SimpleHome

A Home Automation System

December 14, 2015

Team Breakdown

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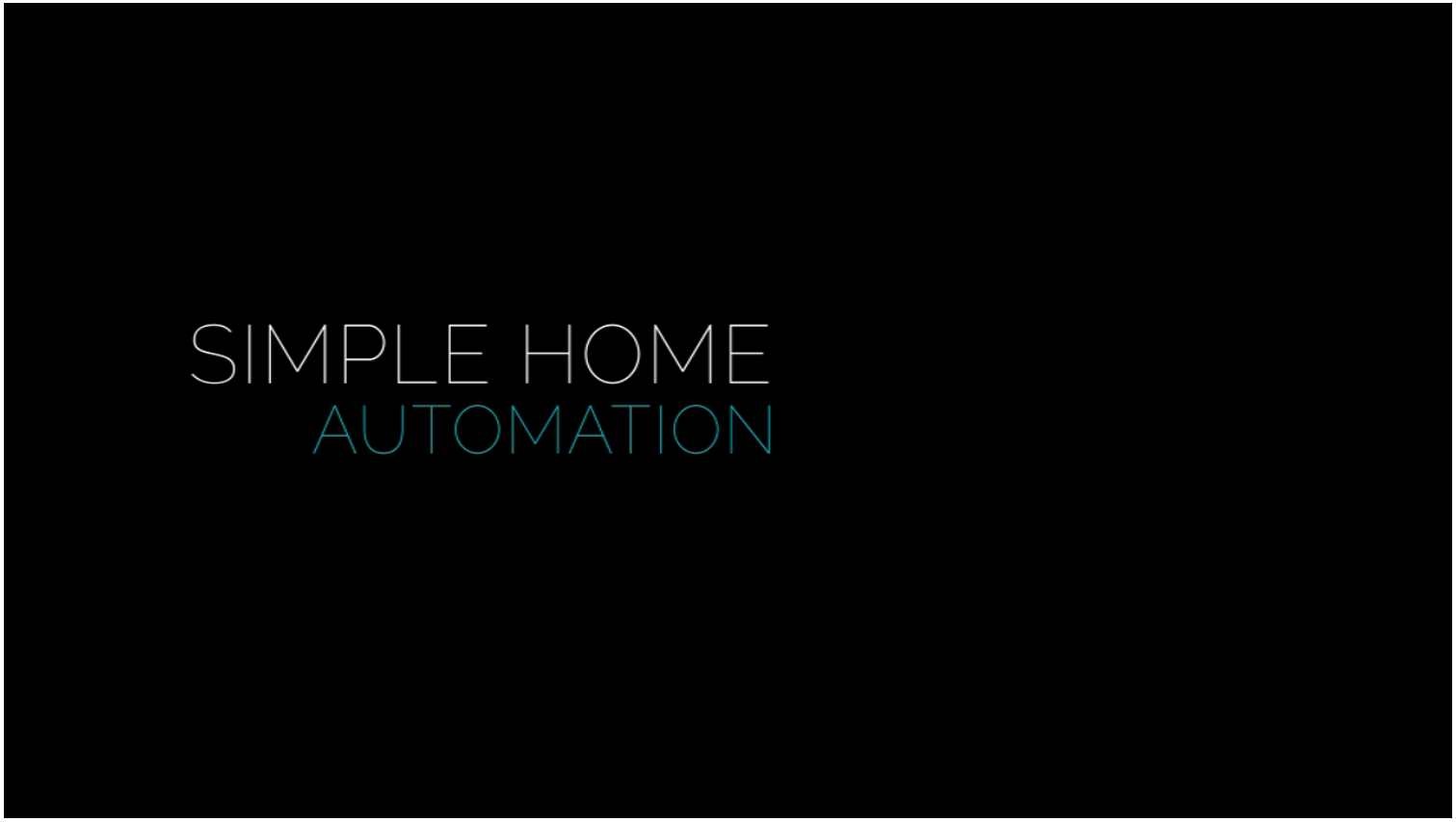
Short Video



Overview

Project Motivation
System Overview
- High Level System Design
- SimpleHome Hub
- Peripherals
- Website & Database
- Machine Learning

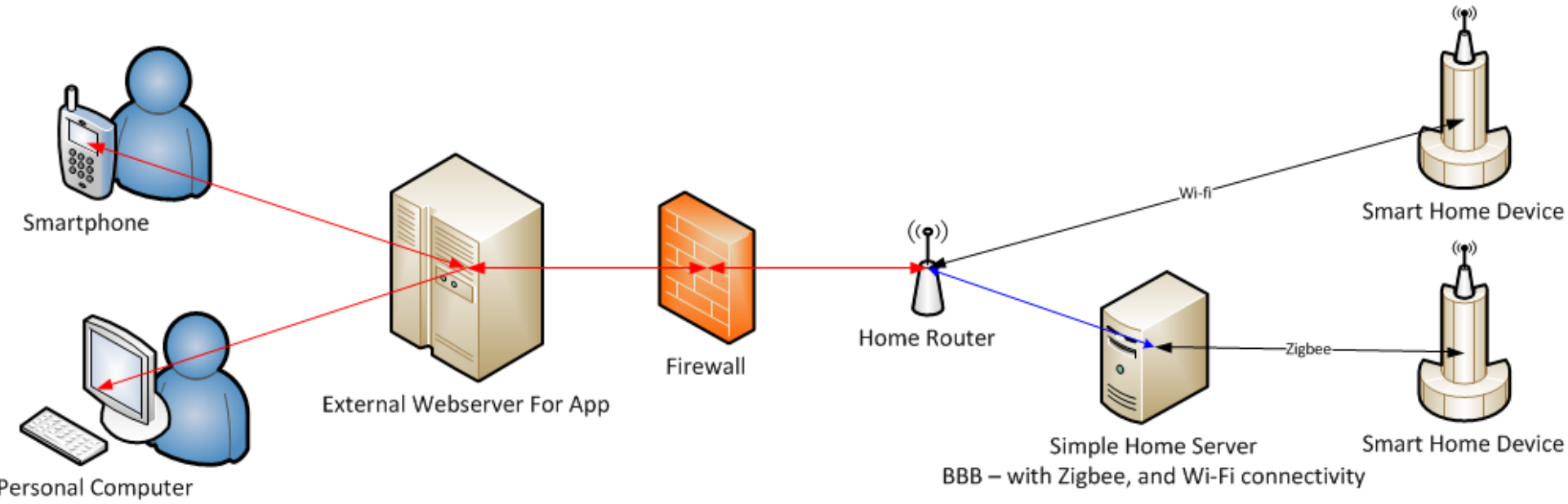
Business Case
- Market and Competition
- Budget
- Timeline

