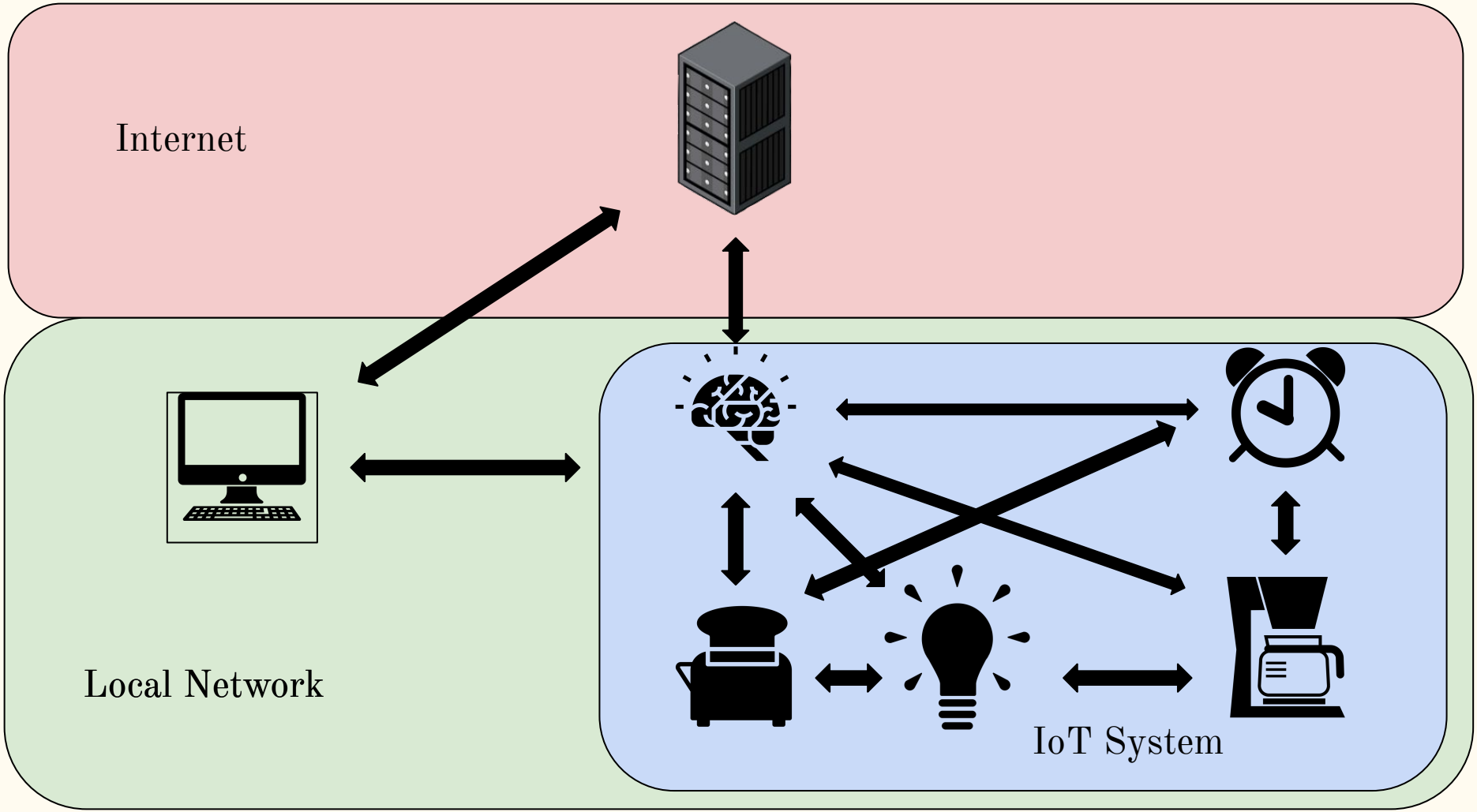
