

IoT sensor integration and back-end development for Sequoia

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Vision

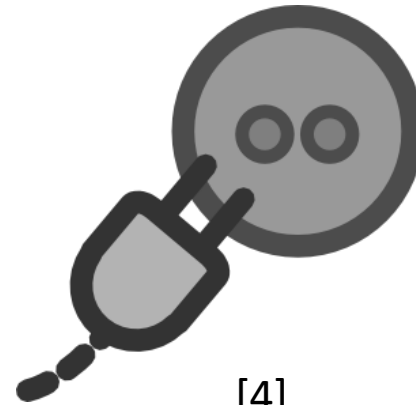
Problem Statement



Sensor Data



[3]



[4]

Behavioral Profile



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Tasks

Android app data display and functionality

Created backend for sensor data

Smart plug

Smartwatch

Flow meter



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Functional Requirements

Smart Plug, Flow Meter, and Smart Watch Monitoring

Utilizing a Smart Hub, daily health events, such as using microwave, getting a cup of water, and smart watch analytics are delivered to a data analysis server.

Data Analysis Server

An analytics server accepts incoming health events and distributes the information to the various systems using it (Mobile App, Webpage), while analyzing the data and providing helpful information to the user.

Non-functional Requirements

Scalability

3rd Party products used are readily available for purchase in large quantities to be scaled to large amounts of customers.

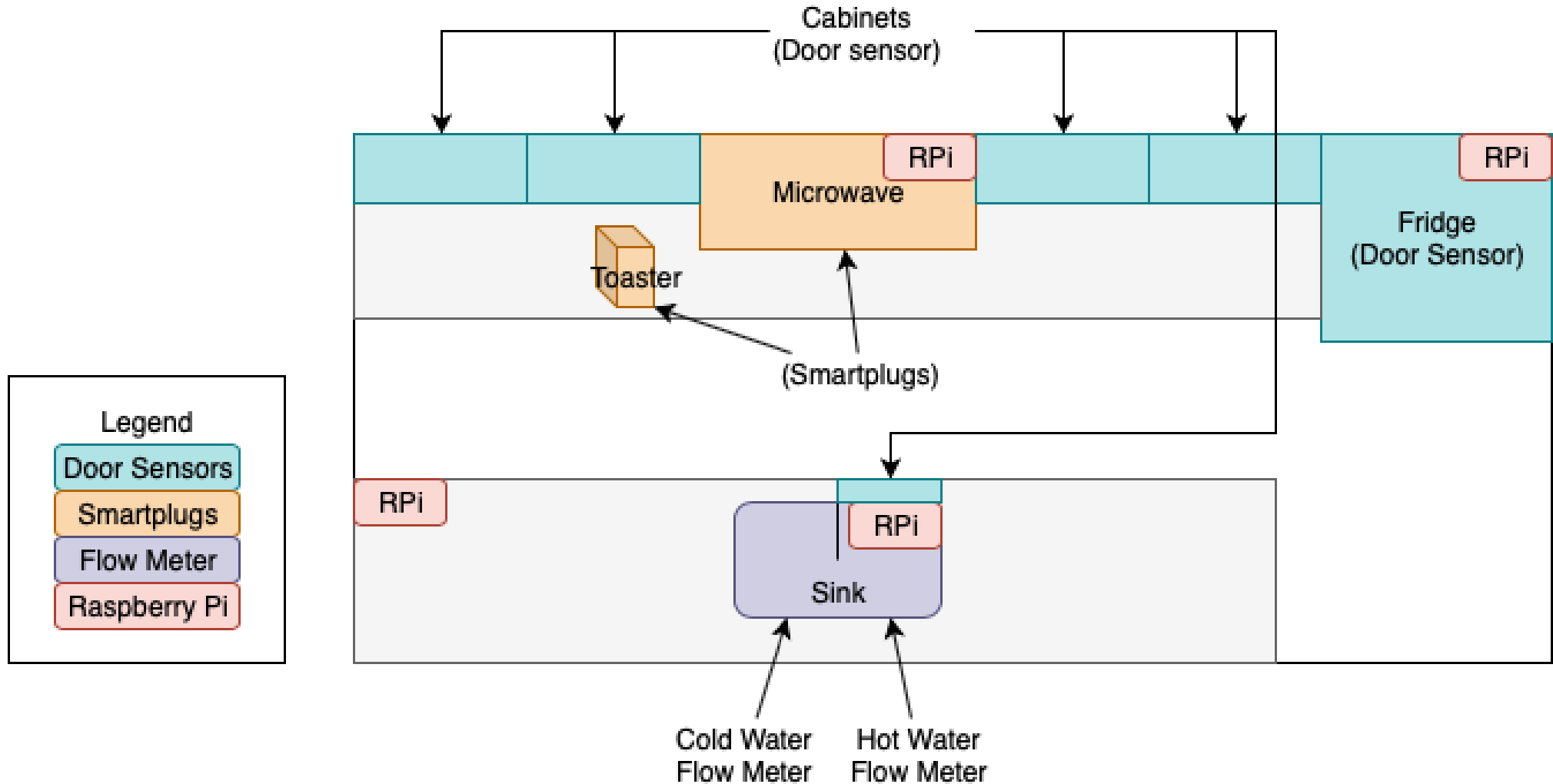
Wireless

Implemented systems operate wirelessly to transfer data and communicate with the smart hub and user.

Independent

The product requires no user interaction or maintenance to continue monitoring and sending data. Accepts updates remotely.

