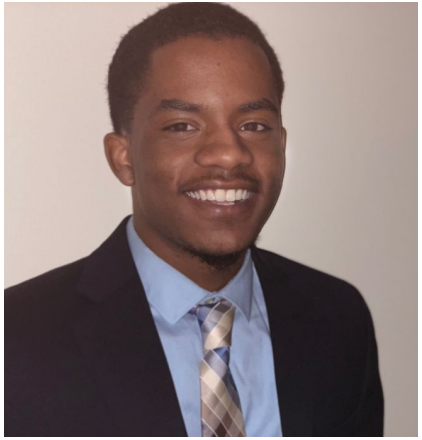
LoadOut: MDR

SDP21 Team 12

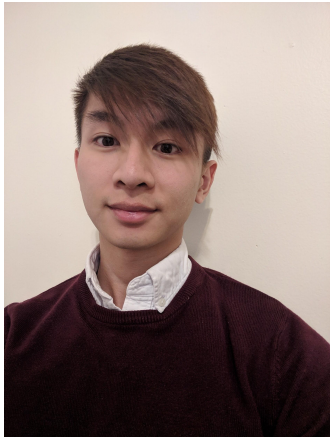
The LoadOut Team

Neyissa Exilus
CompE
Budget Management Lead
User Interface Lead



Smeel Milien
CompE
Website Lead
Processing Lead

Joshua Teixeira
CompE
Team Coordinator
RFID Lead



Wilson Tran
CompE
Altium Lead
Sensing Lead

MOTIVATION

Ever went on a trip and realized mid-way that you forgot to pack something in your luggage? A charger, battery, or maybe a toothbrush? Ever wonder what happens to your luggage and valuables once you check your bag? Traveling can be stressful when you forget to pack certain essentials or when your items are damaged and you have no proof for an insurance claim.

PROBLEM STATEMENT

People have trouble remembering what they need to pack for specific events. A person may have one list of items they need to pack each time they go home for the weekend, and a another list for when they are just leaving their home. LoadOut will provide the ability to make persistent interchangeable lists and will passively update what items the person has packed, and notify the user if an item is missing.

Additionally, LoadOut can provide functionality for monitoring metadata of the bag's journey, such as recording intrusions and substantial drops that could have damaged objects.

PROPOSED SOLUTION: LoadOut

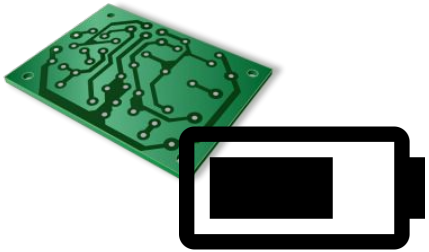
What is LoadOut?

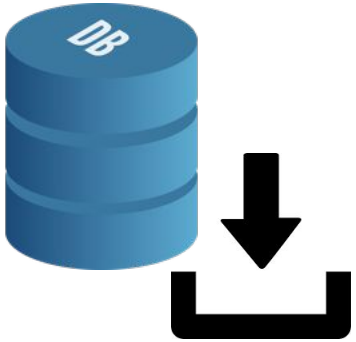
- LoadOut is a suitcase that uses RFID technology to help the user pack, allowing them to quickly swap between different “load out” lists of items.
- Using multiple sensors, LoadOut can detect when your luggage may have been compromised or mishandled and let you know when the event occured when you retrieve your case.

Features of LoadOut

- Create customizable sets for different travel cases (Family Trip / Business Trip..ect)
  - Add/Remove user-tagged items into a set
  - A recorded database of user items in SQL
- Drop/Mishandling Detection
- Interaction logs
- User-End experience application connected via Bluetooth

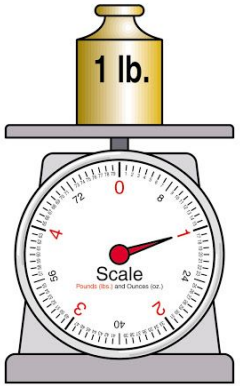
Updated System Specifications





PHYSICAL SPECIFICATIONS

- No more than 4lbs
- Device should be resilient to outside RFID interference
- Final Prototype will be easy to store and pack



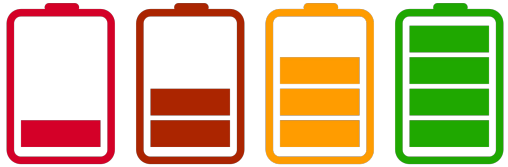
SOFTWARE SPECIFICATIONS

- User should be able to dynamically add/remove items from database and check if an item is in the bag when it is in close range

