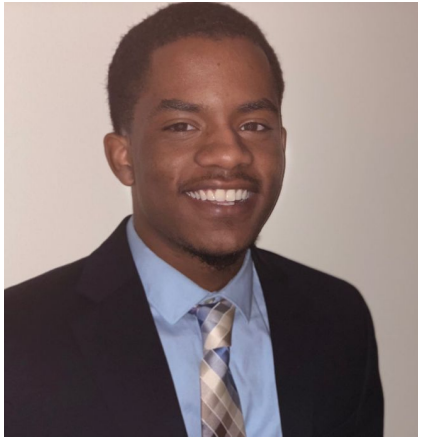
LoadOut: CDR

SDP21 Team 12

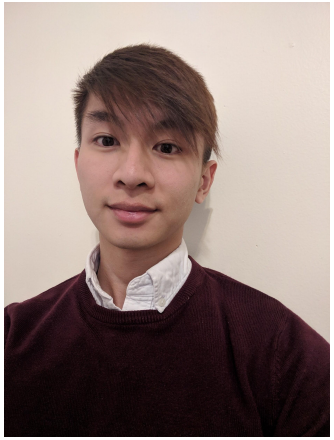
The LoadOut Team

Neyissa Exilus
CompE
Budget Management Lead
User Interface Lead



Smeel Milien
CompE
Online Presence Lead
Processing Lead

Joshua Teixeira
CompE
Team Coordinator
RFID Lead



Wilson Tran
CompE
Altium Lead
Sensing Lead

MOTIVATION

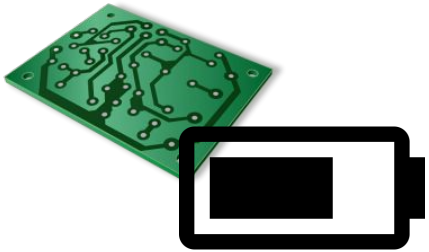
Ever went on a trip and realized mid-way that you forgot to pack something in your luggage? A charger, battery, or maybe a toothbrush? Ever wonder what happens to your luggage and valuables once you check your bag? Traveling can be stressful when you forget to pack certain essentials or when your items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

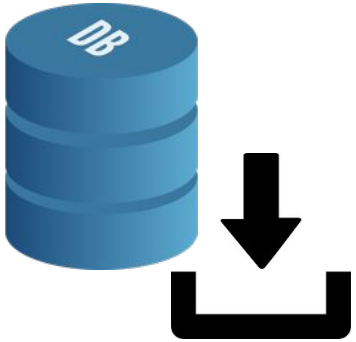
PROBLEM STATEMENT

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.

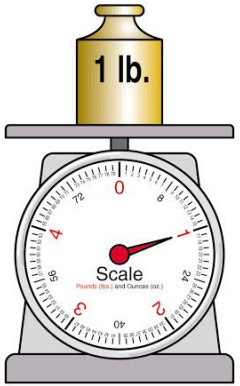
Updated System Specifications





PHYSICAL SPECIFICATIONS

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



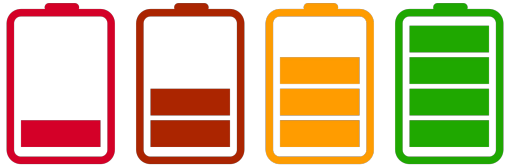
SOFTWARE SPECIFICATIONS

- 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

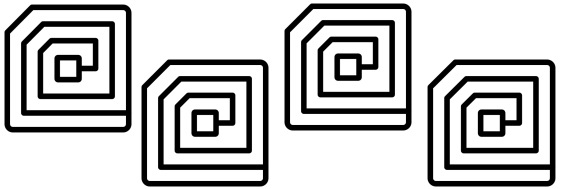
- Device should be capable of recording and storing information about the status of the items and bag while out of wireless range of the user
  - An interaction log will be recorded onto a SD card

HARDWARE SPECIFICATIONS

- Must have at least 12 hours of battery life



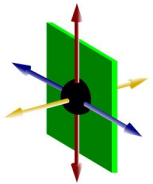
- Must be capable of tracking ~20 items without substantial error



- 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

CDR Deliverables



CDR DELIVERABLES AS SUBMITTED IN ECE 415

Team:

- Functioning Prototype
  - Each of the group member's modules will be integrated such that a user can
    - 1. Create LoadOut lists in the UX Android App
    - 2. RFID module will scan and detect items in the suitcase
    - 3. Sensing module will detect the case opening and drop events
    - 4. These data points from (2) and (3) will be uploaded to the phones local database to be displayed on the App from (1)
  - All of this in one implementation in real time with real data
- Blank PCB (at least)
  - Wilson and Josh will create a schematic document in Altium and send that document to be printed with enough time in advance to receive the boards back before CDR (March 8th-12th 2021).