Design Plan



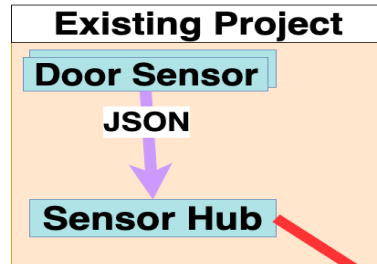
Pre-Existing Architecture Diagram

Bob's Room Wi-Fi Network

External Networks

Legend

Door Sensor Data



Wifi Access Point

JSON

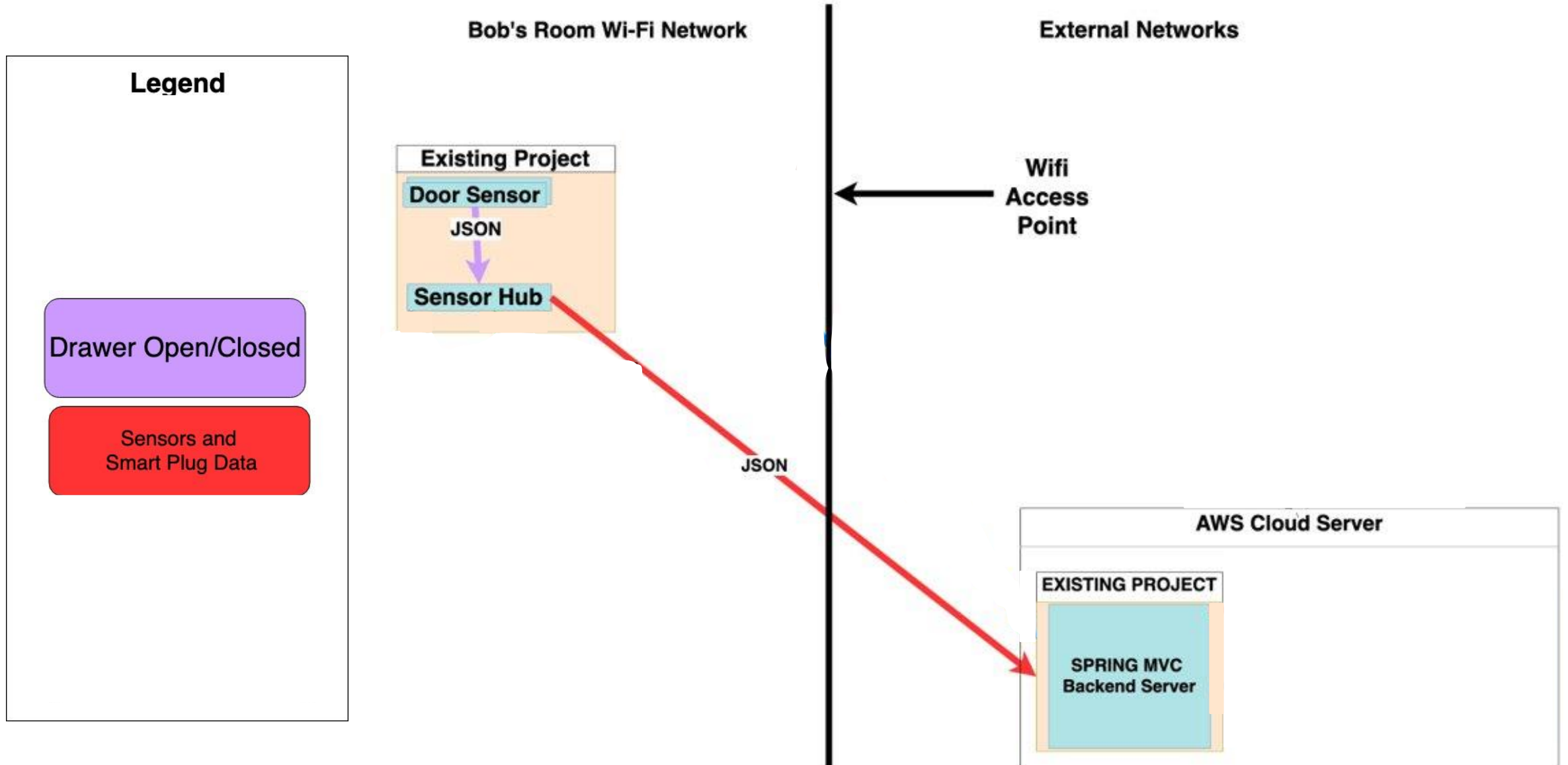
AWS Cloud Server

EXISTING PROJECT

SPRING MVC Backend Server

This diagram shows a large white box labeled 'AWS Cloud Server' containing a smaller light orange box labeled 'EXISTING PROJECT' which contains a blue box labeled 'SPRING MVC Backend Server'.

Architecture Diagram



Implementation Technologies Used

Sensors and Hub

Python

Smart Plugs

Node.JS

Backend Server

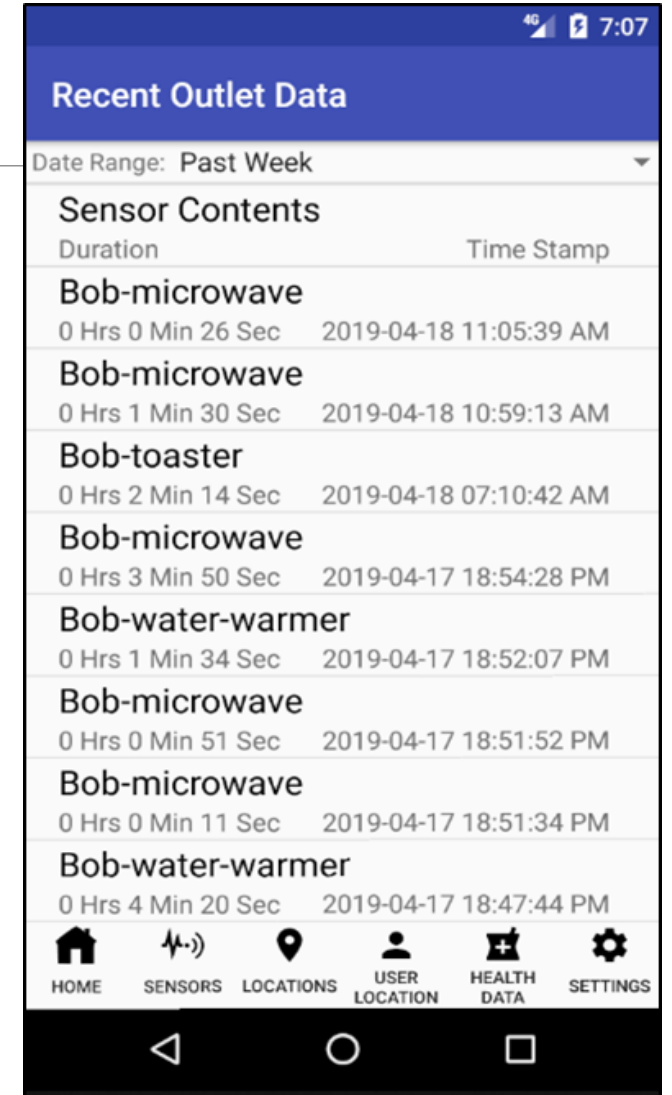
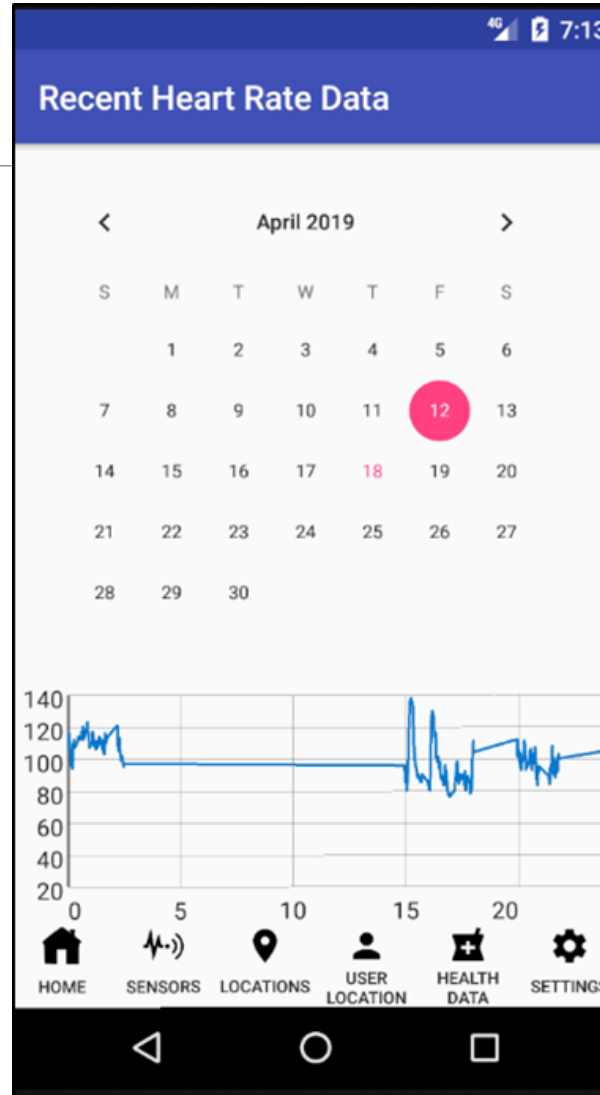
Spring MVC