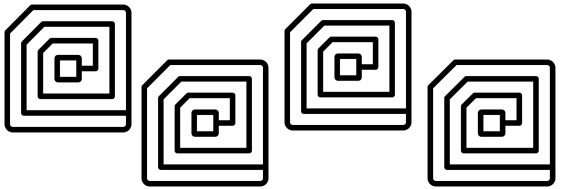
- Device should be capable of recording and storing information about the status of the items and bag while out of wireless range of the user
  - An interaction log will be recorded onto a SD card

HARDWARE SPECIFICATIONS

- Must have at least 12 hours of battery life



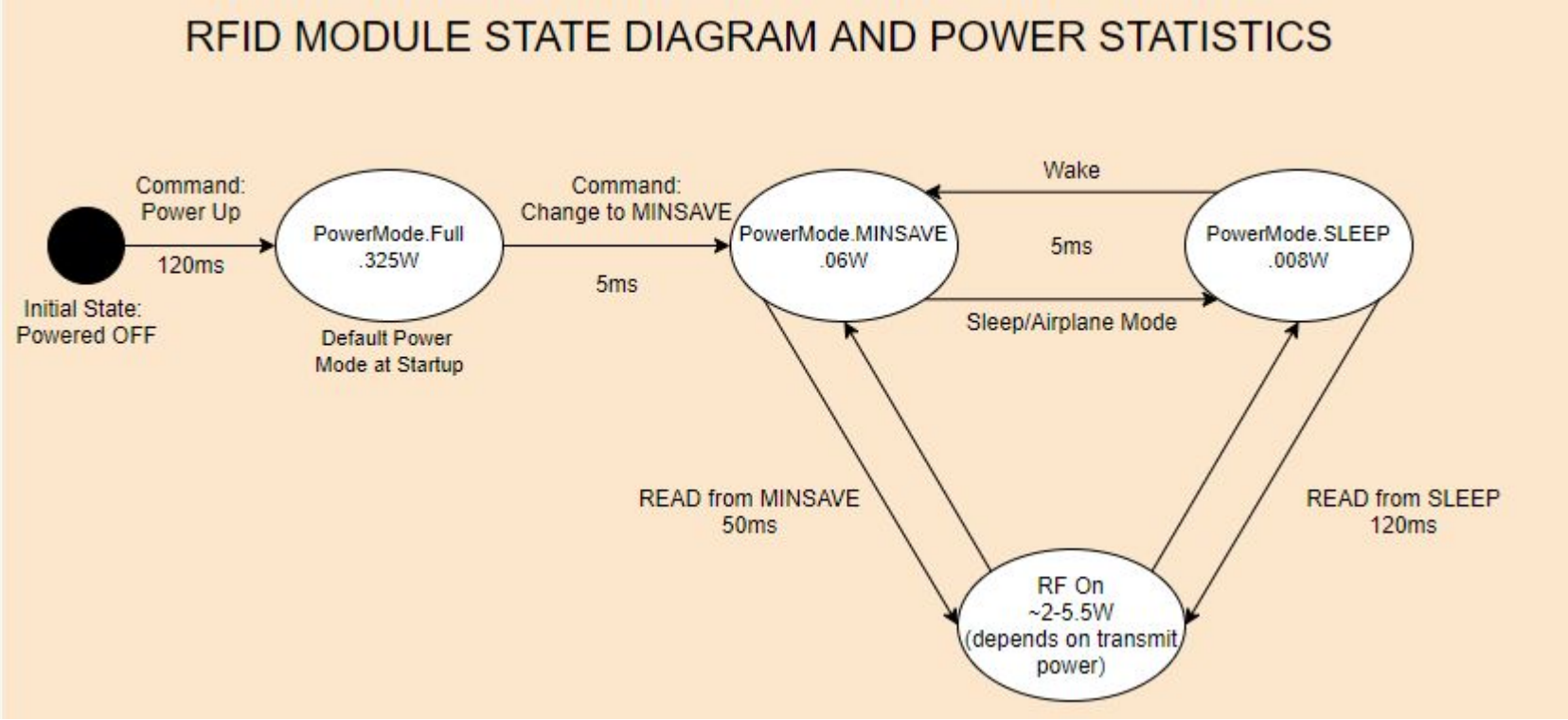
- Must be capable of tracking ~20 items without substantial error



