FAULT DETECTION IN HVAC

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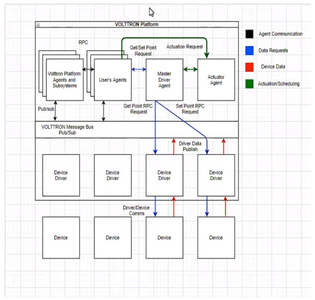
Summary

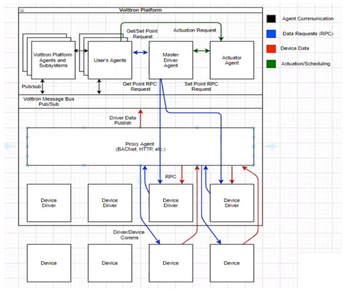
Our project is to design a software package to detect faults and help optimize energy consumption in air handler units. This software performs data collections from Bacnet Control network, real time data storage and analytics and Fault Notification and data Visualization for technicians to have better insights of the sensor's data.

VOLTTRON

Worked with volttron driver framework which used Publish and subscribe relation with Json remote PRC call via Message Bus. User agent was specified to data collection with MQTT historian Agent using Paho MQTT protocol. Master Driver agent built to handle request handling and actuator for scheduling to set value. we used fake driver which generates fake data from CSV files for our Testing.

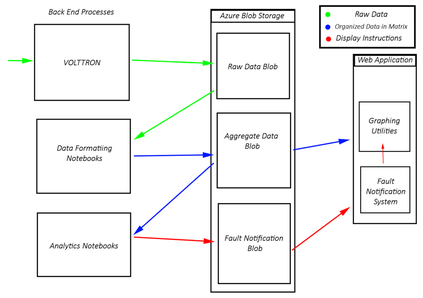


Bacnet specify one to many relation network requriemnt, Proxy Agent was used to handle communications. In our case, we have AHU only (air handler unit as our device).



Data Pipeline

- Raw sensor data flow through VOLTRON and get published to Azure IOT Hub broker
- Data get stored in a certain AZURE blobs with message routing
- Data is organized and stored for further Analytics
- Real time fault detection algorithms routinely scan through the new data and determine any new occurrence of a fault in Azure DataBricks
- When faults are detected notices are sent to the fault notification blob for the UI to access.



User Interface

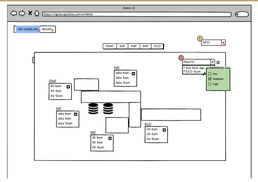
The user interface is where our customers will be staying in when actually using this product.

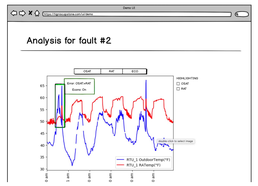
Main advanced features of this user interface, compared with existing software are:

1. Clickable warning messages which will bring customers to more detailed analytical pages.

1. Adjustable sensitivity levels for extra flexibility

Features inherited from existing software are visualized AHU and related multiple data displaying with reasonable positioning.



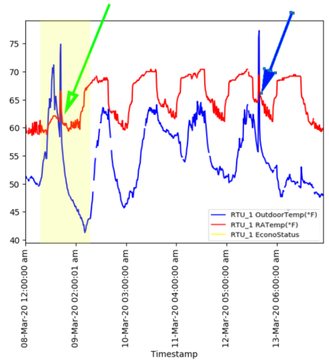


The real web-application is currently under heavy development, in terms of the visualizing applications. Functional parts of the web-application, specifically pulling in real-time API data from where the analytical results are being stored in this project has been done and tested. Iterating and feedbacks from users are needed for future development.

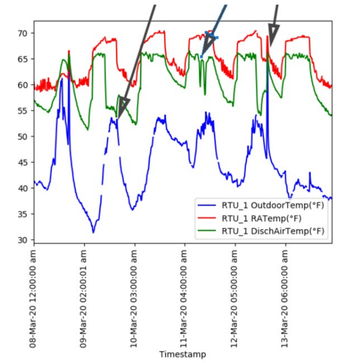
Analytics

Aim for the project was to monitor Air Handler units for common failures technicians currently
cannot diagnose without on site visits.

Example Fault :
Economizer
Activation signal not sent
Anomaly is identified in notebook



Example Fault:
Valves/Dampers
Air Handler Leaking
Anomaly is identified in notebook



- Analytics so far rely on physics based models or logic checks to determine mal behavior
- Parameters for faults were developed alongside with PSR Mehcanical
- Communication to UI is set up for further fault development: adding new faults is extremely simple.

Future Work, References, and Acknowledgments`

- Further additions to fault detection features
- Integration with On-Site Unit
- Scaling Network to handle monitoring multiple units
- Start planning the upgrade to RD53B, the next test chip

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