Automating Campus Dashboards Using Haystack

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Learning Objectives

1. Understand how Haystack enables dashboard automation
2. See some practical examples of Haystack-enabled dashboards
3. Review challenges and solutions for dashboard automation
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May 13-15, 2019
Circa 2003
Facility Floor Area: 323,776 ft²
Occupants: ~450

Circa 2018
Facility Floor Area: 967,390 ft² (+198%)
Occupants: ~2100 (+367%)
NREL’s Energy Management & Information System

23 Facilities

- Complete: 5
- In Progress: 2
- Meters Only: 13
- No Data: 5

22,842 Data Streams

- Electricity Meters
- Building Automation Systems
- Onsite Generation
- Electric Vehicle Service Equipment
- Weather Measurements, Forecasts
NREL’s Dashboard Goals

Provide information to campus occupants
Provide visibility to facility operators
Provide insight for business decision makers
Most dashboards still use manually-configured communication links
Our design philosophy:
Automate dashboard generation using Haystack
Goal: Dynamic Everything!

Benefits:
- Portability
- Scalability
- Minimal Maintenance

Dynamic Navigation

Dynamic Layout

Dynamic Data
Q. How does it work?
A. Tie modular UI elements to Haystack queries
{site, dis:"Cafe", ...}

Autogenerated Navigation:
http://intelligentcampus.nrel.gov/#/building/cafe/
Same data, excluding siteMeter, but different view
Café
Primary Function: Food Service
Year Built: 2012
Area: 12140 ft²

{site, dis:"Cafe", area:12140ft², ...}
1. Query: `elec` and `meter` and `siteRef==@cafe`

2. For meters, query: `active` and `total` and `power` and `point`

3. Read History
1. Query: point and weatherPoint and weatherRef==@cafe->weatherRef and (temp or ghi or cloudage or ...)

2. Read: curVal on each point
Number and placement of gauges from query result (using pre-defined layouts)
Expectation models built automatically from historical meter data
Prediction Points

**Real Power Total**
- navName: “Real Power Total”
- id: @p:nrel:r:4
- point: ✓
- sensor: ✓
- active: ✓
- power: ✓
- total: ✓
- unit: “kW”
- equipRef: @p:nrel:r:3 “Main Meter”
- spaceRef: @p:nrel:r:2 “Meters”
- siteRef: @p:nrel:r:1 “Cafe”

**Real Power Prediction**
- navName: “Real Power Prediction”
- id: @p:nrel:r:5
- point: ✓
- prediction: ✓
- predictionOf: @p:nrel:r:4
- predictionAlgorithm: “ANN”
- predictionConfig: { ... }
- equipRef: @p:nrel:r:3 “Main Meter”

**Real Power Upper Bound**
- navName: “Real Power Upper Bound”
- id: @p:nrel:r:6
- point: ✓
- prediction: ✓
- predictionOf: @p:nrel:r:4
- predictionAlgorithm: “ANN”
- predictionConfig: { ... }
- ub: ✓ // Upper Bound
- equipRef: @p:nrel:r:3 “Main Meter”

**Real Power Lower Bound**
- navName: “Real Power Lower Bound”
- id: @p:nrel:r:7
- point: ✓
- prediction: ✓
- predictionOf: @p:nrel:r:4
- predictionAlgorithm: “ANN”
- predictionConfig: { ... }
- lb: ✓ // Lower Bound
- equipRef: @p:nrel:r:3 “Main Meter”

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Challenges and Solutions
Challenge: Integrating Spatial Data

- Haystack has limited native support for geospatial or 2D/3D asset information
- *(Partial) solution:* cross-reference to an external graphical asset store
- **Drawback:** still requires updates in two places
Challenge: API Limitations

• **Client must initiate communication:**
  Many clients ⇒ many API calls

• **hisRead op is one point only:**
  Many points ⇒ many API calls

• **Limited/unclear support for COV subscription:**
  Polling required to get updates (even with watchSub?)
Challenge: Manage Caching

Rapid Refresh  Low Overhead
(One Possible) Solution: Middleware

Database ➔ Haystack ➔ Middleware ➔ WebSockets ➔ Clients
Roles of the Middleware

1. Manages rescan/refresh
2. Caches asset lists, metadata, navigation
3. Centralizes updates \(\Rightarrow\) reduces API traffic
4. Pushes new data to clients
Challenge: Filtering / Visibility Control

Sometimes, you don’t want everything to show up...

• During setup/commissioning
• Important sites only
• Sensitive facilities

(One Possible) Solution: Filter with dashboard tag
Live Demo

Time and Technology Permitting...