- LoadOut should work in the presence of metals and liquids

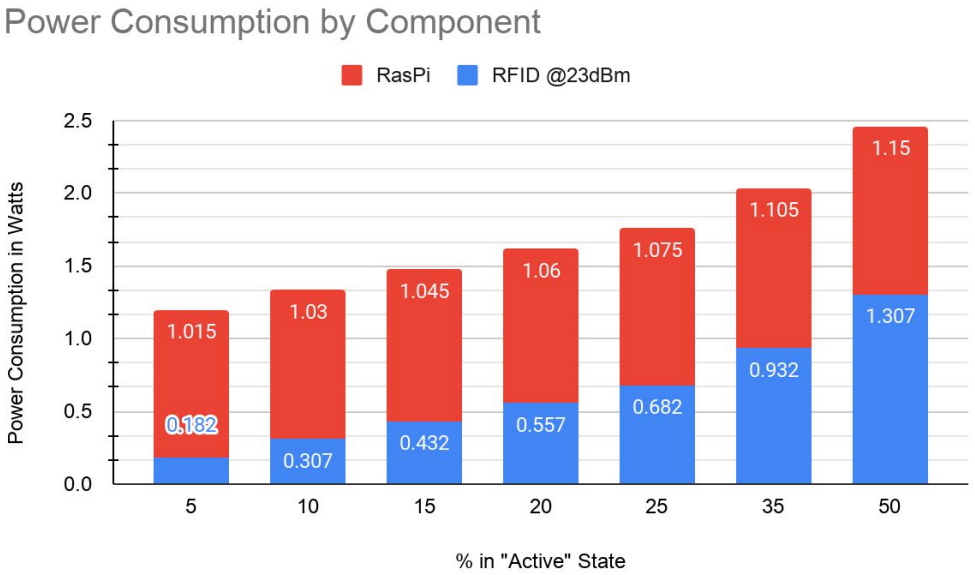
- Device should be able to determine if the container has been opened, and if so, if anything has been disturbed

POWER CONSIDERATIONS



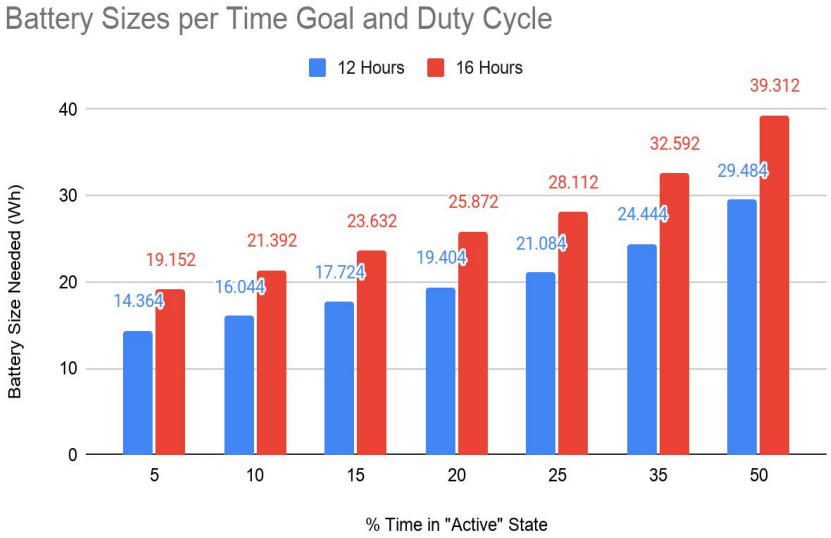
POWER CONSIDERATIONS (cont)

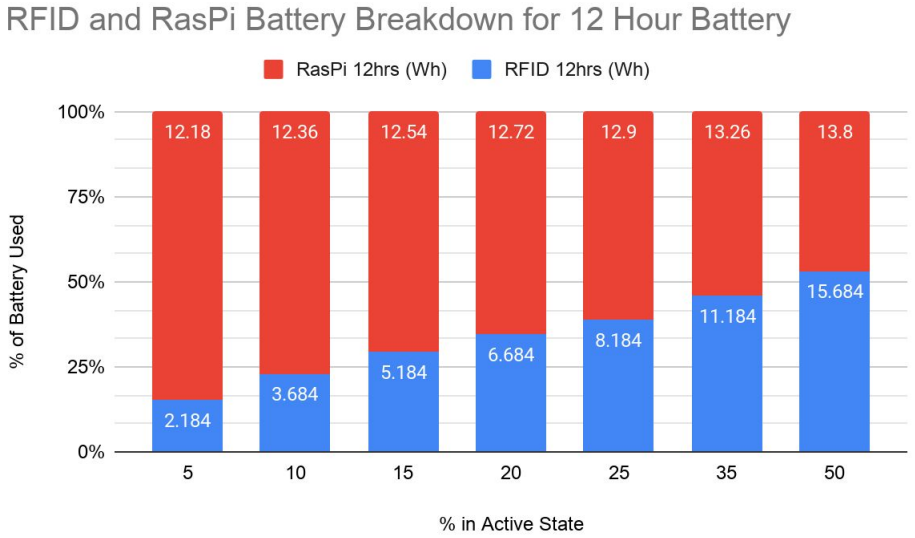
% Time in "Active State"	RF Strength (db)	RFID Power Consumption (watts)	RasPi Power Consumption (watts)	Sum (watts)	Wh to last 12hrs	Wh to last 16hrs
5	27	0.232	1.0150	1.2470	14.964	19.952
5	23	0.182	1.0150	1.1970	14.364	19.152
5	10	0.157	1.0150	1.1720	14.064	18.752
10	27	0.407	1.0300	1.4370	17.244	22.992
10	23	0.307	1.0300	1.3370	16.044	21.392
10	10	0.257	1.0300	1.2870	15.444	20.592
15	27	0.582	1.0450	1.6270	19.524	26.032
15	23	0.432	1.0450	1.4770	17.724	23.632
15	10	0.357	1.0450	1.4020	16.824	22.432
20	27	0.757	1.0600	1.8170	21.804	29.072
20	23	0.557	1.0600	1.6170	19.404	25.872
20	10	0.457	1.0600	1.5170	18.204	24.272
25	27	0.932	1.0750	2.0070	24.084	32.112
25	23	0.682	1.0750	1.7570	21.084	28.112
25	10	0.557	1.0750	1.6320	19.584	26.112
35	27	1.282	1.1050	2.3870	28.644	38.192
35	23	0.932	1.1050	2.0370	24.444	32.592
35	10	0.757	1.1050	1.8620	22.344	29.792
50	27	1.807	1.1500	2.9570	35.484	47.312
50	23	1.307	1.1500	2.4570	29.484	39.312
50	10	1.057	1.1500	2.2070	26.484	35.312