Smart Watch and App

Android Studio

Implementation (Android App)

App is used to display collected data from all sensors



Implementation (Smart Watch)

Measuring

Heart Rate



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Step
Count



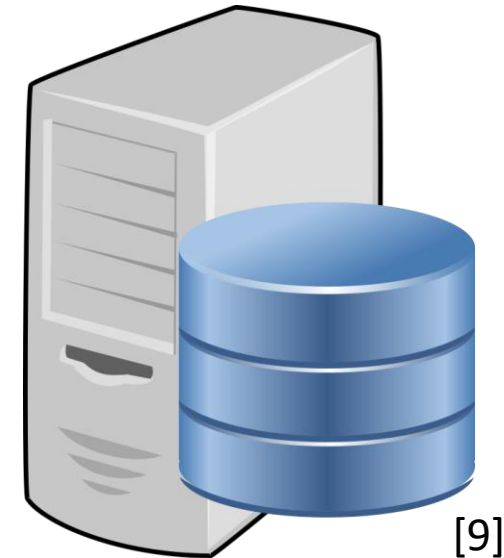
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Collecting

Display
Data



Send Data
To Server



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Implementation (Smart Plug)

Smart Plug
Connected
Device



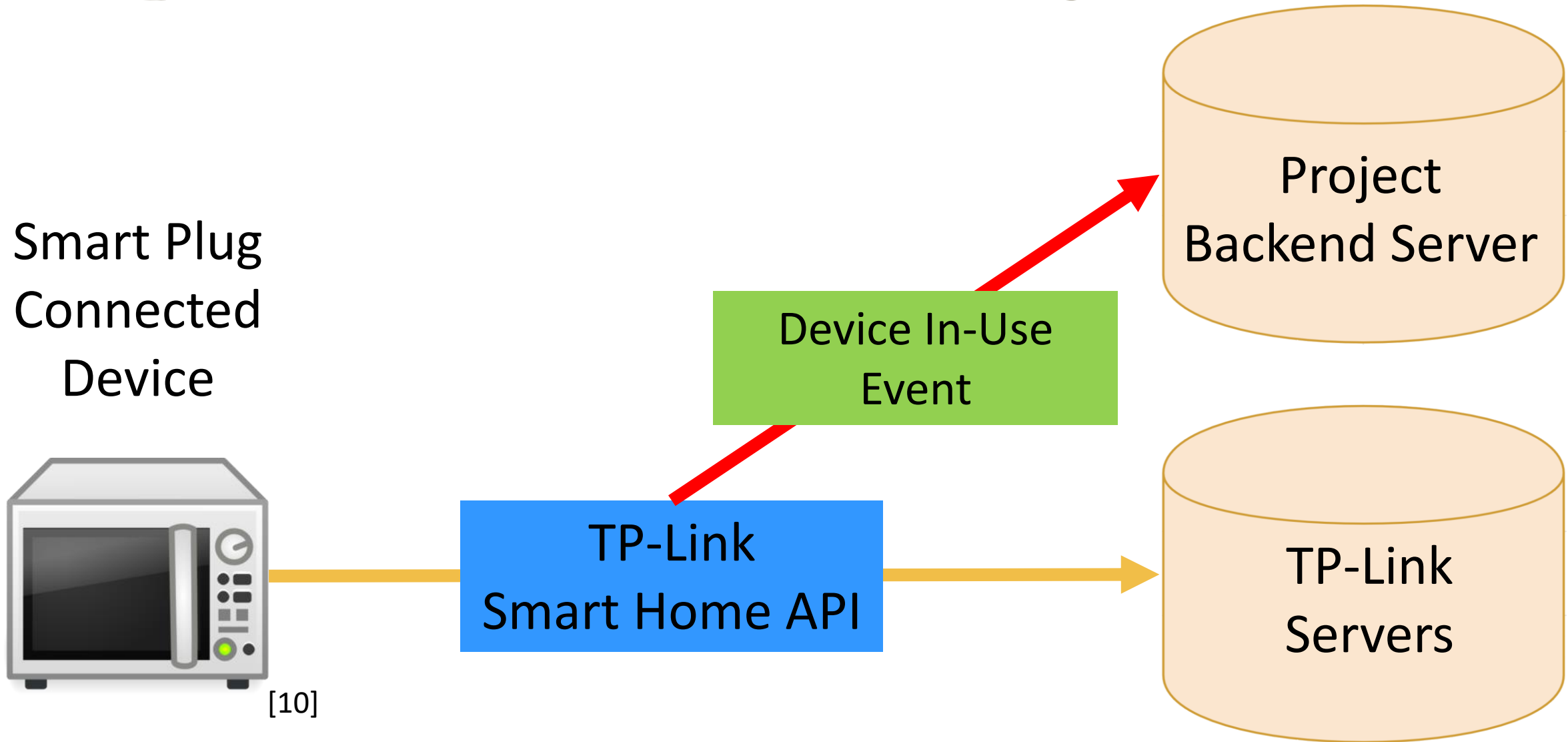
[10]

Not able to access directly

Device Energy
Statistics

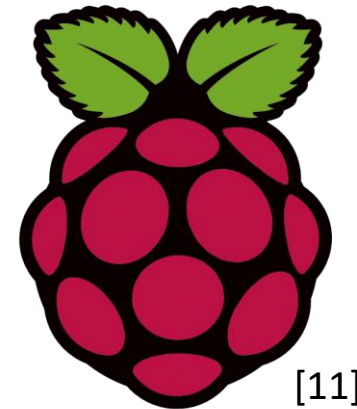
TP-Link
Servers

Implementation (Smart Plug)



