Group 14
IoT Passive Monitoring for Assisted Living Homes

Members: Josh Blanck, Trevor Henderson, Austin Kerr,
Ryan McCullough, Nick Schneider, Austin Sudtelgte

Client: Andrew Guillemette
Advisor: Goce Trajcevski

Task Responsibility/Contributions of Each Member

Nick S   App Team & Meeting Scribe

Trevor H   Backend Team & Test Engineer

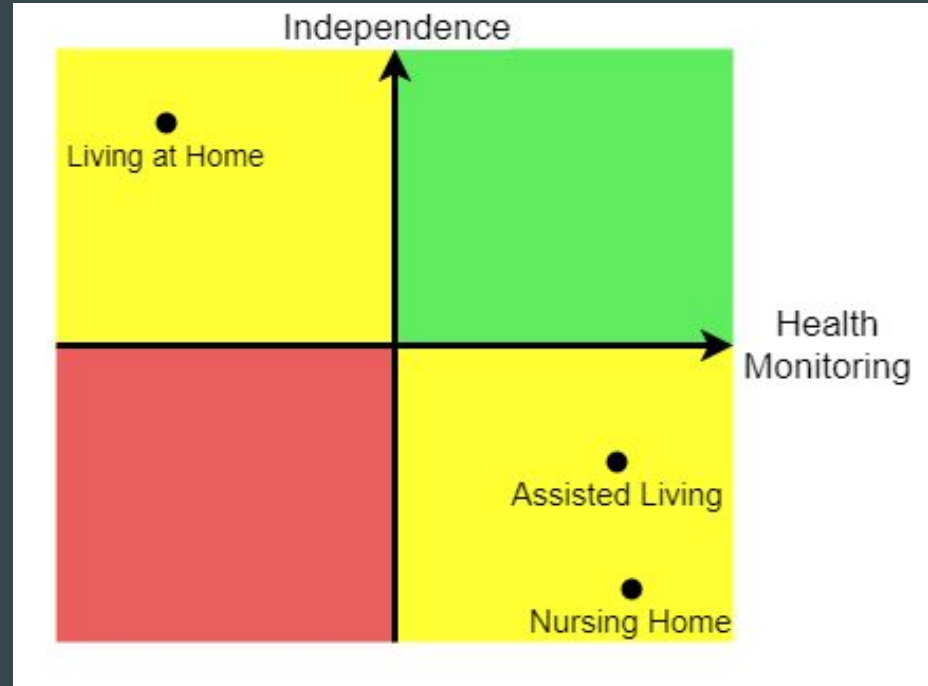Austin S   Sensor Team & Co-Lead Engineer