- We see at low duty cycle percentages the Pi consumes most of the power

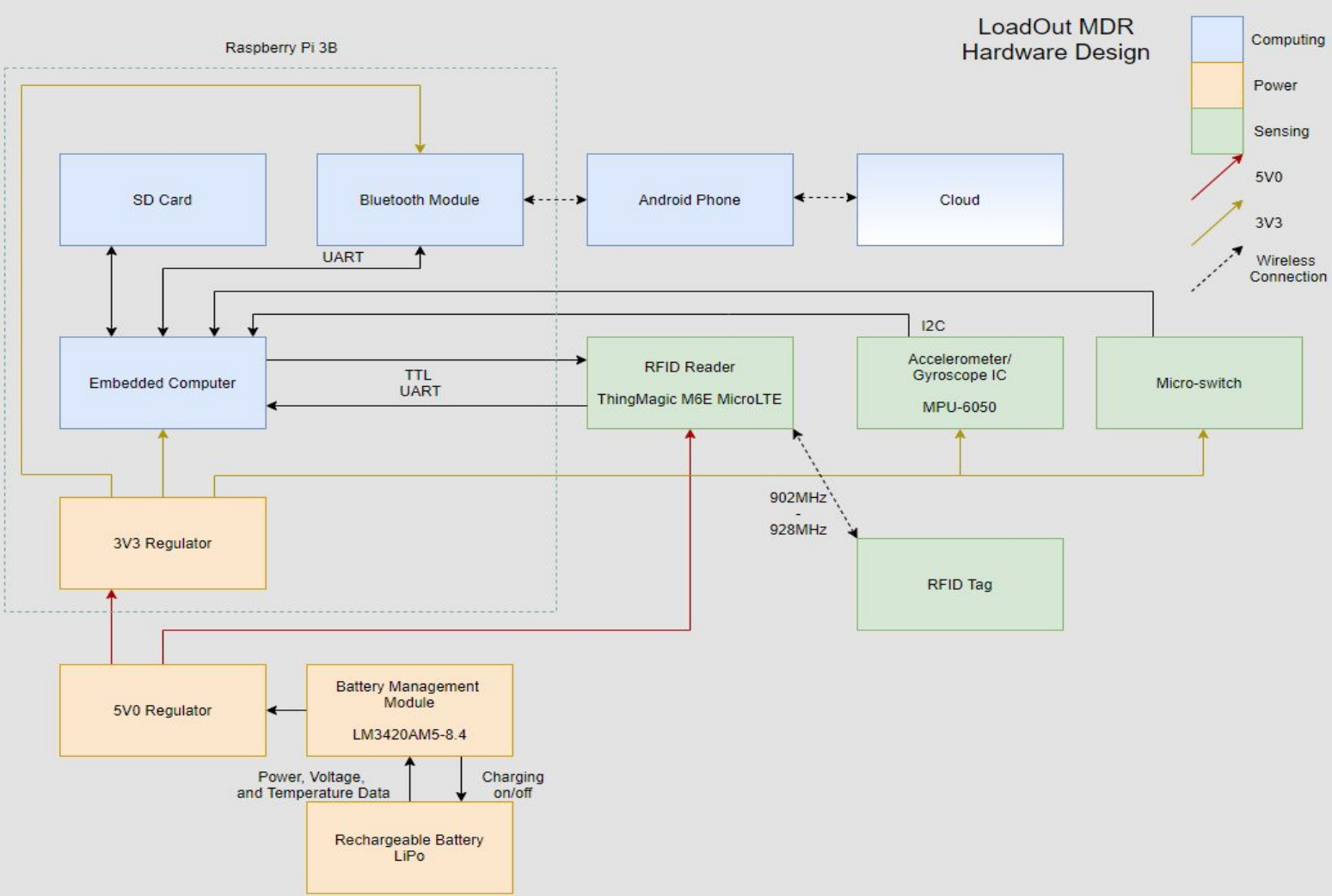
POWER CONSIDERATIONS (cont)