Implementation (Sensor Hub)

- Using a Raspberry Pi
- Connects to local network
- Collects data from sensors around the home
- Sends collected data to AWS backend server
- Running a local NodeJS script
- Running a local HTTP server



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Implementation (Flow Meter)



Collect Water
Usage



Send Data
To Server



Implementation (AWS Server)

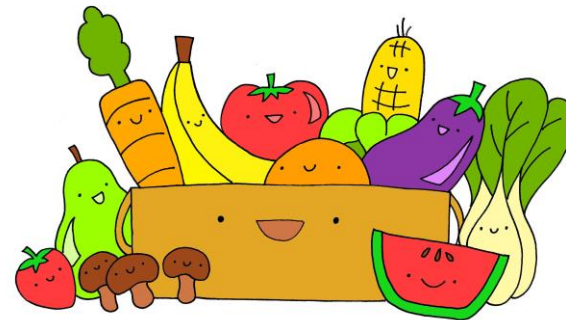
- Hosts Java Spring API endpoints.
- Listens for incoming requests from sensor hub, smart watch, and android app
- Processes incoming data to compute the time duration of each event.
- Stores data on MySQL Database hosted on server.

Standards/Best Practices

- Part 10471: Device specialization
 - Independent living activity hub
- Use food safe products (NSF certified)



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Test Plan

Test Personal Appliances



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Self-Built Flow System



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Personal Body Data Collection



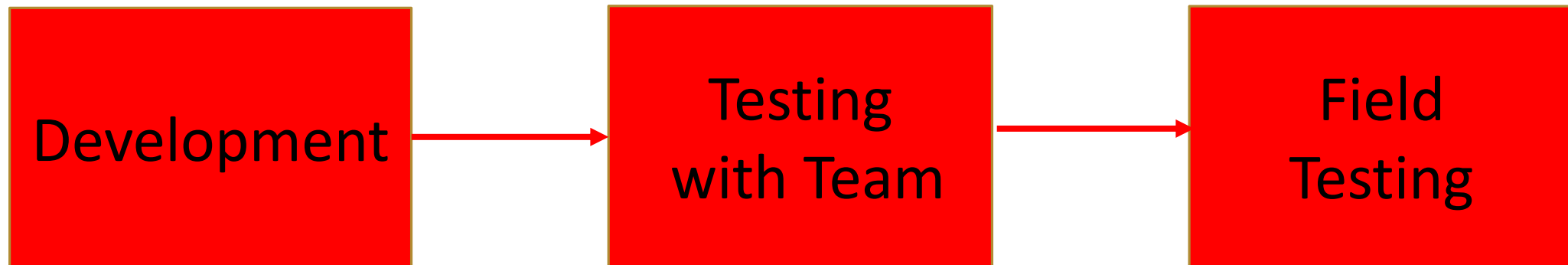
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Integration Testing

Smart Plugs and Flow Meter



Smart Watch



Test Results

Smart Plug Data

1300	8006016023CCC1248DC417E384EC539E1A5...	Bob-micro...	2019-04-09T16:46:27Z[UTC]	in-use	11.8266...	120.150656	344.621...	5.811
1301	8006016023CCC1248DC417E384EC539E1A5...	Bob-micro...	2019-04-09T16:48:31Z[UTC]	not-in-use	0.298469	121.417136	36.0967...	5.872
1302	8006016023CCC1248DC417E384EC539E1A5...	Bob-micro...	2019-04-09T16:48:51Z[UTC]	in-use	6.058751	120.789615	260.045...	5.872
1303	8006016023CCC1248DC417E384EC539E1A5...	Bob-micro...	2019-04-09T16:49:19Z[UTC]	not-in-use	0.045355	121.634196	4.490285	5.884

Smart Watch Data

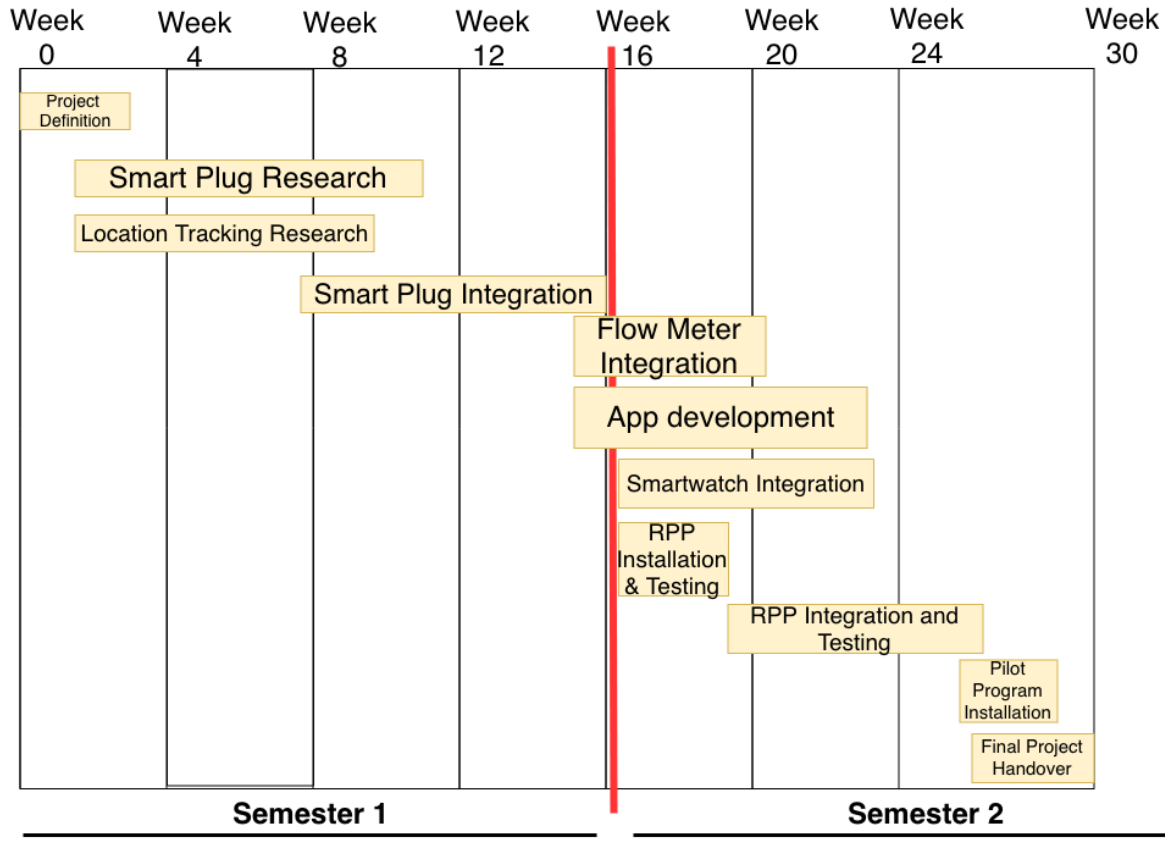
1022	Fossil Sport	testWatch	2019-04-15T23:12:54Z[UTC]	59	187
1023	Fossil Sport	testWatch	2019-04-15T23:18:22Z[UTC]	59	187
1024	Fossil Sport	testWatch	2019-04-16T00:06:18Z[UTC]	59	949
1025	Fossil Sport	testWatch	2019-04-16T00:14:29Z[UTC]	59	988
1026	Fossil Sport	testWatch	2019-04-16T01:12:05Z[UTC]	59	0
1027	Fossil Sport	testWatch	2019-04-16T01:13:09Z[UTC]	59	0
1028	Fossil Sport	testWatch	2019-04-16T07:51:51Z[UTC]	59	0
1029	Fossil Sport	testWatch	2019-04-16T07:52:22Z[UTC]	59	0
1030	Fossil Sport	testWatch	2019-04-16T08:22:08Z[UTC]	59	0
1031	Fossil Sport	testWatch	2019-04-16T08:27Z[UTC]	59	0
1032	Fossil Sport	testWatch	2019-04-16T08:27:31Z[UTC]	59	0
1033	Fossil Sport	testWatch	2019-04-18T04:28:21Z[UTC]	63	14
1034	Fossil Sport	testWatch	2019-04-18T04:29:55Z[UTC]	63	14