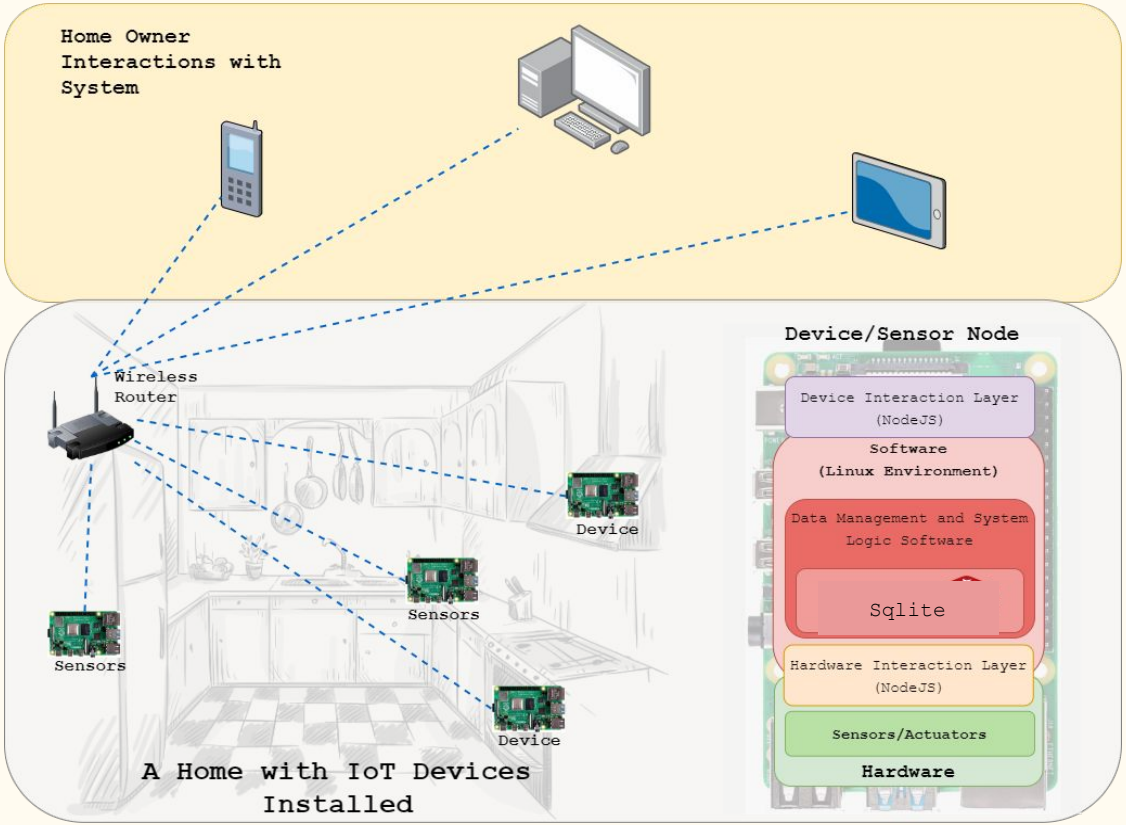