Project Wrap Up

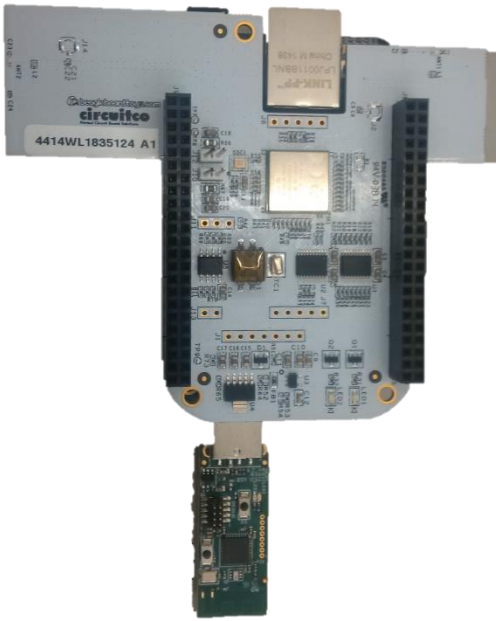
Project Motivation

- Easy-to-use, Inexpensive, Energy-Efficient and Secure Home Automation System
- By 2030, 25% of Canadian population will consist of senior citizens
- Reduce dependence on old-age homes
- Can be integrated with existing Home Automation Systems

System Overview



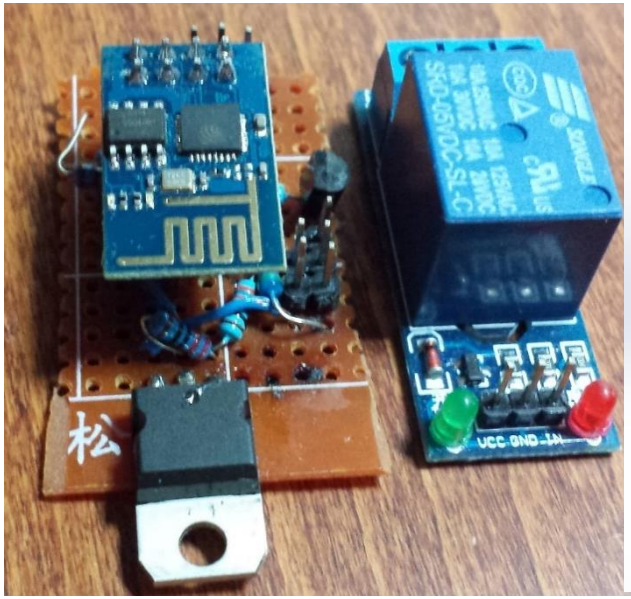
SimpleHome Hub

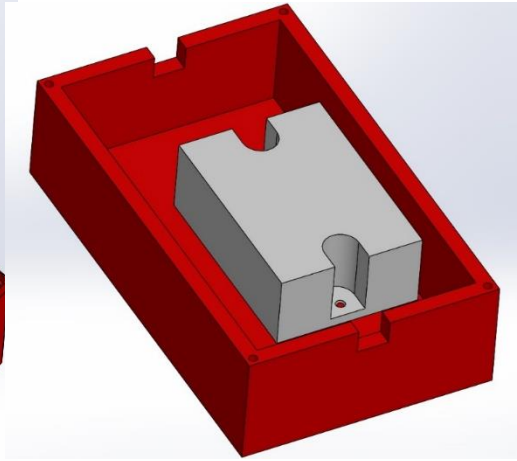


- Used a BeagleBone Black as the core of the Hub
- Powerful processor, connectivity benefits and reliability of device
- Connect to WiFi devices
- Connect to ZigBee devices
- Send structured data collected from devices to the web-server
- Respond to user-requests by sending commands to devices