Josh:

- Team Coordinator
- RFID Lead
- Altium schematic
- Battery

- Josh will work with Wilson to create and order the PCBs through Altium
- Josh will work with the other team members to determine their overall power needs in combination with the Raspberry Pi's and RFID module and then order an appropriate battery
- Josh will ensure the Mercury API can be ran on a Raspberry Pi by consulting documentation obtained from Jadak engineers

Neyissa:

- Budget Management Lead
- User Interface Lead

- Neyissa will create a fully functional application with all the necessary features.
- Neyissa will synchronize SQLite databases with Azure SQL databases.

Smeel:

- Online Presence Lead
- Processing Lead

- Smeel will create a Website containing all the project information
- Smeel will create a GitHub repository for all components of the project

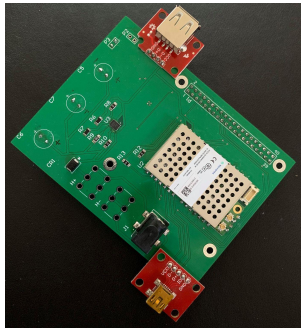
- Smeel will work with josh to create process that will run on pi to issue read request, receive and deliver data to phone in real time
- Smeel will work with Wilson to create a process to detect interaction log events and deliver it to the phone in real time
- Smeel will implement an error checking mechanism to ensure data is properly getting transferred.

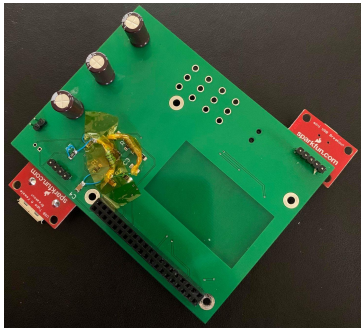
Wilson:

- Altium Lead
- Sensing Lead
- Wilson will be coordinating with Josh in creating a PCB schematic
- Wilson will implement a script for Airplane mode detection on LoadOut
- Wilson will implement interrupt functions to reduce power consumption

CDR Deliverables Update: JOSH

- Create and order PCBs through Altium
  - Schematic created, worked with Wilson on layout, have PCBs in hand and just about populated. In testing phase.





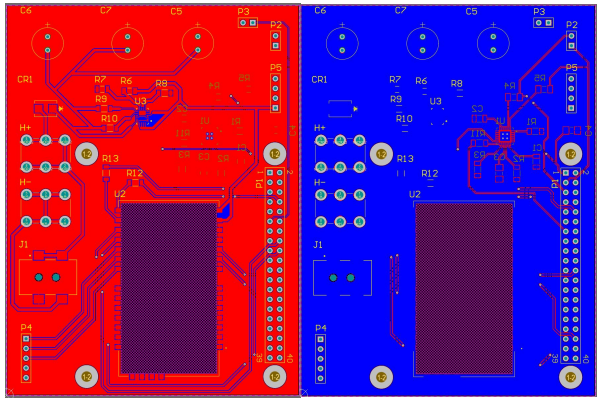
- Determine power needs and order battery
  - Battery is in hand

- Configure MercuryAPI to run on Raspberry Pi
  - MercuryAPI and RFID subsystem are fully integrated into Raspberry Pi

CDR Deliverables Update: WILSON

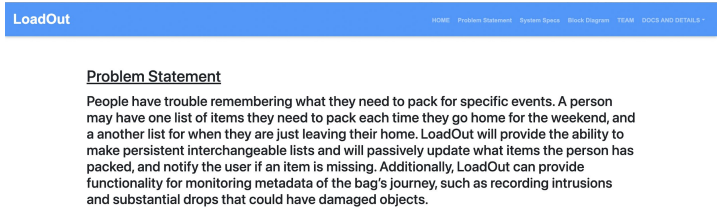
- Create and order PCB through Altium
  - Figured the layout of the PCB with Joshua and created the PCB through Altium
  - PCB is currently populated and in process of integration

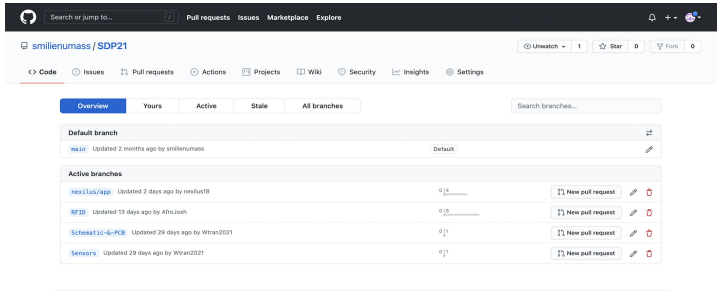
- Power Consumption optimization
  - Raspberry Pi 4 does not have a sleep mode built in
  - Pseudo Low Powered state
    - Throttling CPU clock
    - Turning off onboard LEDs
    - Turning off HDMI ports
    - Turning off WiFi