Flow Meter Data

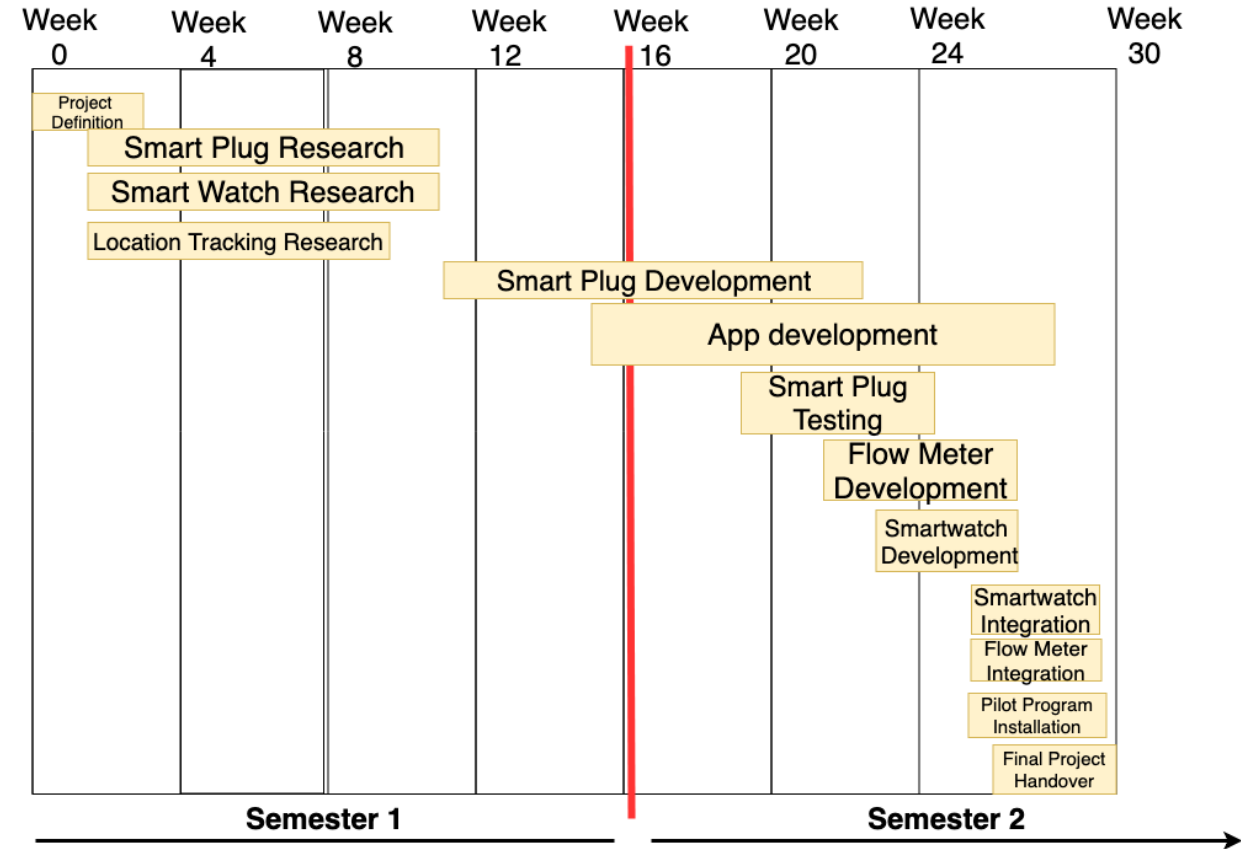
220	Sun Apr 21 12:07:22 2019	10.373449087142944	1912	1	200
221	Sun Apr 21 12:07:28 2019	8.575279951095581	1536	1	201
222	Sun Apr 21 22:09:47 2019	18.88332200050354	4108	1	201
223	Mon Apr 22 06:02:00 2019	12.66430377960205	1601	1	200
224	Mon Apr 22 07:19:00 2019	1.5027740001678467	0	1	200
225	Mon Apr 22 07:19:16 2019	17.08009433746338	3450	1	201
226	Mon Apr 22 07:30:38 2019	12.900035619735718	2532	1	200
227	Mon Apr 22 12:12:36 2019	4.467366933822632	36	1	201
228	Mon Apr 22 12:12:37 2019	6.11074161529541	732	1	200
229	Mon Apr 22 12:15:08 2019	31.997990608215332	7496	1	200
230	Mon Apr 22 19:05:21 2019	4.979029893875122	171	1	201