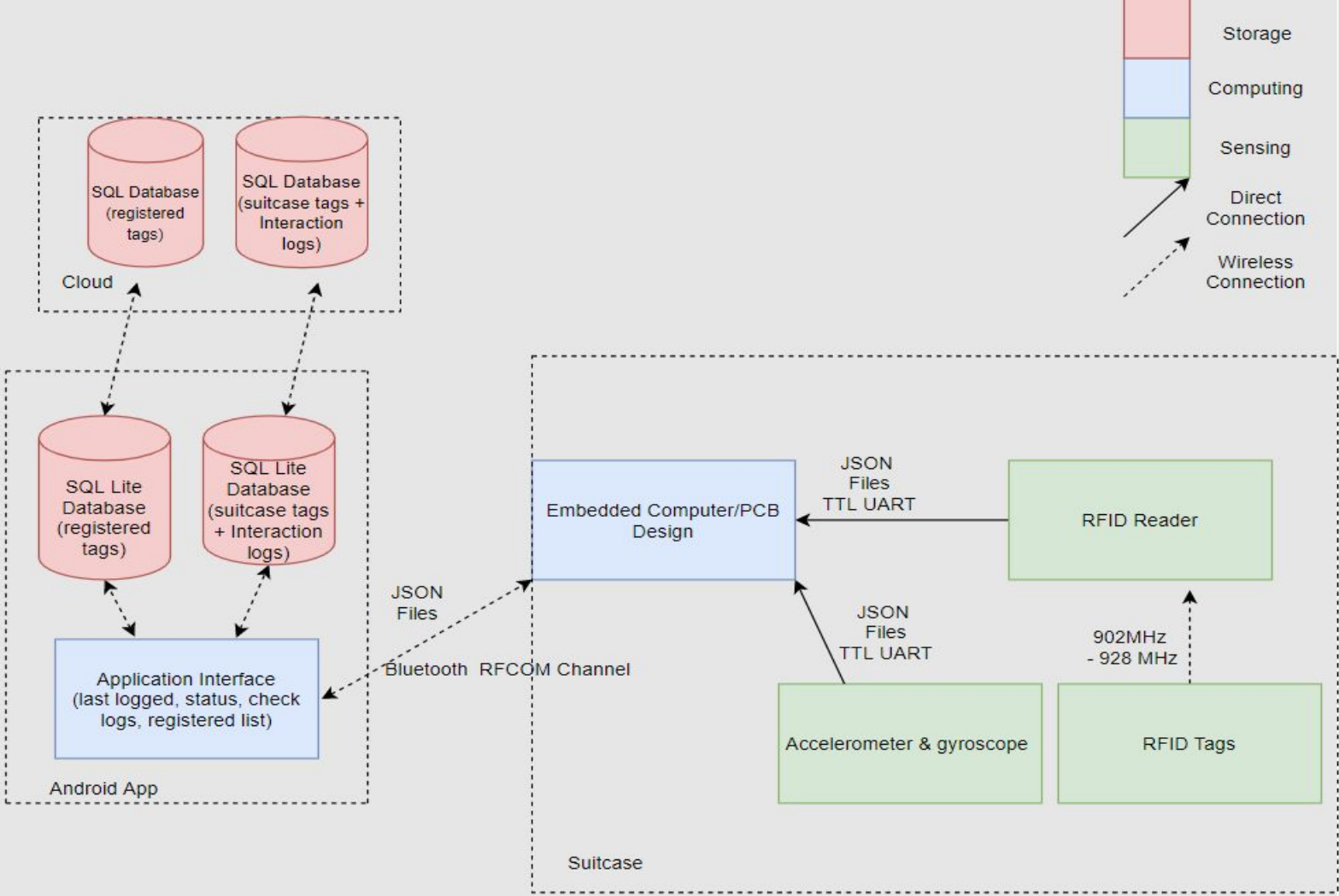


- At 10%, there is 72 minutes of read time, or 2160 read events
- LiPo batteries are well suited for our Wh needs, and weight restrictions
- The Pi is a meaningful target for optimization at low duty cycle percentages