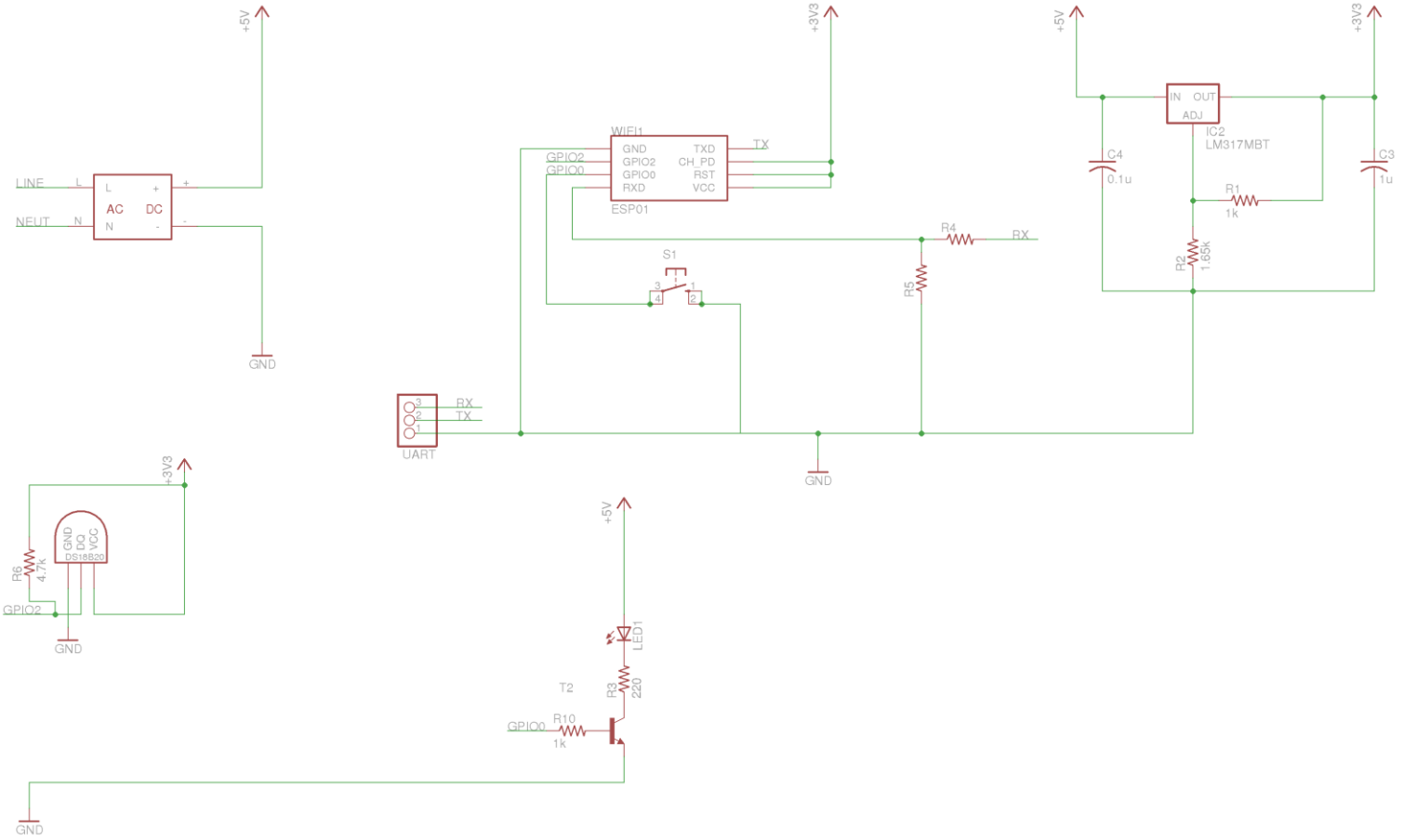
Outlet Peripheral

- High current Wall plug, with a SolidWorks model

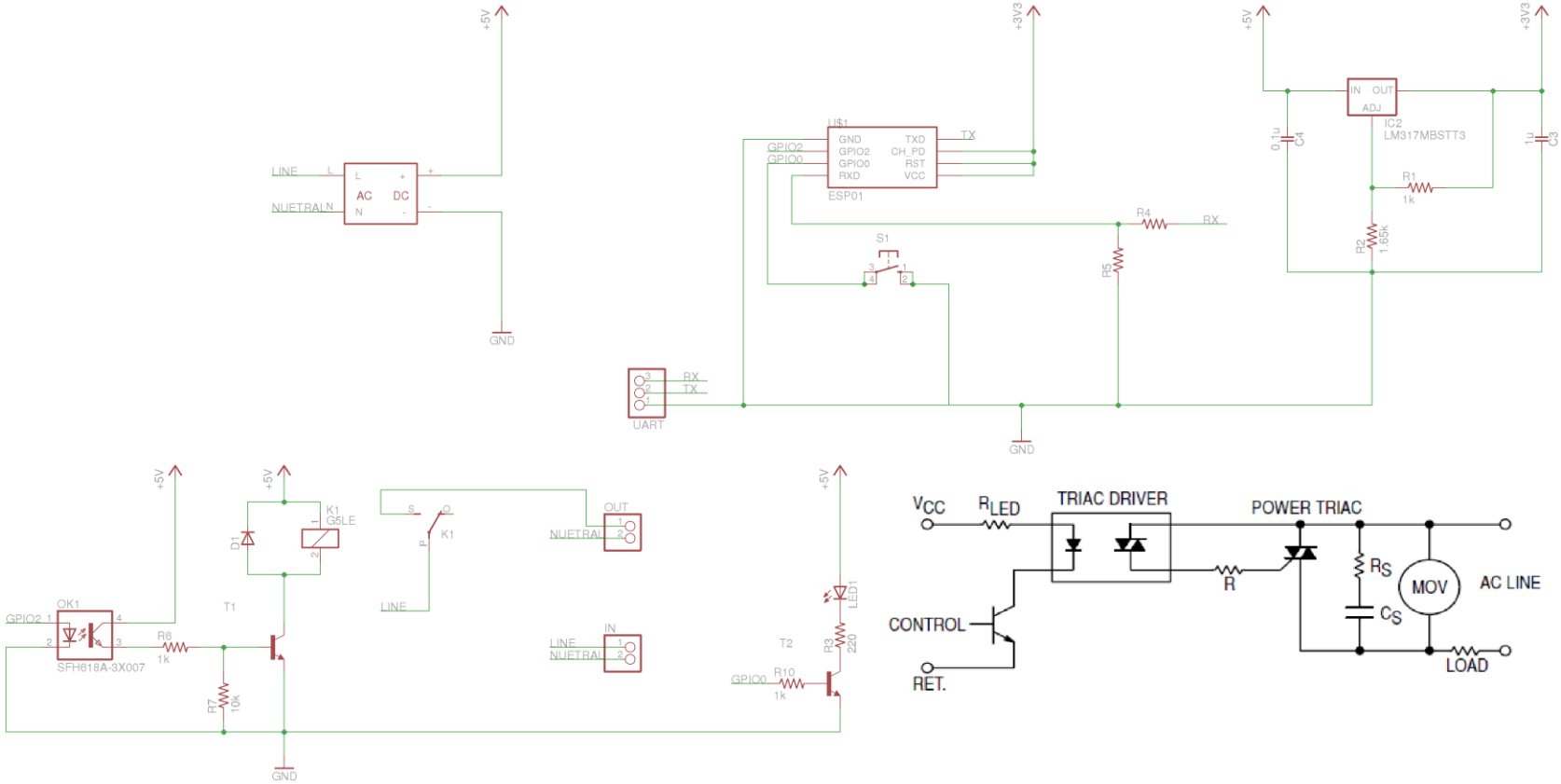




Light SW Peripheral 1



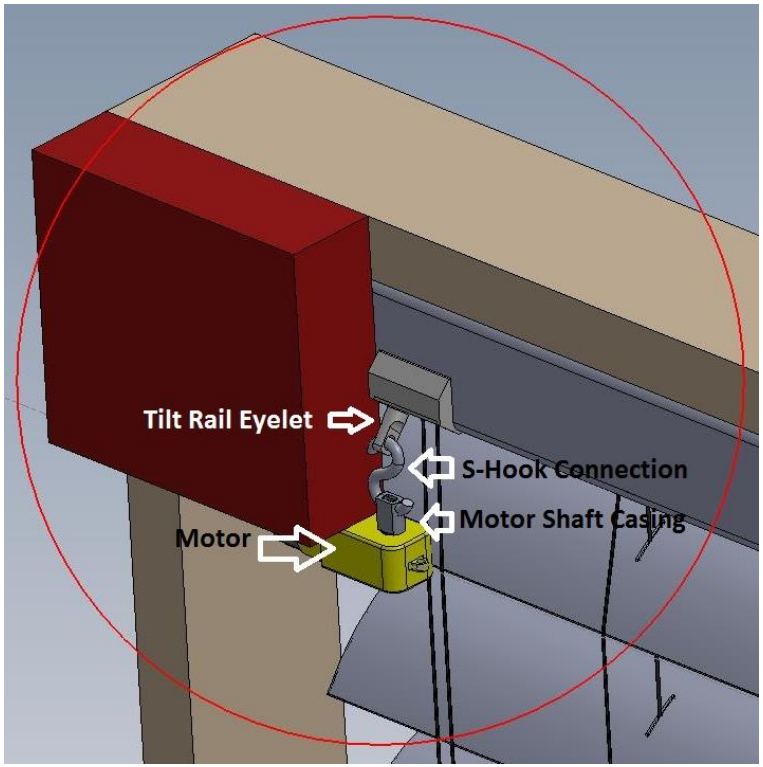
Light SW Peripheral 2

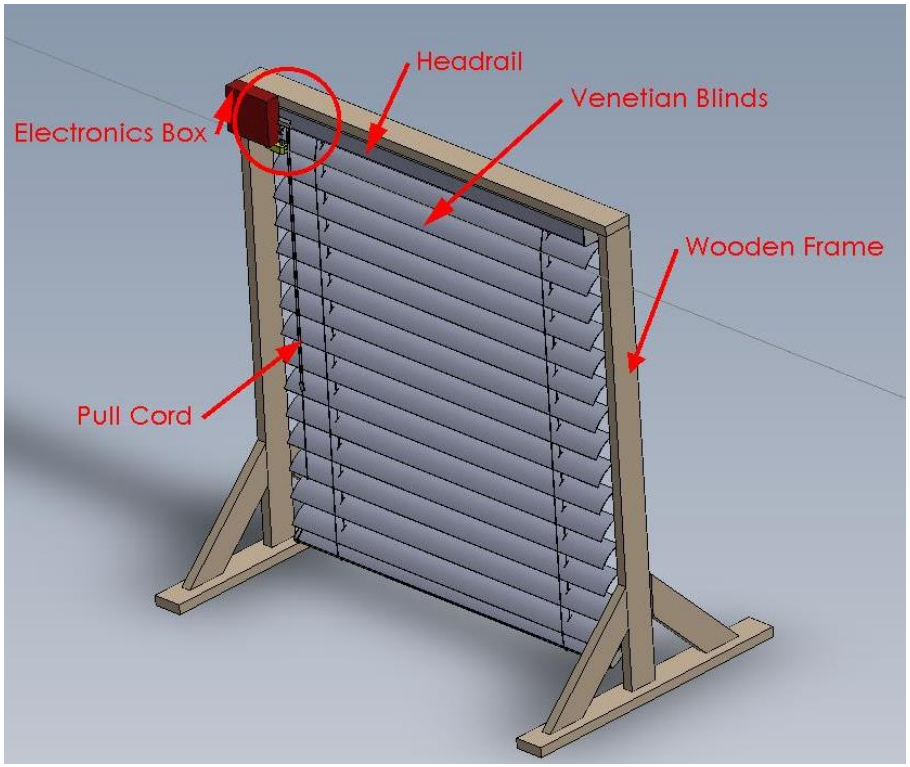


Firmware

- Used eLua as the main language
- Standardized API Across Peripherals
- Adding UDP Discovery