Internet
Local Network
IoT System

Solution Approach



Problems

- Web interface
- Sensor data
- Device interactions

Solution Approach

Web Interface	Data Storage	Device Interactions
● Elect a master node ● Run lightweight webapp locally		

System Specification (Hardware)

Rasperry Pi as a central platform

- Powerful enough to run the databases we want
- Most documented Single Board Computer available
- Small enough to fit into home without being considered a “computer”

Alarm Clock Device - Rpi with clock and buzzer

Light Device - LEDs connected to RPI

Coffee Pot Device - Relay HAT on RPI connected to consumer pots power

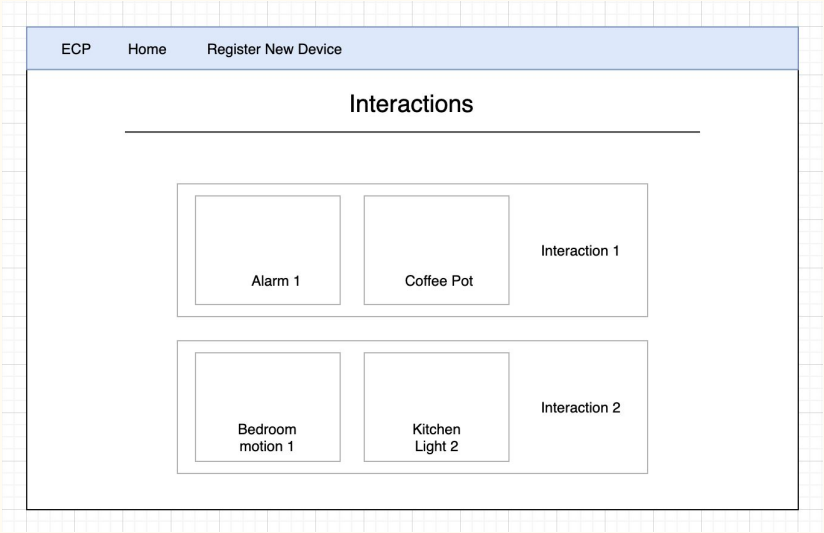
Sensor Device - Sensors connected to RPI

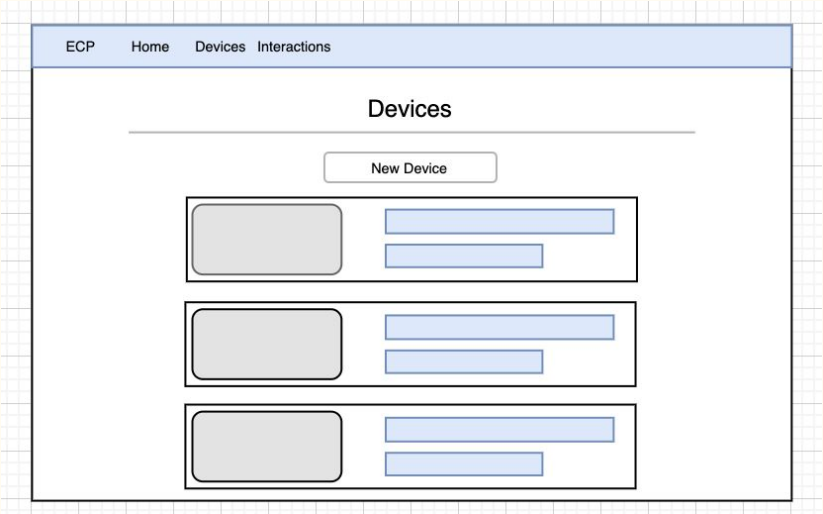
This strategy makes the workflow of implementing each device the same, and the interfaces between device and databases on the board the same.

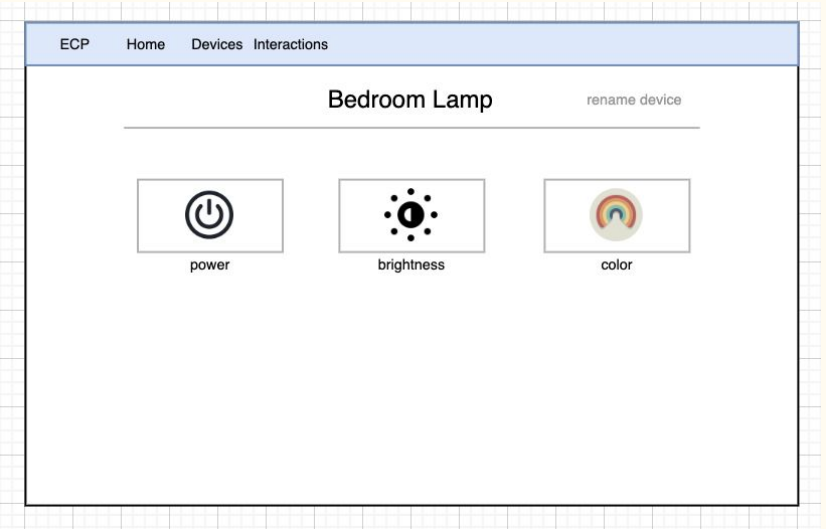
System Specification (Interaction Layer)