Josh B   Sensor Team & Report Manager

Ryan M   Sensor Team & Meeting Facilitator

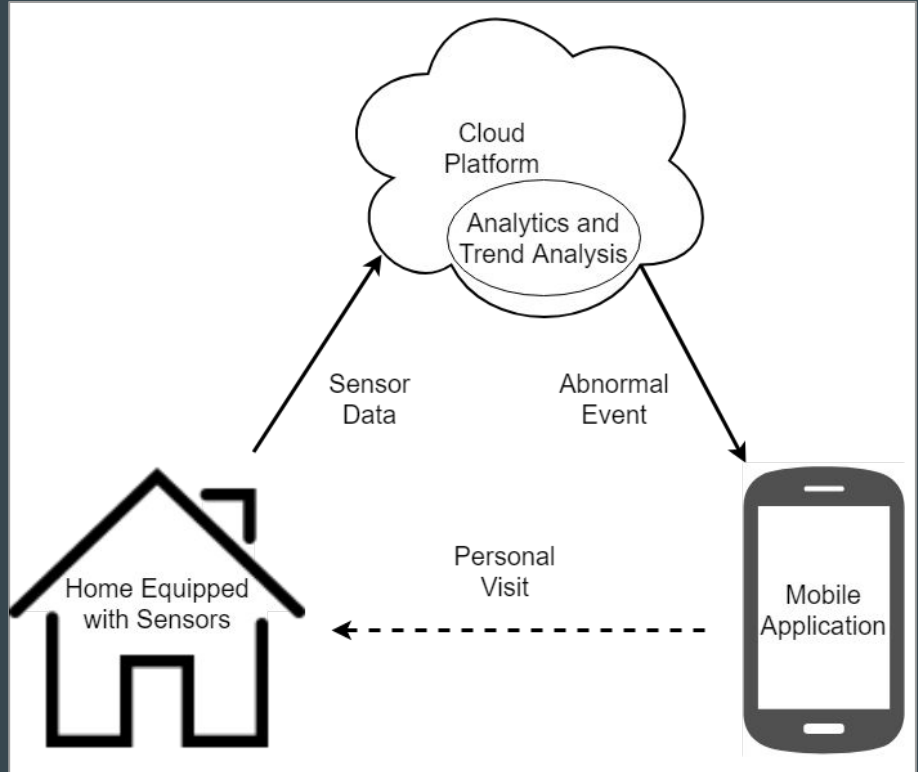Austin K   App Team & Co-Lead Engineer

Problem Statement

- Elderly or disabled family members want to maintain independence

- Family members are concerned for their health

Proposed Solution

- Use Sensors to Track Events

- Determine Trends

- Notify Users

Functional Requirements

- Detect and record events

- Data is collected and stored

- App is responsive

- View distinct events
  - Pull-based queries

Non-Functional Requirements

- Sensors must be non-intrusive

- Sensing is not continuous

- Multiple sensors and data types

- Data provenance

Technical Constraints and Considerations

- Constraints
  - User compliance
  - Cost

- Technical Considerations
  - Wifi Communication:
    - between the sensors and the hub
    - between the hub and the AWS server
  - REST Service
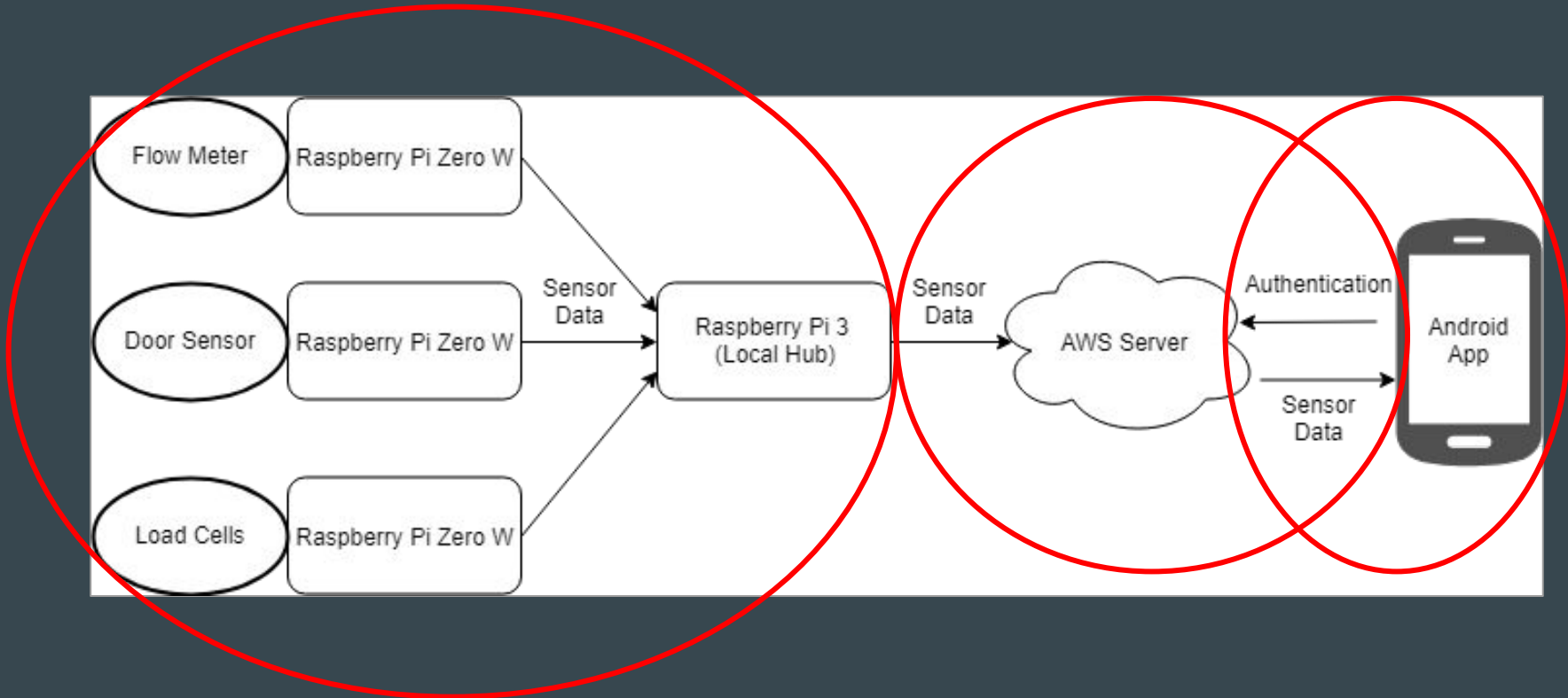
Market Survey