  - The SOC FW needed to be recompiled

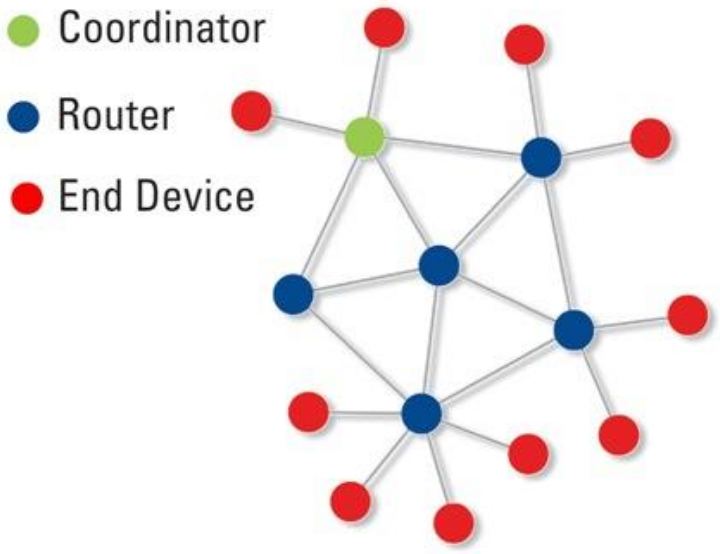
Automated Blinds





Zigbee Protocol

- Wireless protocol using mesh network
- Coordinators, routers and end devices



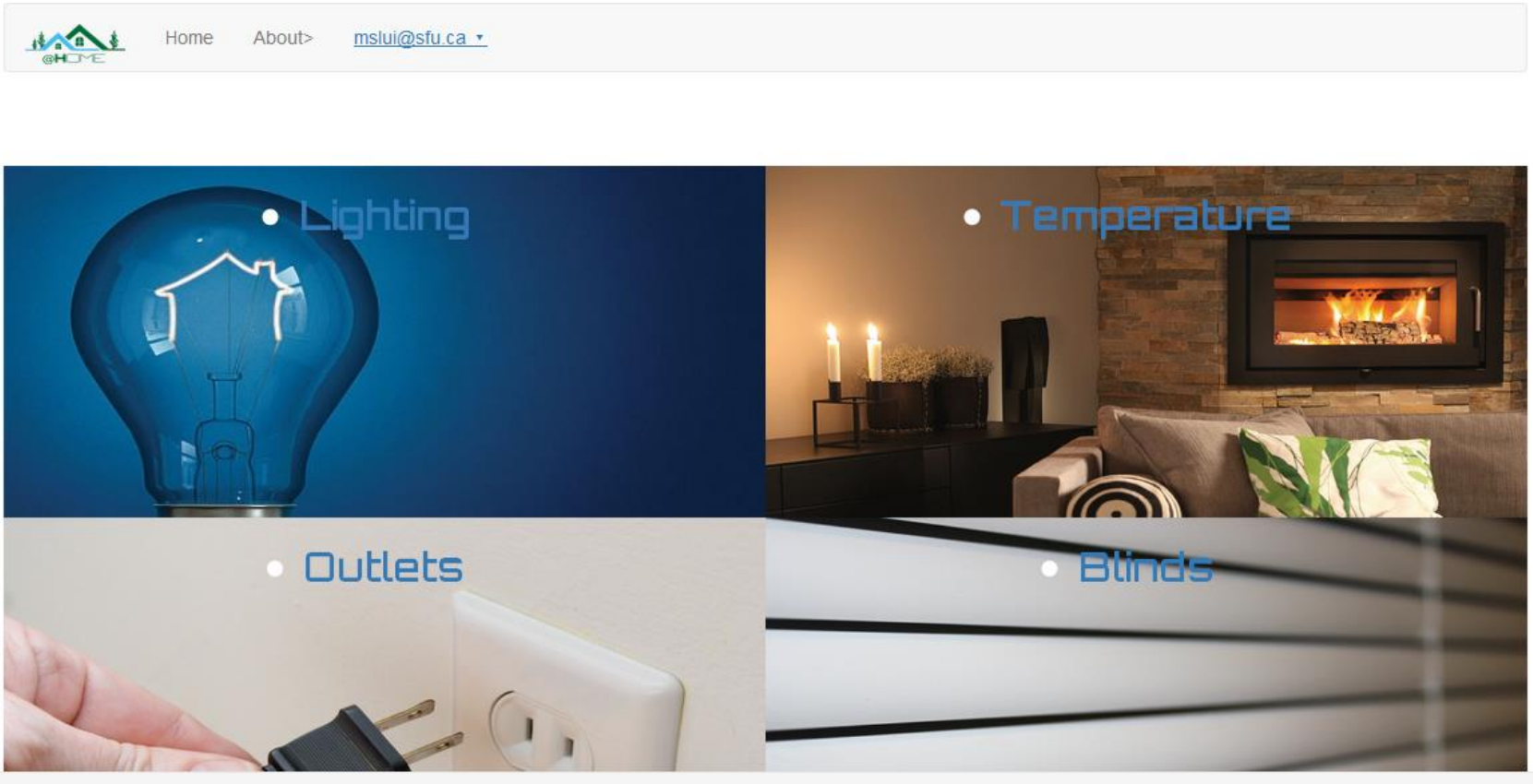
Zigbee Protocol

- Zstack Linux Gateway Software on hub
- CC2531 Dongle and GE Link Bulb
- Endpoint communication – Virtual Wire