Webapp	Data Storage	Device Interactions
● WebSocket to each device ● Push shared data when updated		

System Specification (Webapp)







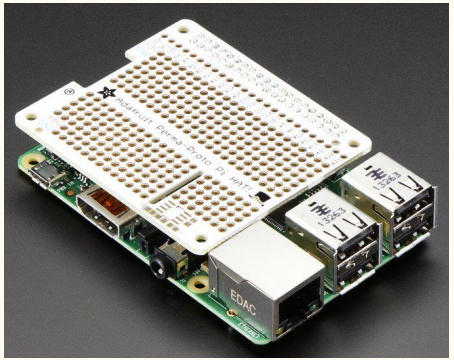
Implementation Plan (Hardware)

For MVP:

- Implement all hardware on breadboards
- Sensors and leds working
- Interfaces with databases built out

For Final:

- Implement hardware on solderable HATs
- Have tuned sensors and testing methods for the sensors



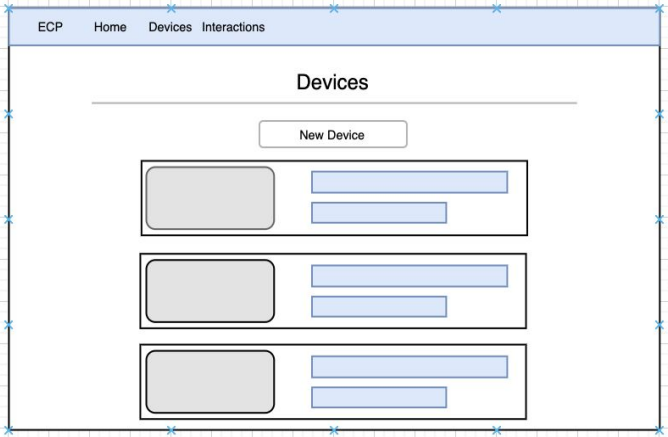
https://www.adafruit.com/product/2310

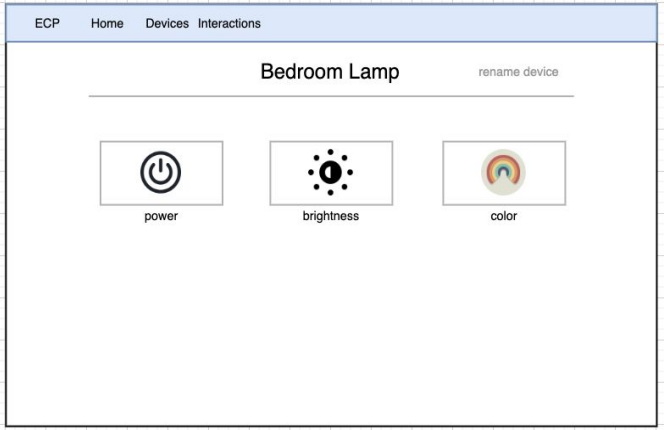
Implementation Plan (Interaction Layer)

Webapp	Data Storage	Device Interactions
● Master sends heartbeats to other nodes every 3 seconds ● Master gets device heartbeats every 3 seconds ● If master down, then node with lowest serial number promotes		

Implementation Plan (Webapp)

- Frontend: React
  - Light and responsive
- Backend: Express
  - Simple, Barebones API
- Mounted using: Docker
  - Lightweight containers won't strain devices
  - Simplifies deploying and running webapp on new devices





Metrics and Validation

- Timing interactions
  - Time the difference between change in input and change in output
- Functionality
  - Unit test all devices in the network
  - Integration tests to verify interactions
- Resiliency (Chaos Testing)
  - Knock random devices off the network
  - Unit test for devices, integration tests for interactions to verify system functionality
  - Shut off web application node
    - Define new interactions to ensure whole system functionality