- Staff monitoring in Hospitals and work-in Nurses

- ALARM-NET

- Smart Homes for Seniors - Qorvo

Potential Risks and Mitigation

- Client and investors may want the project to change direction

  - Modular system

- Nutrient intake vs. medications

  - Consult with physicians

- Ethics

  - Non-invasive

  - Non-intrusive

Overall Architecture

Hardware, Software, and Technology Platforms

- Raspberry Pi Zero
- Raspberry Pi 3
- Python
- Raspian
- Android Studio
- Java Spring Framework
- Amazon Web Services
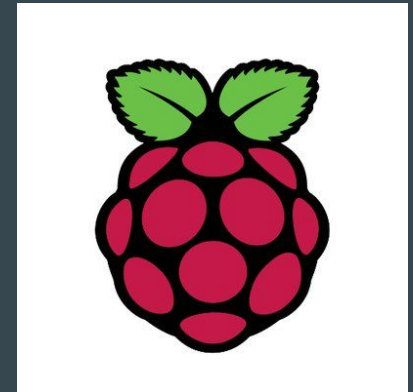
Resource/Cost Estimate - Testing Prototype

- Sensors - $76
  - $8.20 each for flowmeters (2)
  - $51.70 for load cells and accessories
  - $3.95 each for door sensors (2)
- Raspberry Pi's - $63.64
  - $35.64 for a Raspberry Pi 3
  - $14 each for Raspberry Pi 0w's (2)
- Misc. - $66.45
  - $43.95 for 5 SD cards
  - $7.50 each for Pi Power Supplies (3)
- **Net Total: $206.09**
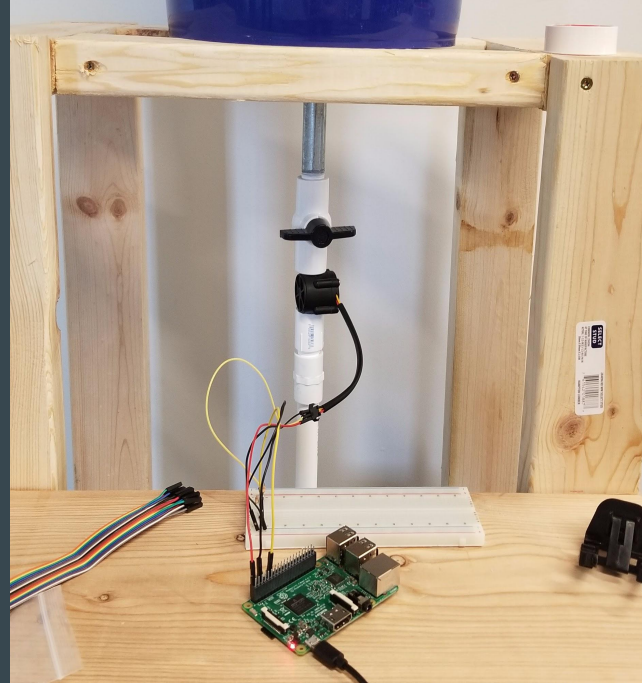- **Other: open source resources (python, linux…)**