Website

- Utilized Meteor Framework for easy front and back end integration
- Implemented UI with Bootstrap library
- Simple design with 4 peripheral images

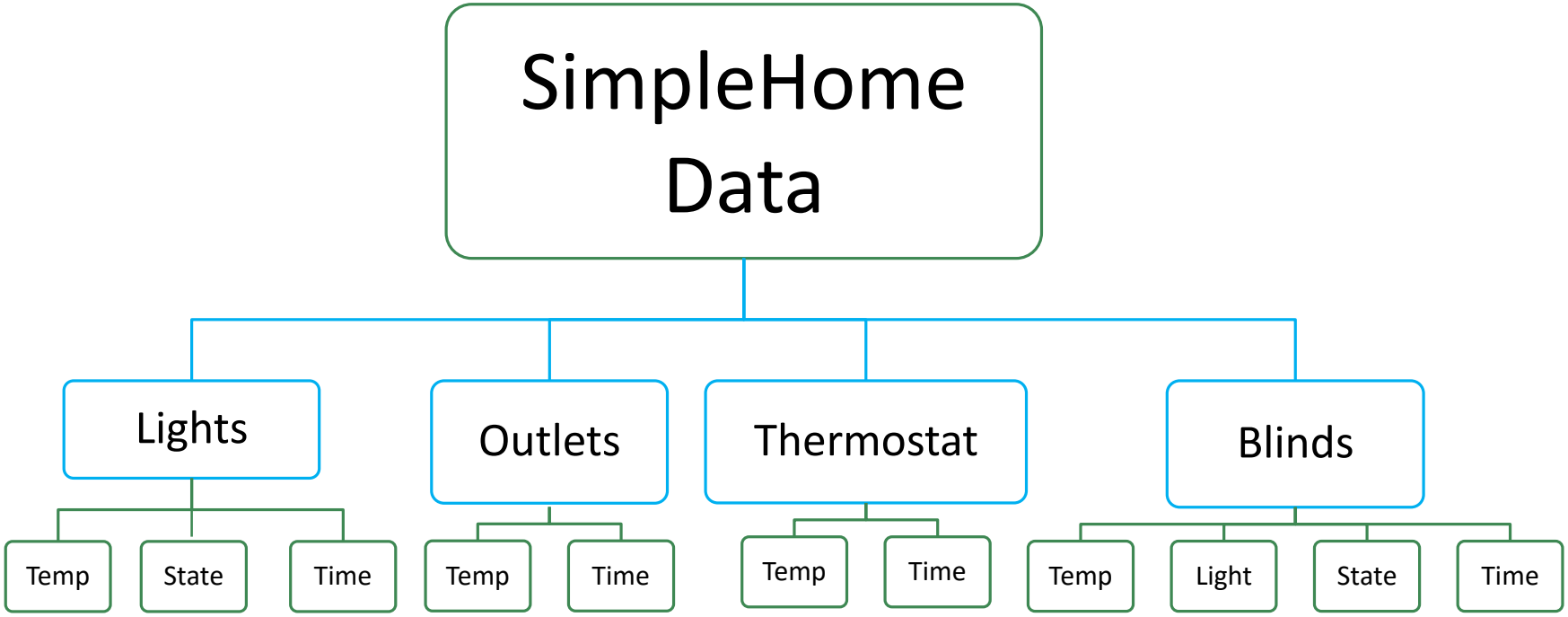
Website


Home
About>
mslui@sfu.ca
Lighting
Temperature
Outlets
Blinds

Database

- Website interface synched with MongoDB
- The Hub subscribes to the database
- Uses Distributed Data Protocol (DDP) to communicate