Schedule

Proposed Schedule

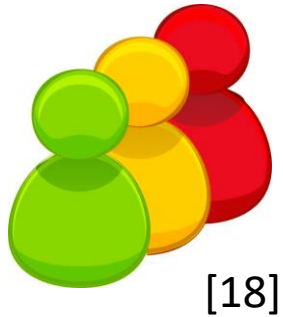


Actual Schedule

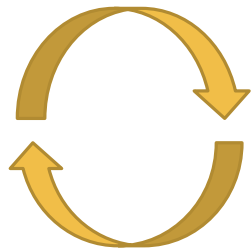


Risks

Expected



Project
Inheritance



Changing
Requirements

Unexpected



Heart rate data varies
with how its worn

Task Distribution

Cody: Research and Smartwatch backend development

Guan: Flow Meter development and implementation

Josh L: Research and Smartwatch frontend development

Josh H: Smart Plug Event recording and Duration calculations

Justin: Smart Plug Development & AWS Server Management

Mike: Team Manager, Android App developer

Future Work

Machine Learning

- Meaningful insights from health data

Apple Watch compatibility

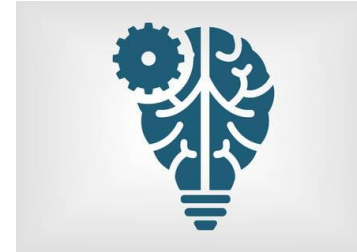
RightMinder fall detection

Indoor location tracking

Guest tracking and data separation

Additional sensors in the home

HIPAA Security Considerations



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Summary

Collect data
with sensors



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Build a
behavioral profile

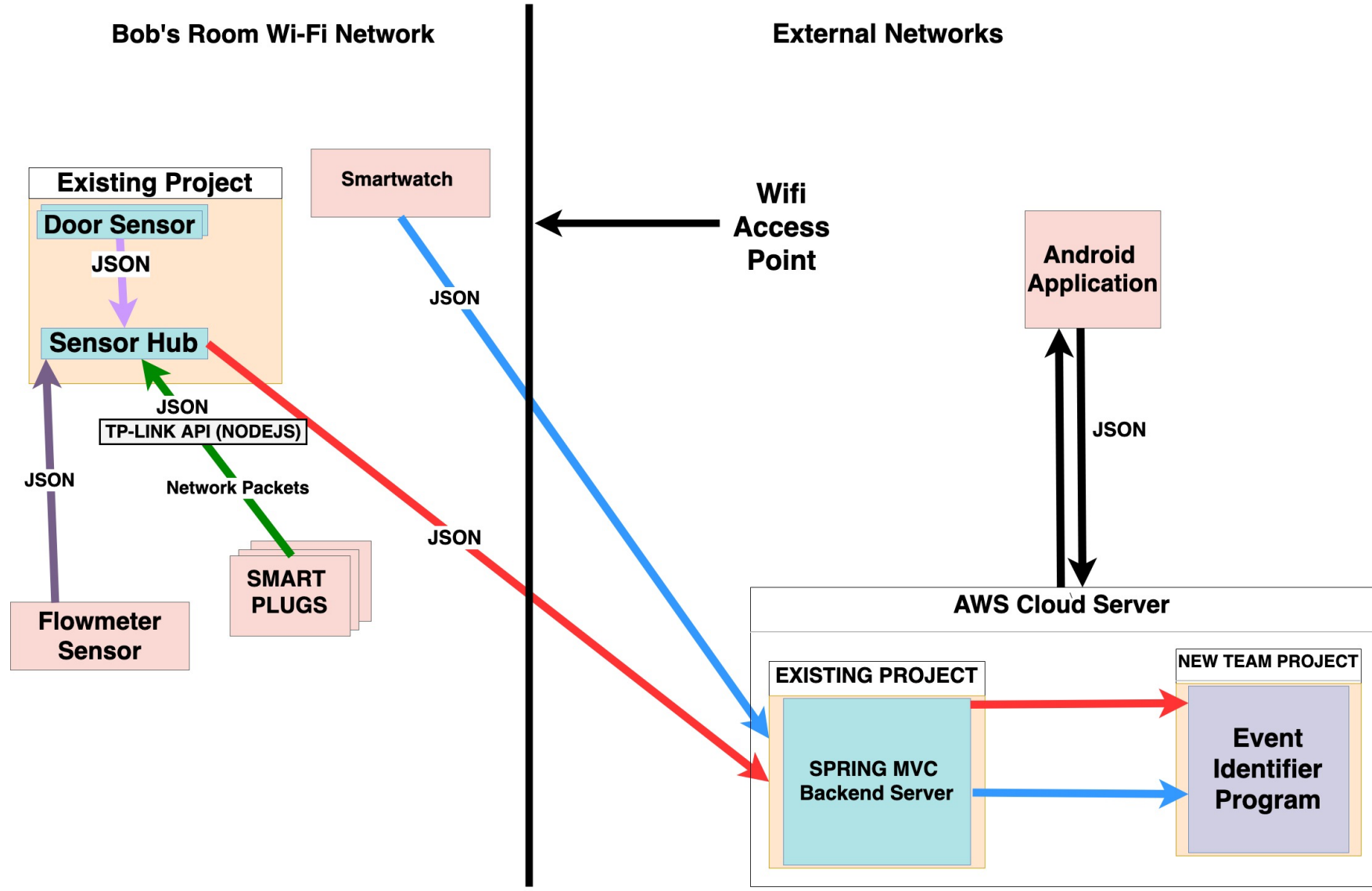
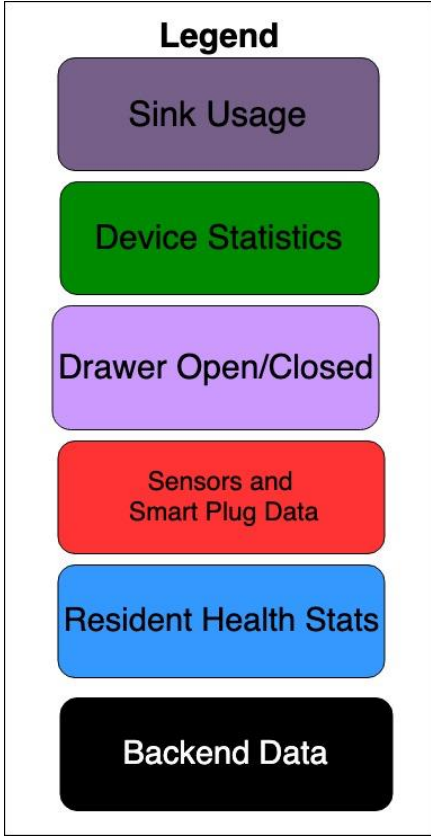


[5]

Keep our
seniors healthy



[2]