Resource/Cost Estimate - Live Environment

- Sensors - $47.40
  - $3.95 each for door sensors (12)
- Raspberry Pi's - $63.64
  - $35.64 for a Raspberry Pi 3
  - $14 each for Raspberry Pi 0w's (2)
- Misc. - $66.45
  - $43.95 for 5 SD cards
  - $7.50 each for Pi Power Supplies (3)
- **Net Total: $177.49**
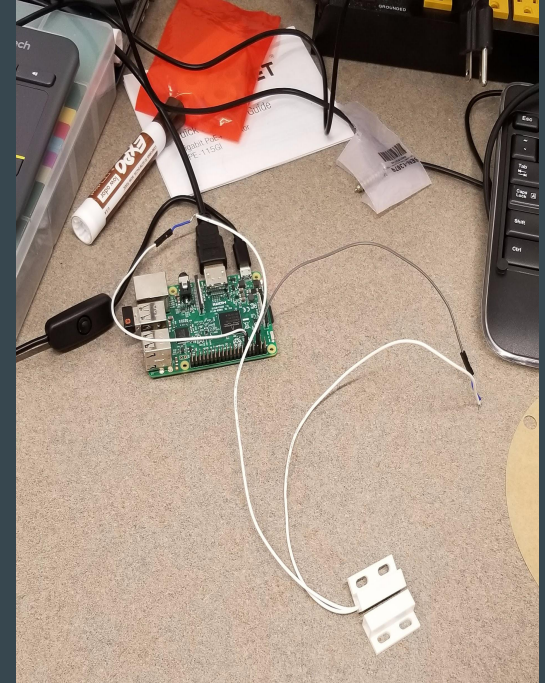- **Other: open source resources (python, linux...)**

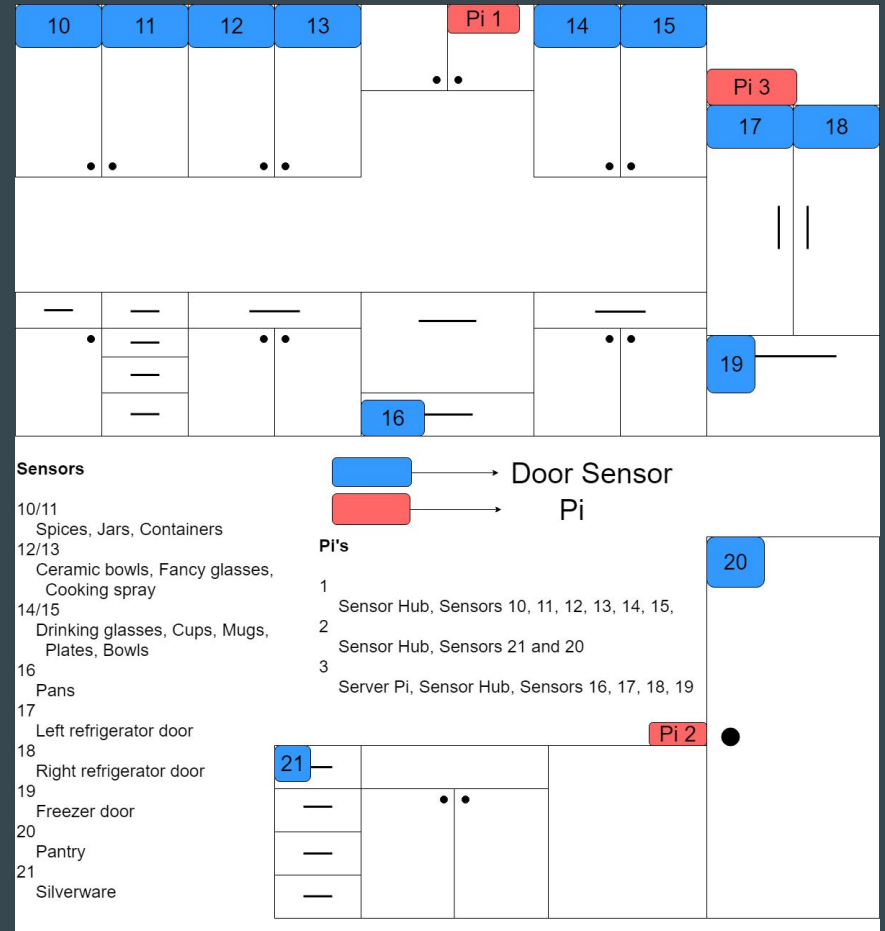# Test Environment

Flow Meter Testing

Flow Meter

Door Sensor

Live Environment

- Installed in Green Hills Retirement Community

- Living resident to collect data from

- Door sensors installed

- Data validation
  - Questionnaire we created
  - Collected three times week

Sensors

10/11
  Spices, Jars, Containers
12/13
  Ceramic bowls, Fancy glasses, Cooking spray
14/15
  Drinking glasses, Cups, Mugs, Plates, Bowls
16
  Pans
17
  Left refrigerator door
18
  Right refrigerator door
19
  Freezer door
20
  Pantry
21
  Silverware