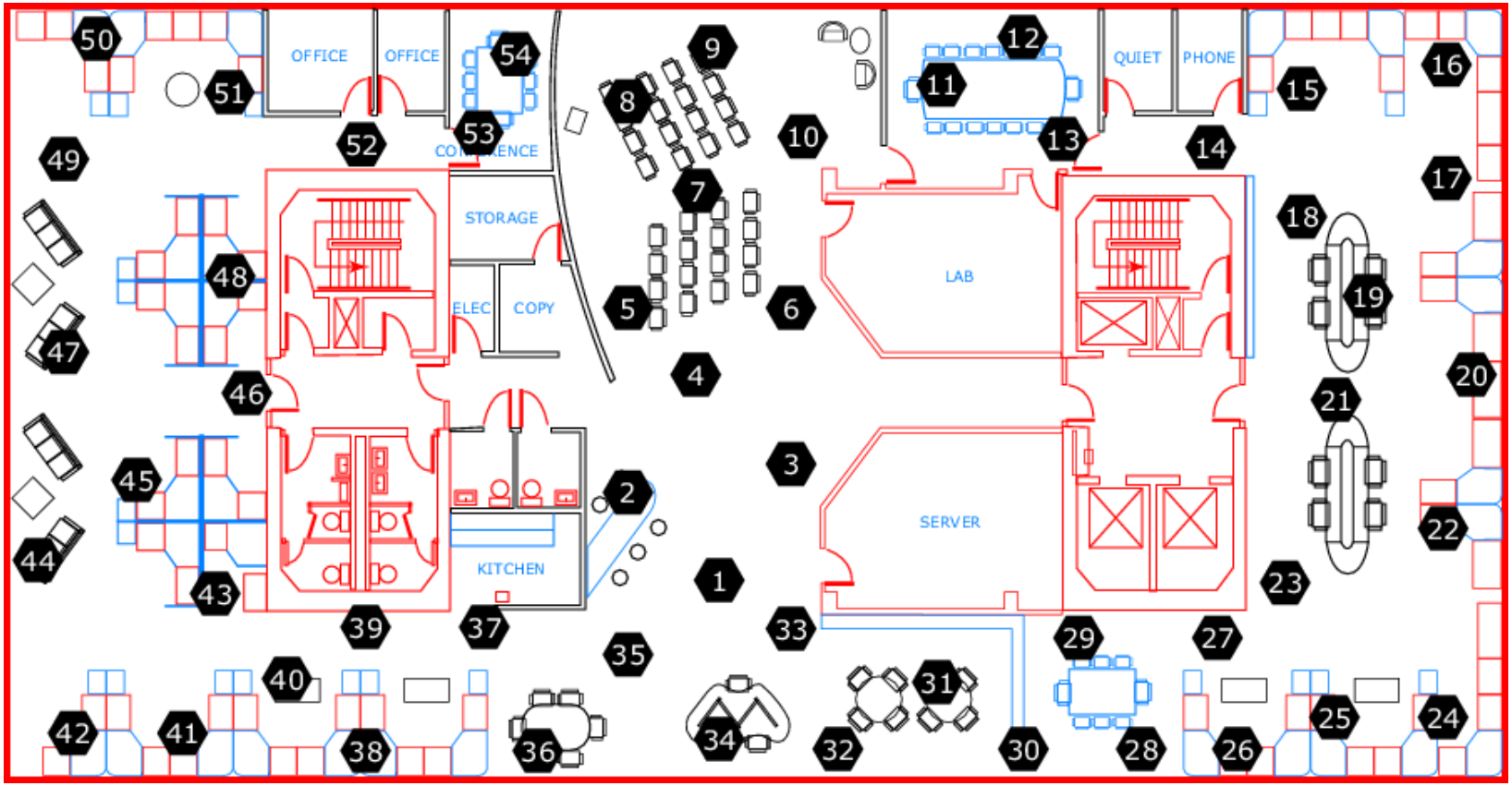
Database Hierarchy



Security

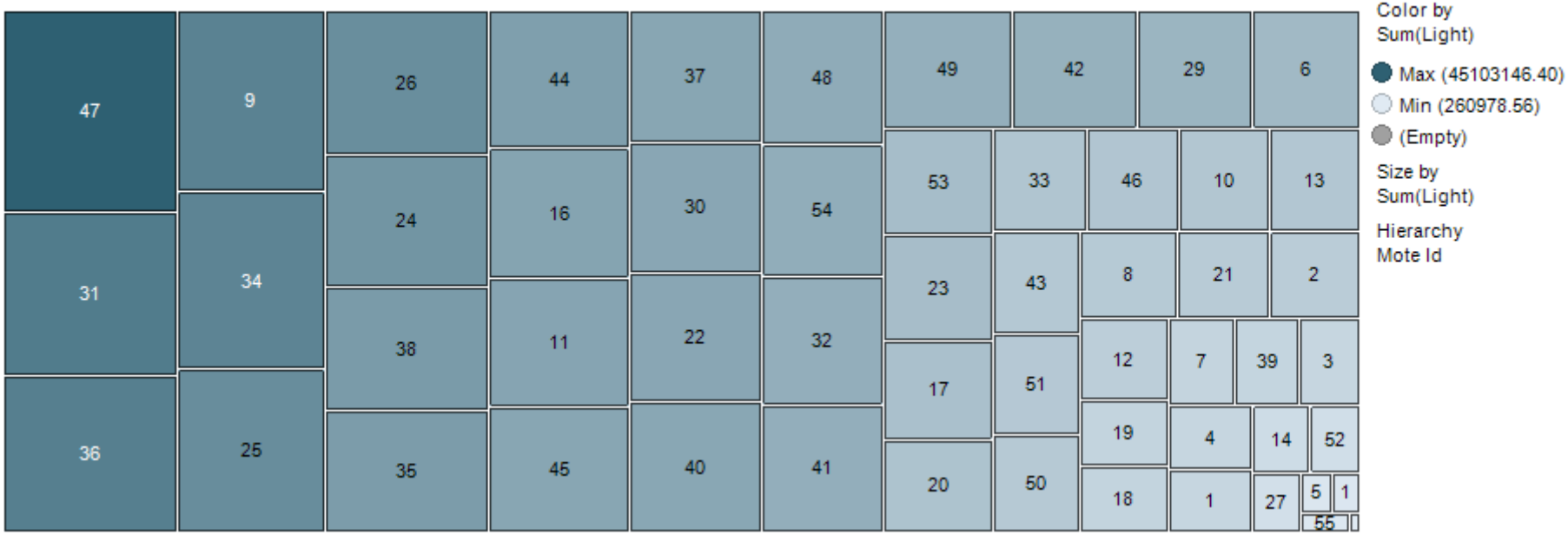
- Using VPN to connect the hub to the server
  - Reliable
  - Secure, Encrypted
- Making sure to lock permissions on the hub
- 30,000 websites are hacked a day

