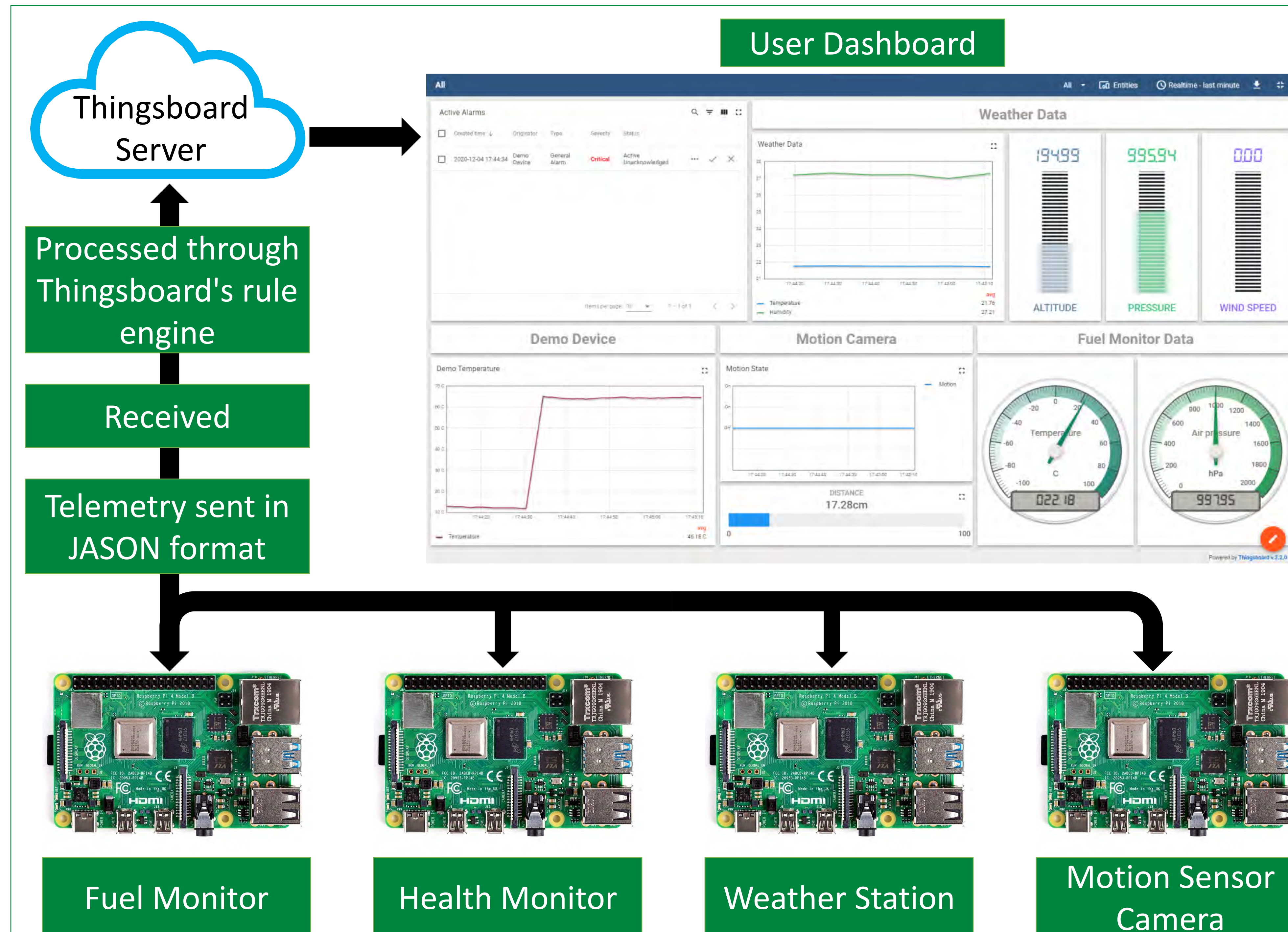
The objective of this project was to:

- Examine an open source IoT cloud platform, that is available today, to function aboard a spacecraft without a connection to Earth.
- Create test applications that will demonstrate how well the cloud platform processes data, how it displays the data, and other features of the platform.

Implementation

- Thingsboard was chosen can run without an internet connection and has interesting features.
- To communicate with devices, Thingsboard uses protocols like MQTT, HTTP(S), and BLE.
- To test those features 4 different test applications were developed, a fuel monitor, health monitor, weather station, and motion video sensor. The application help demonstrate different features of Thingsboard like, the ability to raise an alert, process/calculate telemetry, and more.

Overall System Design



Results

We have been able to demonstrate several different features of Thingsboard such as:

- The ability to react to data when defined conditions are met, like a low blood oxygen. An alert on the dashboards can be shown, send an email to necessary parties, send information over HTTP to another device so it can react, or any combination of those.
- We have demonstrated Thingsboard's ability to perform calculations on telemetry that it receives and use telemetry from the device's history to compute more useful data, like taking the fuel level's history and computing how much fuel has been consumed.
- The video data while not able to be sent directly to Thingsboard it can be sent and processed on the server computer.

Conclusion

We do NOT recommend the use of the Thingsboard platform

- Thingsboard's provided rule engine, and rule nodes, are great for modifying and analyzing telemetry that come in the form of an integer, float, or string.
- Comparatively, Thingsboard's native support of receiving and processing telemetry not in the form of an integer, float, or string is near non-existent .
- Thingsboard allowing the development of custom rule nodes in Java, for the rule engine, alleviate some of non-native support but they come with their own limitations.
- In addition, Thingsboard allows the development of custom cards in HTML to be displayed on the user dashboards.

In conclusion, if native support of different niche use cases is required and if Java development is not desired, we would not recommend using the Thingsboard platform.

Future Work

Future work with Thingsboard:

- With the amount of data being tracked by Thingsboard one thing a future team could look at is implementing third party analytics.
- Integrate maps to Thingsboard with GPS which would allow to track vehicles.
- Enabling energy management to control devices like smart meters.

Other future work:

- Explore other IoT platforms for comparison

Acknowledgements