Door Sensor
Pi

Pi's

1
  Sensor Hub, Sensors 10, 11, 12, 13, 14, 15,
2
  Sensor Hub, Sensors 21 and 20
3
  Server Pi, Sensor Hub, Sensors 16, 17, 18, 19

Application and Testing

- Testing in Postman

- User login

- UI Updates / Date Range

- Sensor Contents

- Timestamps

- Daily log validation

- Set up for other sensors

  - Flow meters

  - Smart outlets

Recent Door Events

Date Range: Today	▼

Sensor Id	
Duration	Time Stamp
Silverware	
5 seconds	Nov 29, 2018 07:27 AM
Silverware	
5 seconds	Nov 29, 2018 07:27 AM
Silverware	
4 seconds	Nov 29, 2018 07:26 AM
Glasses, Cups	
4 seconds	Nov 29, 2018 07:24 AM
Fancy Dishware	
14 seconds	Nov 29, 2018 07:23 AM
Fancy Dishware	
14 seconds	Nov 29, 2018 07:23 AM
Pan, Spatula	
8 seconds	Nov 29, 2018 07:22 AM
Pan, Spatula	
8 seconds	Nov 29, 2018 07:22 AM
Jars, Tubs	
50974 seconds	Nov 29, 2018 07:13 AM
Plates, Bowls	
262952 seconds	Nov 29, 2018 07:13 AM

HOME   SENSORS   LOCATIONS   SETTINGS

Integration Testing and Validation

- Sensor data automatically stored

- Current data on Android app

- Sensors and cables are non-intrusive

Timelines - First Semester

January	February	March	April
-Determine what data will be useful to health monitoring **Hardware** -Brainstorm various sensor use cases -Generate and justify list of sensors to collect data	-Work on hardware and software flowcharts **Hardware** -Brainstorm ways to bypass selected sensors **Server** -Research cloud/ local server solutions **Application** -Begin work on data visualization solution	**Hardware** -Present and finalize sensors and use cases -Design and build tests for sensors **Server** -Implement interface between sensors and storage **Application** -Work on storage system (cloud and local)	-Begin collecting test data -Prep for in depth testing over the summer (to be done by Client) **Server** -Refine storage solution **Application** -Finish MVP of app prototype

Timelines - Second Semester

September	October	November	December
Hardware -Finalize pin configuration -Implement multithreading on Pi's **Application** -Create Heatmap visualization **Server** -Create sensor ID API	**Hardware** -Plan and install into test environment **Application** -Improve application UI **Server** -Implement Login and Authentication API **Testing** -Create and finalize Daily Log and Questionnaire for test resident	**Hardware** -Debug and solve issues in test environment **Application** -Improve data readability via string mapping **Server** -Create APIs to facilitate the revisions to the application **Testing** -Collect and analyze daily logs	Finalize Project documentation

Future Extensions

- Additional sensors and devices
  - Smart outlets
  - Wearable Identification/Authentication
- Robust, Proprietary Hardware
- Machine Learning
- UI and UX design
- Security

Lessons learned

- Define scope early on and for all parts of the project

- Iterative development
    - Small scale testing environment
- Resident interviews

Image Credits

http://www.healthcarefinancenews.com/sites/healthcarefinancenews.com/files/styles/companion_top/public/DrPatientistock_2.jpg?itok=YbNNENoe

https://www.raspberrypi.org/products/raspberry-pi-3-model-b/

https://readlearncode.com/spring-4/insights-from-stackoverflow-most-voted-for-spring-4-questions/

https://www.invitereferrals.com/blog/tagNpin-reliable-technolgy-infrastructure

Thanks!

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Questions?

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