Appendix

Event Recording and Duration Calculations

Smart Plug Event

Device: A

Timestamp: 4-30-19-8:30

Type: In Use

Smart Plug Event

Device: A

Timestamp: 4-30-19-8:35

Type: Not In Use

Smart Plug Duration

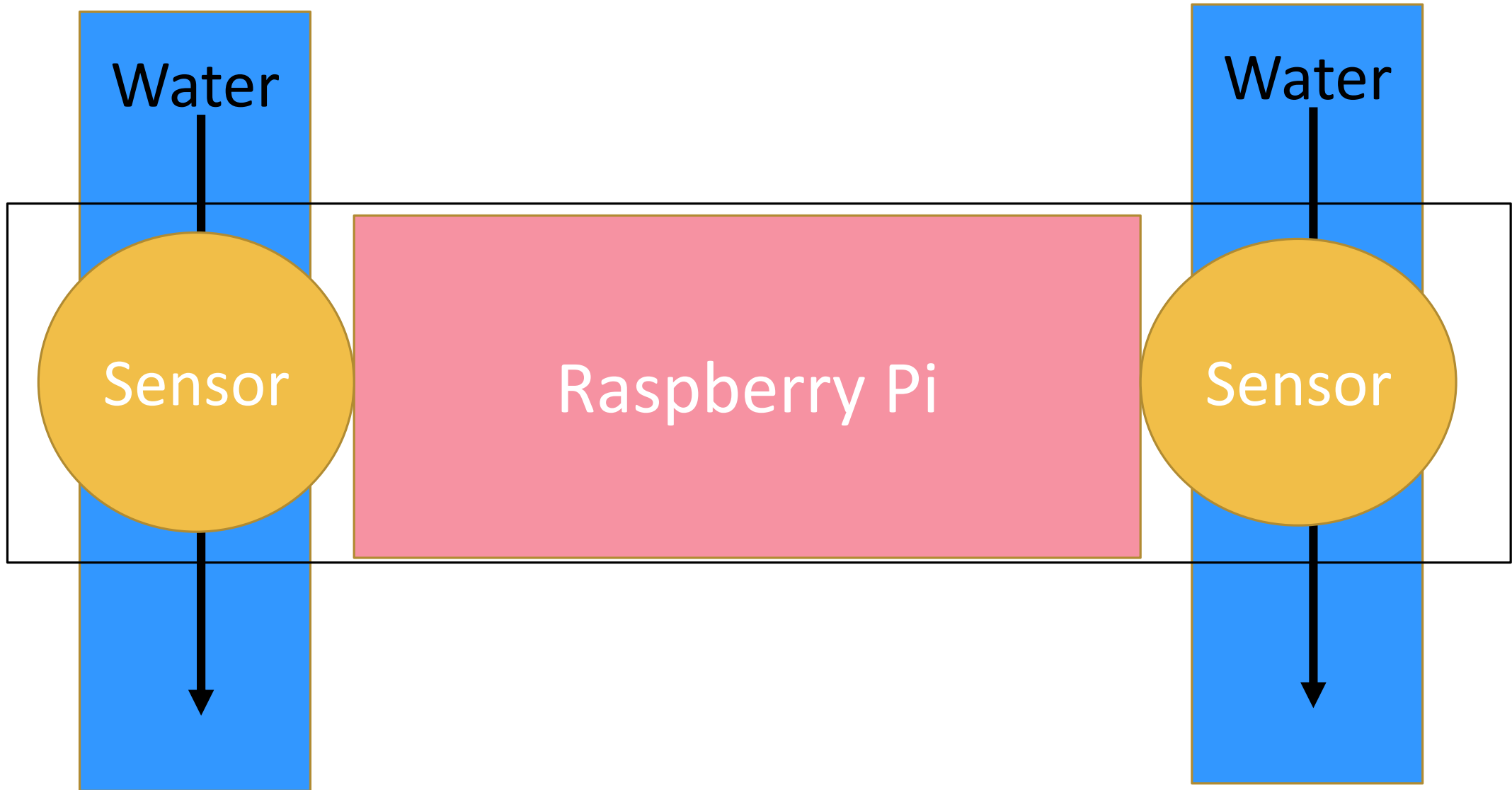
Device: A

Start Time: 4-30-19-8:30

End Time: 4-30-19-8:35

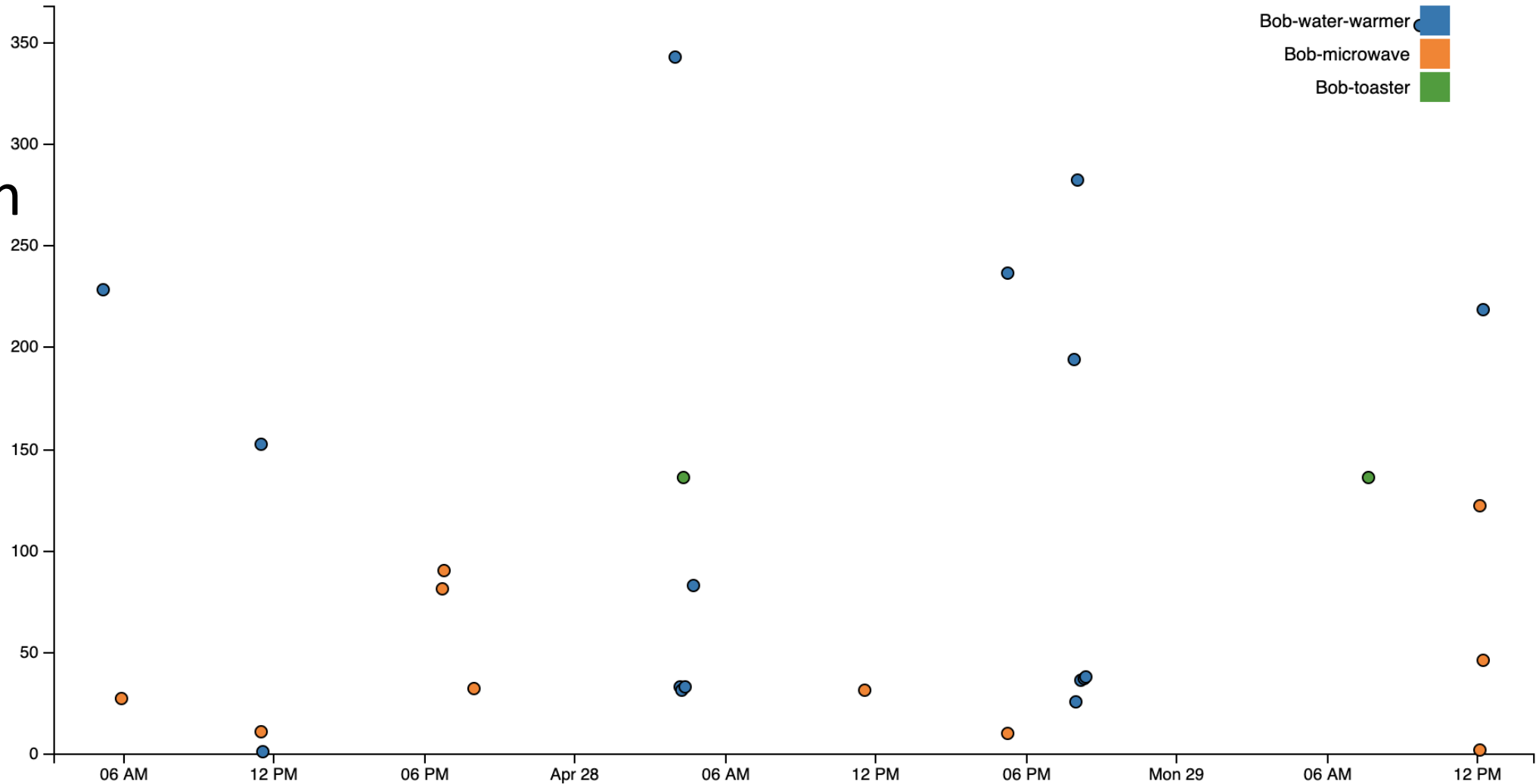
Duration: 5m

Flow Meter Internals



Smart Plug Event Data Visualization