Intel Lab Data

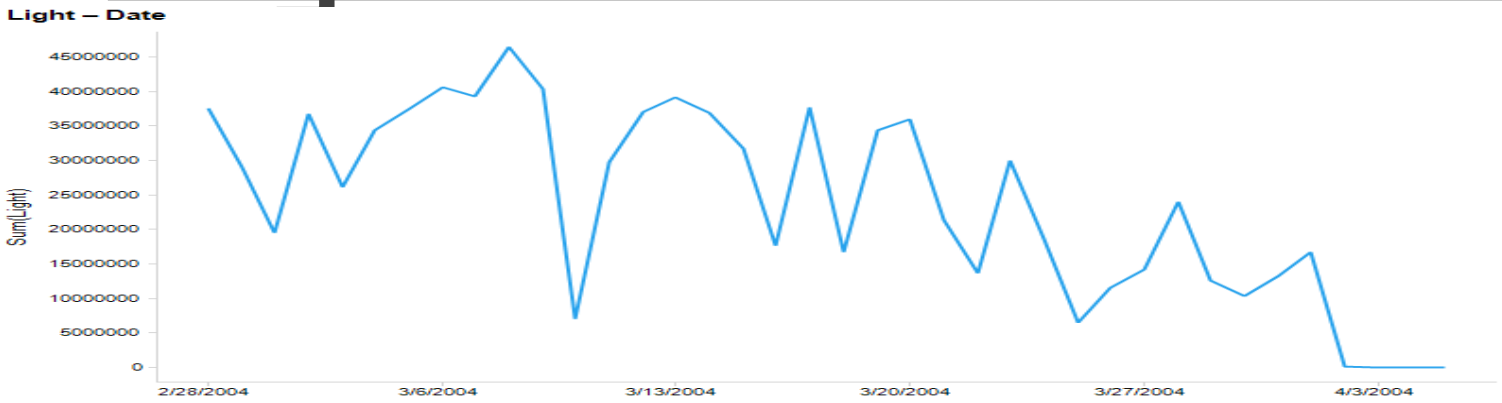


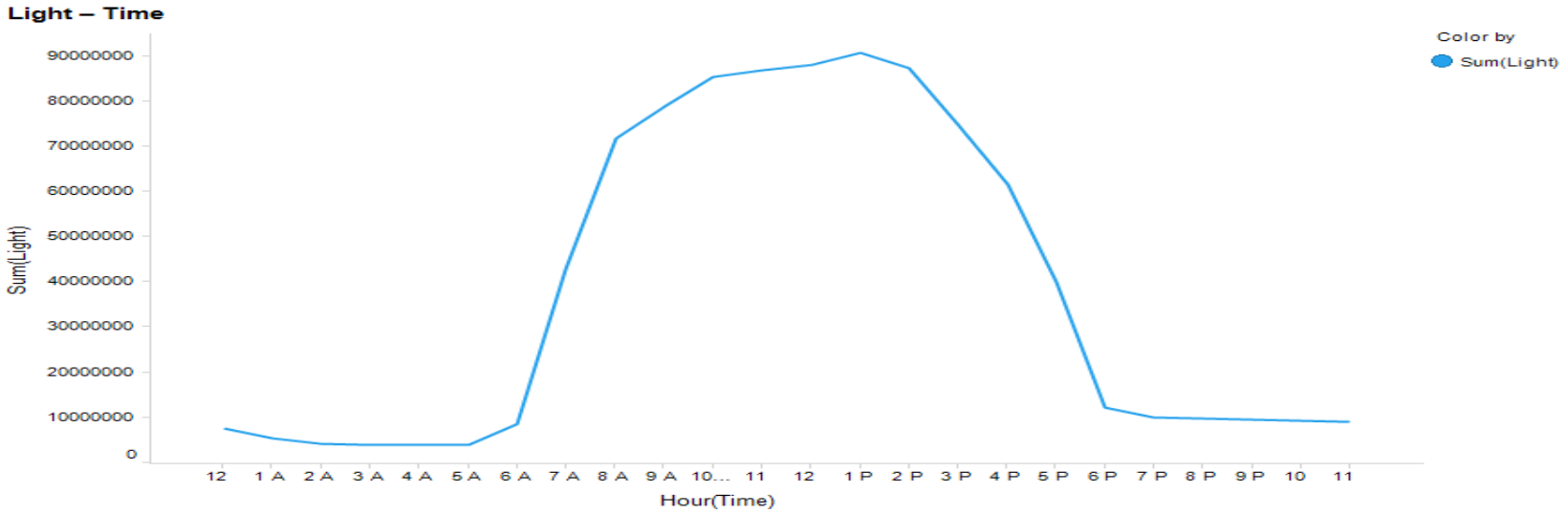
Machine Learning

Light per Mote Id

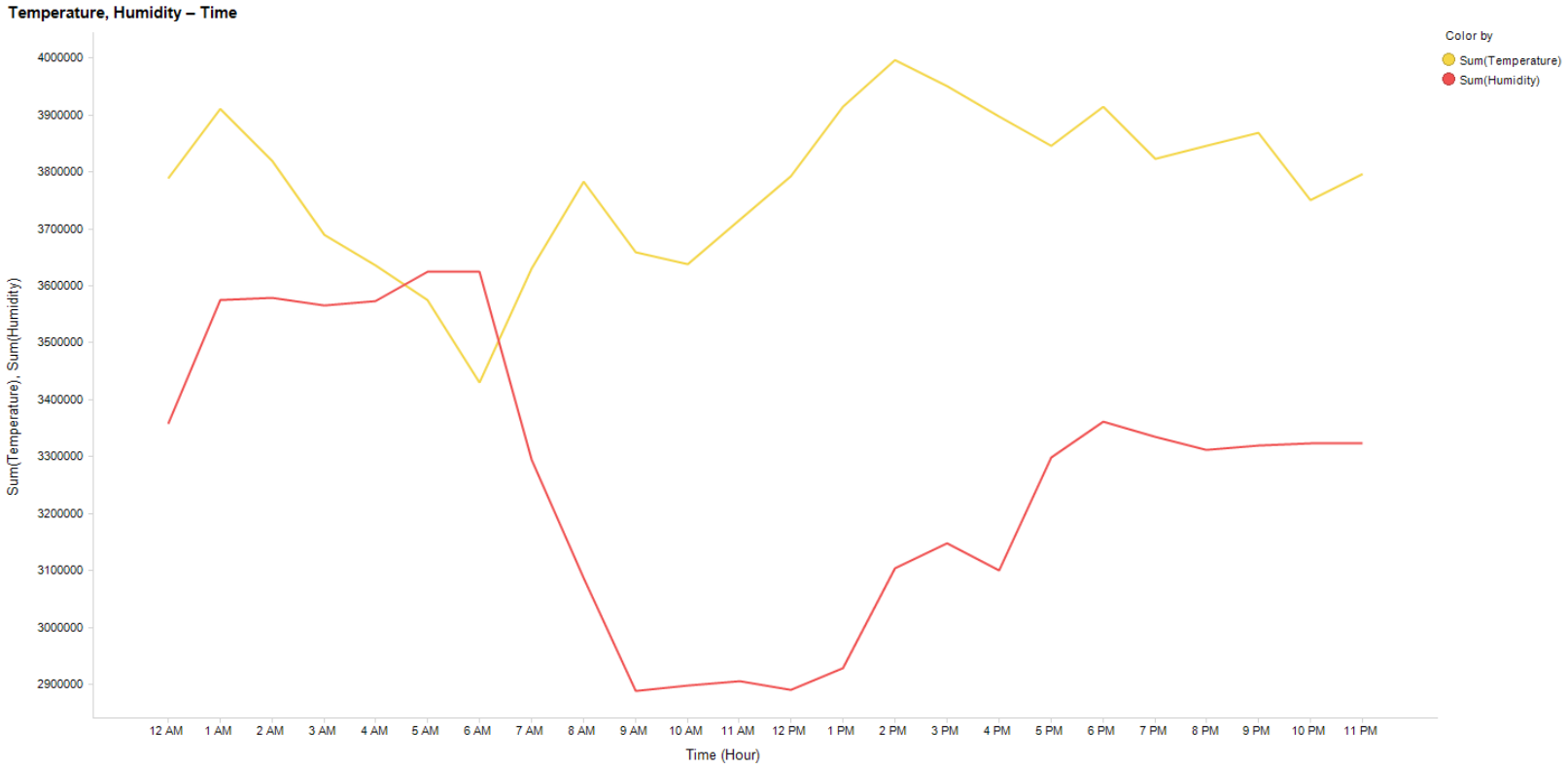


Light Balance

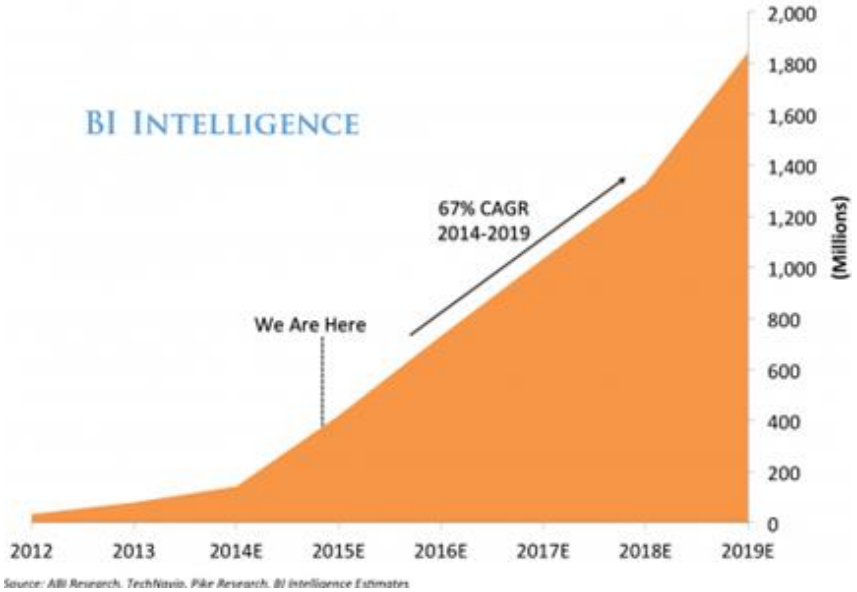




Temperature and Humidity



Business Case



- Home Automation: estimated worth 9-12 million USD
- Big-name competitors: Apple's HomeKit and Samsung's Smart Home
- Why choose SimpleHome?