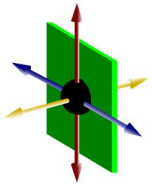
UPDATED HARDWARE DESIGN FLOWCHART:



UPDATED SOFTWARE DESIGN FLOWCHART:



MDR Deliverables



MDR Deliverables Update: JOSH

- "Configure RFID reading module to read and write to item tags, display information legibly for computing module"
  - Read program in Java outputs data in JSON format for processing suite

- "Create PCB prototype (shared task)"
  - As advised by the course coordinators, we transitioned from wanting to have the whole PCB designed to having a more general plan for the PCB.


```
{
"readEvent": [
{"RSSI":-63,"Phase":16,"Readcount":6,"EPC":"E2004078410B02151140A50F","Timestamp":"2020-11-10T17:48:16.519-0500"},
{"RSSI":-34,"Phase":70,"Readcount":8,"EPC":"E2004078410B02561140A558","Timestamp":"2020-11-10T17:48:16.388-0500"},
{"RSSI":-61,"Phase":45,"Readcount":5,"EPC":"E2004078410B02321140A528","Timestamp":"2020-11-10T17:48:16.513-0500"},
{"RSSI":-44,"Phase":165,"Readcount":7,"EPC":"E2004078410B02141140A507","Timestamp":"2020-11-10T17:48:16.523-0500"},
{"RSSI":-28,"Phase":45,"Readcount":8,"EPC":"E2004078410B02411140A540","Timestamp":"2020-11-10T17:48:16.508-0500"}
]}
```

JOSH'S DEMO VIDEO

MDR Deliverables Update: WILSON

- “Accelerometer & Gyroscope sensor extraction + processing”
  - Extract Accelerometer & Gyroscope data
  - Drop detection
  - Output events into a JSON file for processing
  - Additional feature: Micro-switch detection

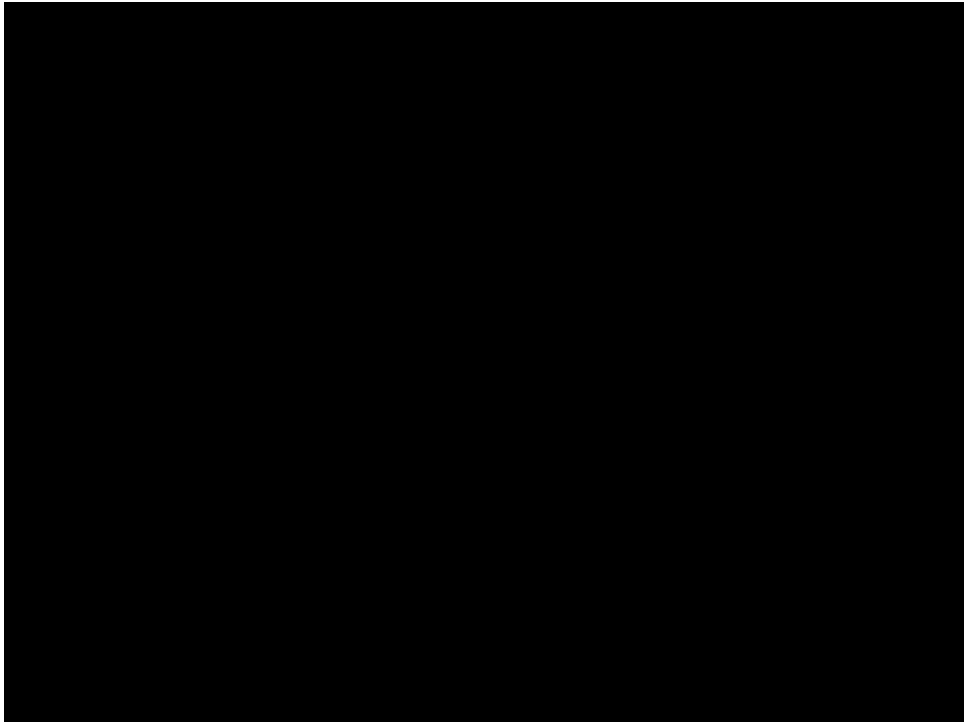
- “Create PCB prototype (shared task)”
  - As advised by the course coordinators, we transitioned from wanting to have the whole PCB designed to having a more general plan for the PCB.