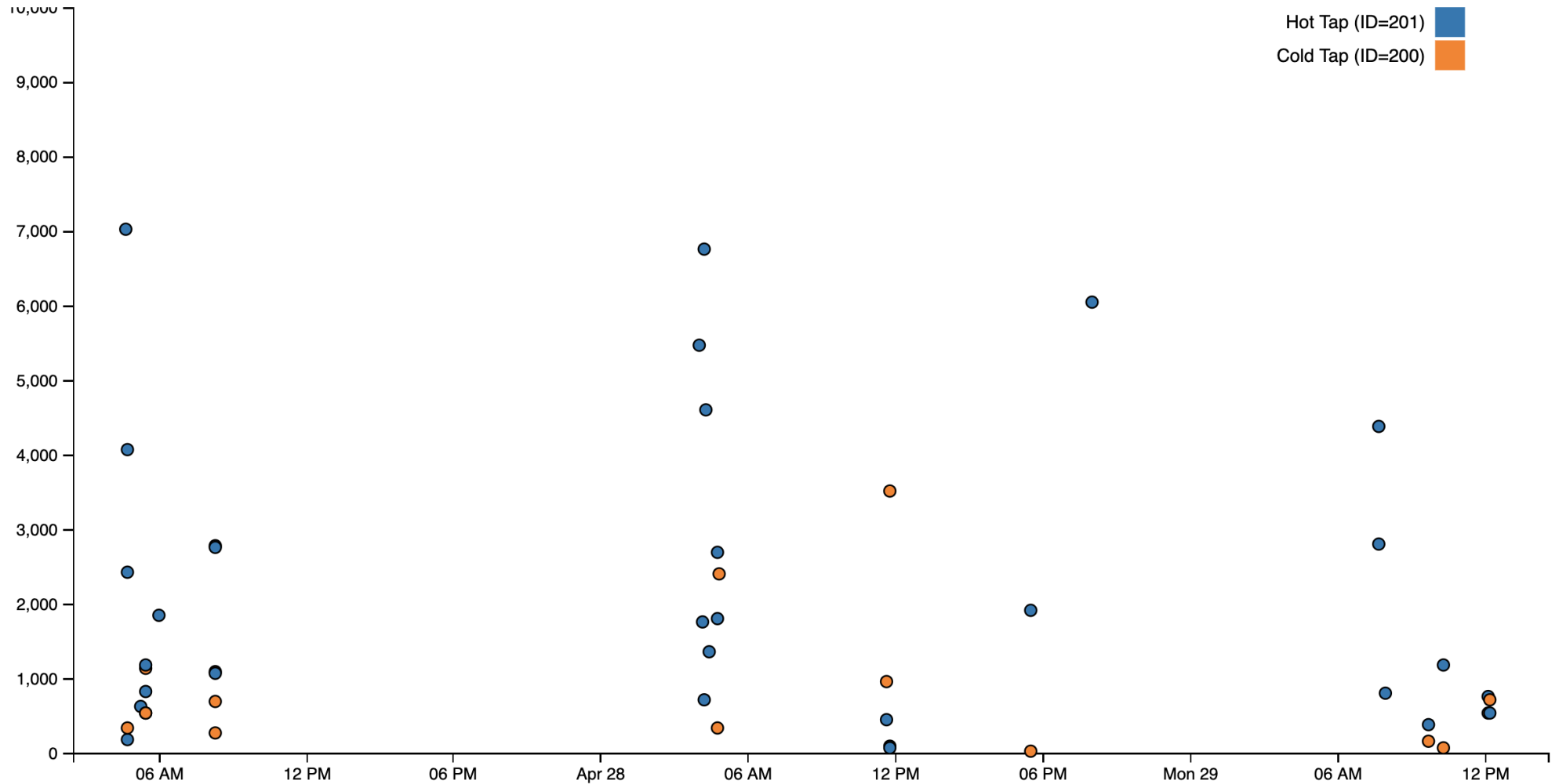
Duration
(Secs)



Smart Plug Event start time (4-27-19 - 4:30 pm on 4-28-19)

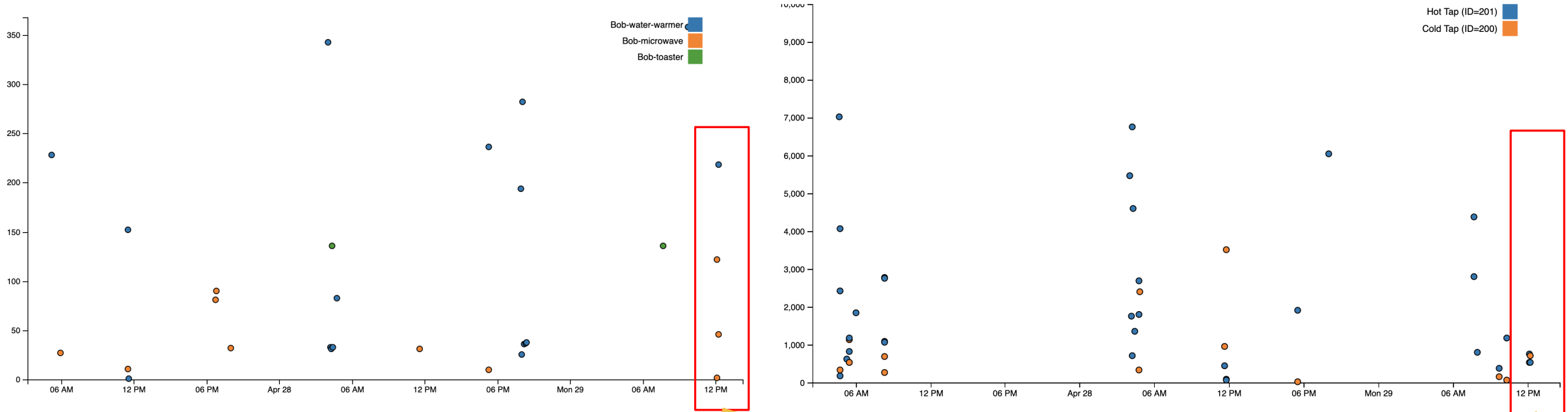
Flow Meter Data Visualization

Amount
Of Water
(mL)



Flow Meter start times (4-27-19 - 4:30 pm on 4-28-19)

Event Identification (Behavioral Profile)



Resident Eating Event Likely (Lunch)

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