Budget

- Projected Costs

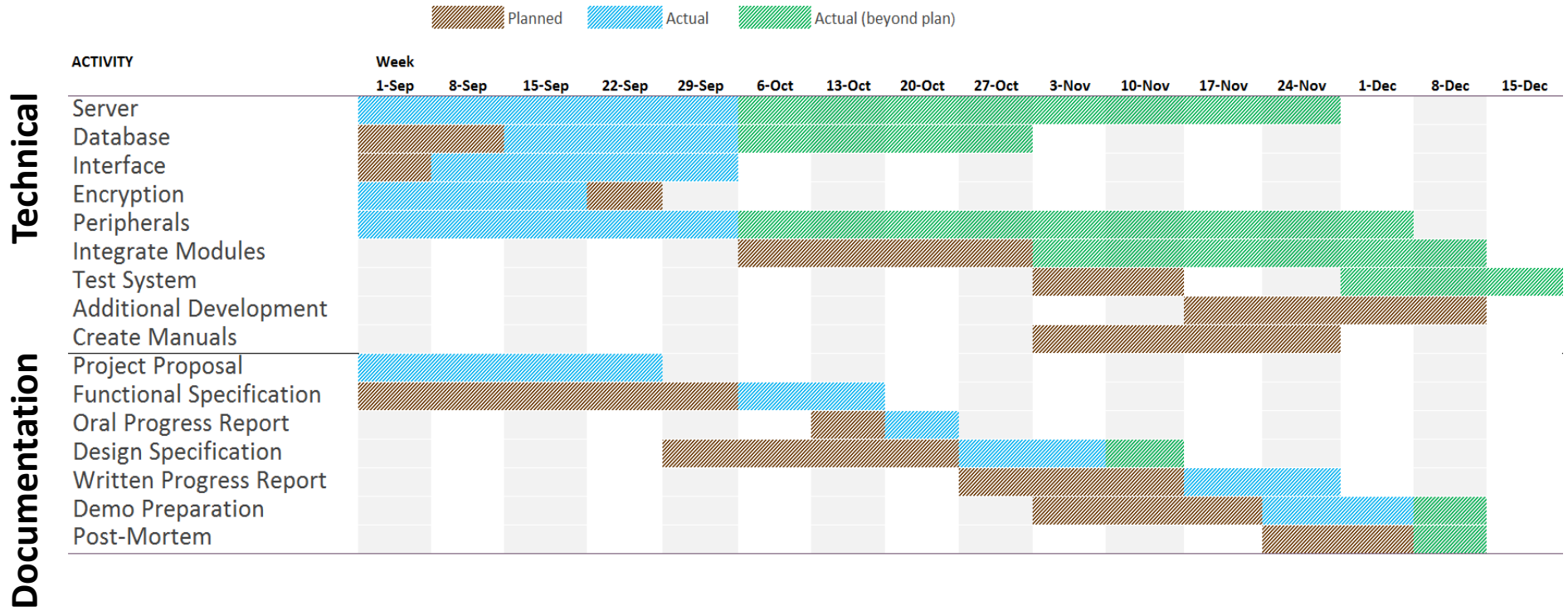
Item	Description	Qty.	Cost Estimate ($)		
			Unit	Subtotal	Total
1	BeagleBone Black Board RevC	2	80.00	160.00	**160.00**
2	TI WL1835MOD Wifi with chip antenna	1	50.00	50.00	**50.00**
3	Xbee Module	2	17.00	34.00	**34.00**
4	ZigBee HomeAutomation Gateway	1	49.00	49.00	**49.00**
5	3D Printed Hub Case	1	10.00	10.00	**10.00**
6	GE Link Bulb	1	25.00	25.00	**25.00**
7	Electrical Test Board:	1	51.75	51.75	**51.75**
8	Relay Switch Module:	1	15.50	15.50	**15.50**
9	Temperature Sensor Module:	1	16.75	16.75	**14.75**
10	Alarm Module:	1	16.75	16.75	**16.75**
11	Automated Blinds	1	116.75	116.75	**116.75**
12	Automated Sprinkler Valve	1	46.75	46.75	**46.75**
13	Smart Device	1	127.75	127.75	**127.75**
14	Thermostat	1	100.00	100.00	**100.00**
15	Termination and Connection Hardware	1	12.00	12.00	**12.00**
				subtotal	830.00
				10% Shipping	83.00
				20% Contingency	166.00
				Total Estimated Cost	1079.00

Budget

- Actual Costs and Funding

Item	Description	Amount ($)
	EXPENSES	
1	BeagleBone Black and Accessories	218.00
2	Zigbee Peripheral	283.00
3	Test Boards	7.00
4	Switch Peripheral	30.50
5	Temperature Sensor Peripheral	36.50
6	Automated Blinds	137.00
7	Thermostat Peripheral	183.00
8	Engineering Journals	40.00
9	Application Costs for Funding	27.00
10	Presentation Setup	27.00
	Total Costs	**989.00**
	FUNDING	
11	IEEE Canadian Foundation	820.00
12	ESSEF	550.00
	Total Funding	**1370.00**
	Remaining Total	**381.00**

Timeline


Planned
Actual
Actual (beyond plan)
ACTIVITY
Week
1-Sep
8-Sep
15-Sep
22-Sep
29-Sep
6-Oct
13-Oct
20-Oct
27-Oct
3-Nov
10-Nov
17-Nov
24-Nov
1-Dec
8-Dec
15-Dec
Technical
Server
Database
Interface
Encryption
Peripherals
Integrate Modules
Test System
Additional Development
Create Manuals
Documentation
Project Proposal
Functional Specification
Oral Progress Report
Design Specification
Written Progress Report
Demo Preparation
Post-Mortem

We Did Not Kill Each Other

"When you're feeling overworked, stop and smell the roses that we installed as an app on your BlackBerry."

Project Wrap Up

What We Learned

- Teamwork and Communication
- Website and Database
- Home Automation
- Zigbee Protocol
- Hardware Development
- Integration

Acknowledgements

- Dr. Andrew Rawicz
- Steve Whitmore
- Lukas-Karim Merhi
- IEEE Canadian Foundation and ESSEF for helping fund our project

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Questions