WILSON'S DEMO VIDEO

MDR Deliverables Update: SMEEL

- Implemented a simple android Application to Connect to Raspberry pi and receive data.
- Established an RFCOMM channel for communication between a process running on the raspberry pi and android application
- Successfully sent RFID data and sensing data as a JSON file to the android application for the Interface Module

SMEEL'S DEMO VIDEO

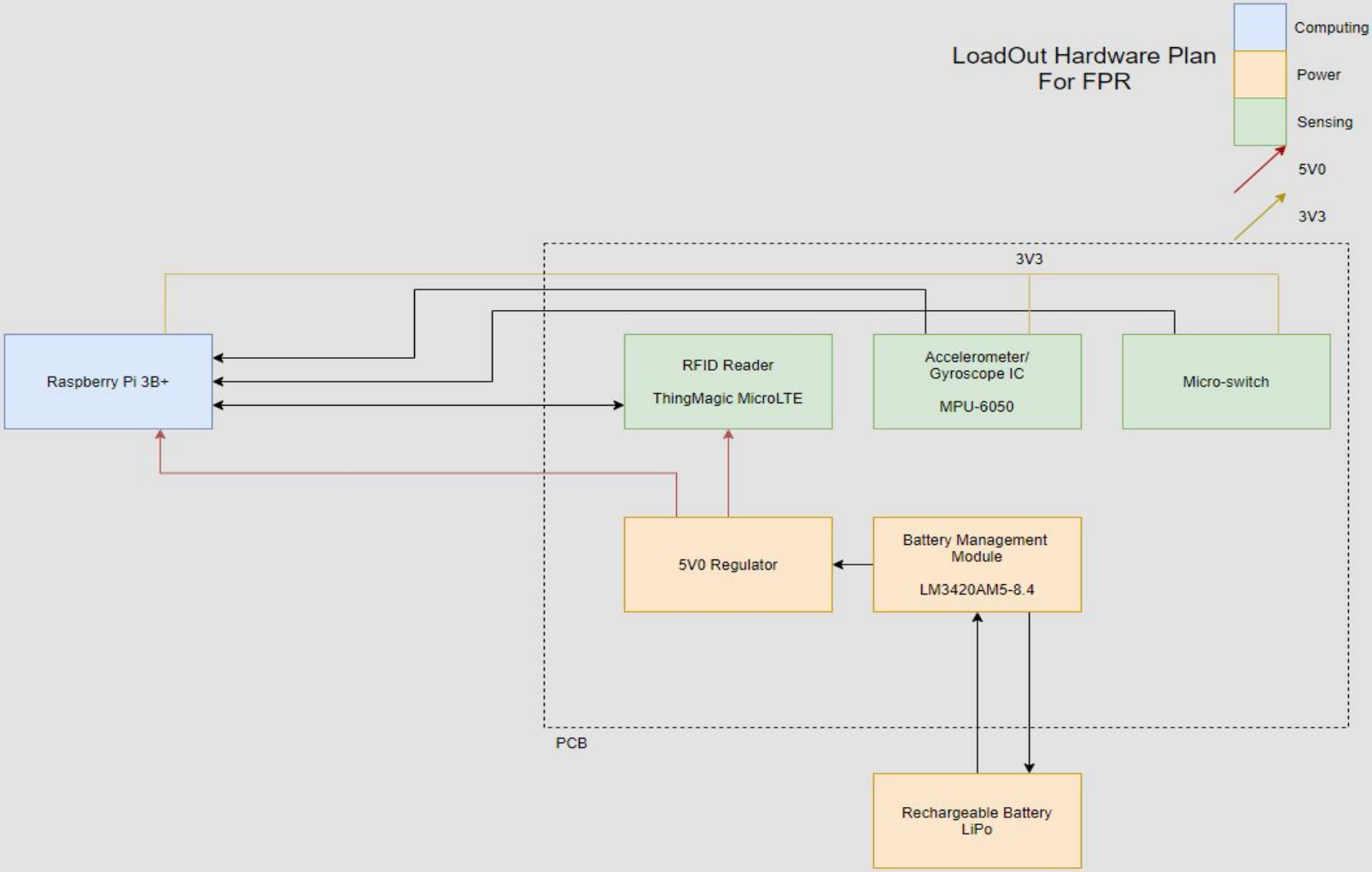


MDR Deliverables Update: NEYISSA

- Implemented an android studio application which allow user to enter items for a trip
  - These items are mapped to a tag ID and stored in a SQLite Database
- Modeling data coming from the Raspberry Pi and displayed it on the app
  - This data is stored in a different SQLite Database
- Compare the two databases

NEYISSA'S DEMO VIDEO

HARDWARE PLAN FOR FPR:



LIST OF HARDWARE AND SOFTWARE

RFID Module (Josh):

- Hardware
  - Micro-LTE RFID Developer Kit
- Software
  - Mercury API
  - Netbeans Java IDE
  - Altium

Sensing Module (Wilson):