Risks and Unknowns

- Lots of moving parts
  - Integrate early and often
- Difficult to validate IoT devices
  - Unit test each software and hardware component individually
  - Add integration tests whenever we integrate
- Fault tolerance in distributed systems is hard
  - Plan B minimum viable product assumes benign system where things don’t go wrong

Project Management

Team A6 Capstone Project Schedule

Rip Lyster, Richard Deng, Niko Gupta

Project Start Date: 1/13/2020 (Monday) — Display Week: 4

WBS	TASK	LEAD	START	END	DAYS	% DONE
1	**Research Design Elements**					
1.1	Research Decide on Devices	Rip	Mon 2/03/20	Fri 2/07/20	5	0%
1.1.1	Decide what interactions those devices will have	Rip	Sat 2/08/20	Sun 2/09/20	2	0%
1.2	Research Storage System for Devices	Richard	Mon 2/03/20	Fri 2/07/20	5	0%
1.2.1	Decide on Storage System	Richard	Sat 2/08/20	Sun 2/09/20	2	0%
1.3	Research Interaction System for Devices	Niko	Mon 2/03/20	Fri 2/07/20	5	0%
1.3.1	Decide on Interaction System	Niko	Sat 2/08/20	Sun 2/09/20	2	0%
2	**Draft Main Systems**					
2.1	Hardware Design and Order for MVP Devices	Rip	Mon 2/10/20	Mon 2/24/20	15	0%
2.2	Webapp Framework Design Decisions	Everyone	Mon 2/10/20	Wed 2/12/20	3	0%
2.2.1	Webapp Framwork Demo	Richard	Thu 2/13/20	Mon 2/24/20	12	0%
2.3	Interaction Layer Design Decisions	Everyone	Mon 2/10/20	Wed 2/12/20	3	0%
2.3.1	Interaction Layer Demo	Niko	Thu 2/13/20	Tue 2/25/20	13	0%
2.4	Design Presentation Work	Everyone	Fri 2/21/20	Sun 2/23/20	3	0%
3	**Build / Integrate Main Systems**			-		
3.1	Test Hardware Devices	Rip	Mon 2/24/20	Wed 2/26/20	3	0%
3.2	Write Hardware Interaction Layer	Rip	Thu 2/27/20	Sat 2/29/20	3	0%
3.3	Integrate Webapp and Interaction Layer	Niko & Richard	Mon 2/24/20	Sat 2/29/20	6	0%
3.4	Integrate Hardware and Interaction Layer	Everyone	Sun 3/01/20	Wed 3/04/20	4	0%
4	**Second Iteration of System**			-		
4.1	Decide and Design Final Devices	Rip	Mon 3/16/20	Thu 3/26/20	11	0%
4.2	Design and Build Commissioning	Niko	Mon 3/16/20	Thu 3/26/20	11	0%
4.3	Design Detailed Interaction Builder	Richard	Mon 3/16/20	Thu 3/26/20	11	0%
4.4	Free Space, Extra Time	Richard	Fri 3/27/20	Sun 3/29/20	3	0%
5	**Second Integration Phase**			-		
5.1	Integrate New Hardware with Interaction Layer	Rip	Mon 3/30/20	Wed 4/08/20	10	0%
5.2	Integrate Commissioning to Webapp	Niko	Mon 3/30/20	Wed 4/08/20	10	0%
5.3	Create Demo Interactions	Richard	Mon 3/30/20	Wed 4/08/20	10	0%
5.4	Free Space, Extra Time	Everyone	Thu 4/09/20	Sun 4/12/20	4	0%
6	**Time Padding**			-		
6.1	Working on Project Report/Presentation	Everyone	Mon 4/13/20	Sun 4/26/20	14	0%
6.2	Work on Finalizing Demo	Everyone	Mon 4/13/20	Sun 4/26/20	14	0%
6.3	Work on Added Features	Everyone	Mon 4/13/20	Sun 4/26/20	14	0%