- Hardware
  - MPU-6050 on Breakout board
  - Microswitch
  - Raspberry Pi 4
- Software
  - Python 3 (Thonny IDE on Raspberry PI OS)
  - Altium

Processing Module (Smeel):

- Hardware
  - Raspberry Pi
- Software
  - Python
  - Android Studio

User Interface Module (Neyissa):

- Hardware
  - Phone (user owns)
- Software
  - Android Studio
  - Microsoft Azure

COST ESTIMATES

Items	Our Cost	Cost Estimate Qty 1	Cost Estimate Qty 1000
ThingMagic M6E Micro LTE UHF RFID Reader	$243.00	$243.00	$201.89
Development Board	Loaned	$792.00	$0.79
Antennas	$50.29	$50.29	$34.66
Coaxial Cable	(2) $11.40	$5.70	$5.70
RFID Tags (25)	$8.44	$8.44	$3.04
Raspberry Pi	Loaned	$35.00	$35.00
16GB SD Card	Loaned	$6.19	$3.05
Suitcases	Loaned	$30.00	$5.20
RFID Insulation	Loaned	$3.41	$1.50
Accelerometer	Loaned	$7.55	$3.71
Gyroscope	Loaned		
Breadboards	(2) Loaned		
Battery Controller	(2) $13.30	$6.65	
PCBs (not ordered yet)	(2) ~ $116.00	$58.00	$1.89
Other Expenses	27.64	(No longer needed components, shipping, tarrifs)	
	(without dev board)	$454.23	$295.63
TOTALS	$354.07	$1,246.23	$296.43
Cash Remaining	$145.93		
Cash After Estimated PCB Costs	$29.93		

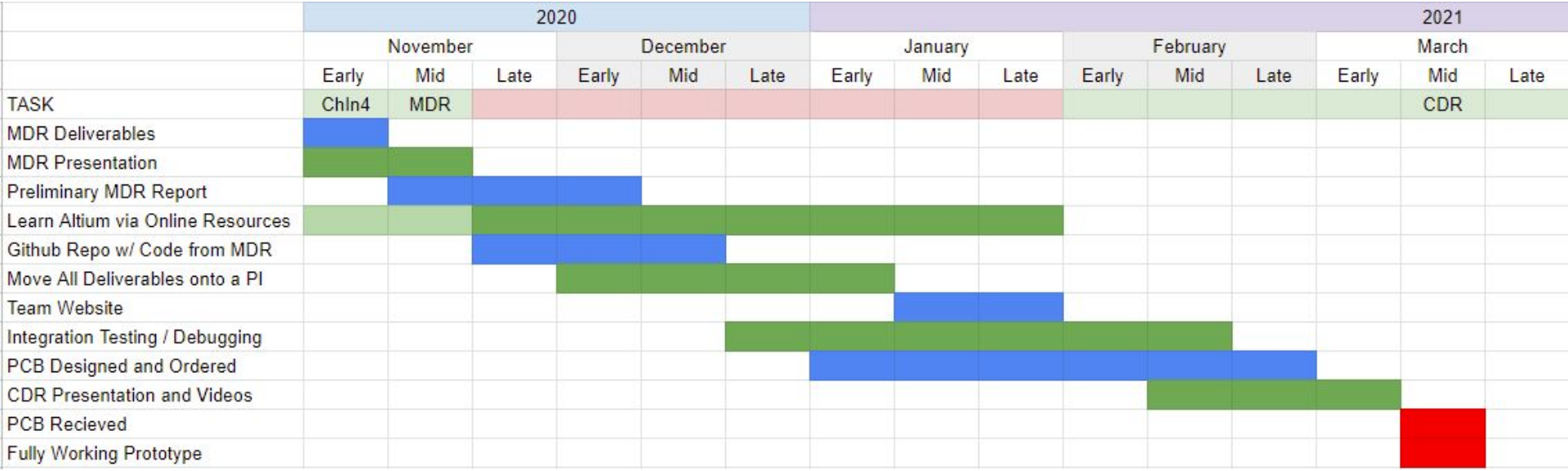
The extreme bulk of the x1000 QTY cost is the RFID reader, with merely $94.54 making up the rest of the cost

PROJECT MANAGEMENT

Team Responsibilities:

- Team Coordinator: Josh
- Altium Lead: Wilson
- Budget Management Lead: Neyissa
- Online Presence Lead: Smeel
- Technical Responsibilities
  - Josh: RFID Program/API running on PI, Design work on PCB
  - Wilson: Sensor data extraction & event log output, Design work on PCB
  - Smeel: Storing and Processing data on Raspberry Pi, Delivering Data to Android app via bluetooth.
  - Neyissa: Getting data from Raspberry Pi and complete user interface

PROJECT MANAGEMENT



Thank you!