CDR Deliverables Update: SMEEL

- Create a Website containing all the project information
  - Uploaded the project website
- Create a GitHub repository for all components of the project
  - Created the github repository for all the codes
- Work with Josh to create process that will run on pi to issue read request, receive and deliver data to phone in real time
  - Able read the tags and deliver the phone upon request in real time
- Work with Wilson to create a process to detect interaction log events and deliver it to the phone in real time
  - Able deliver logged events upon user request in real time
- Implement error checking mechanism to ensure data is properly getting transferred
  - Not finalized but was able to assert json file attributes via unit test
  - Planning performing more tests now that system is integrated for FPR

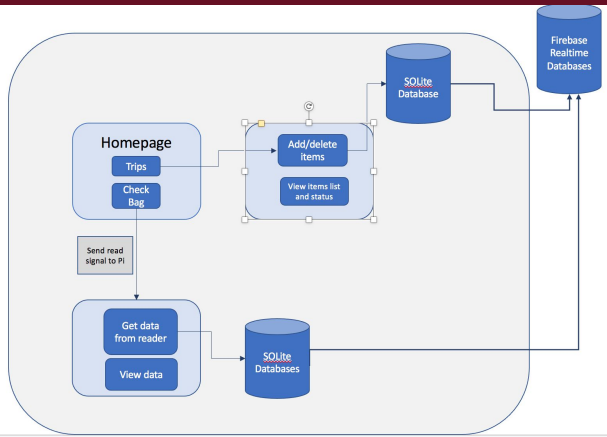


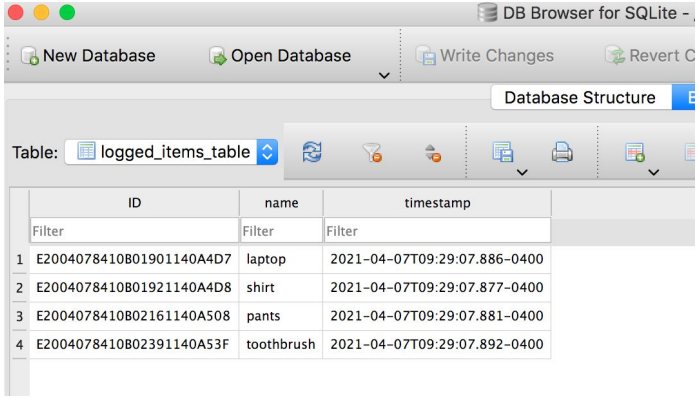


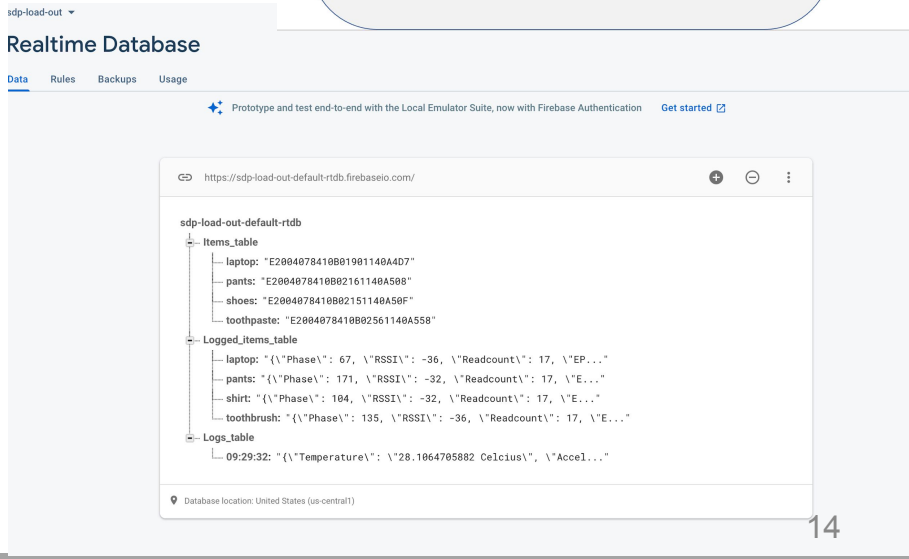
CDR Deliverables Update: NEYISSA

- Create a fully functional application with all the necessary features.
  - Most features are implemented, still need a register mode.

- Synchronize SQLite databases with Azure SQL databases.
  - Successfully synchronize application, but converted to FireBase Realtime Database

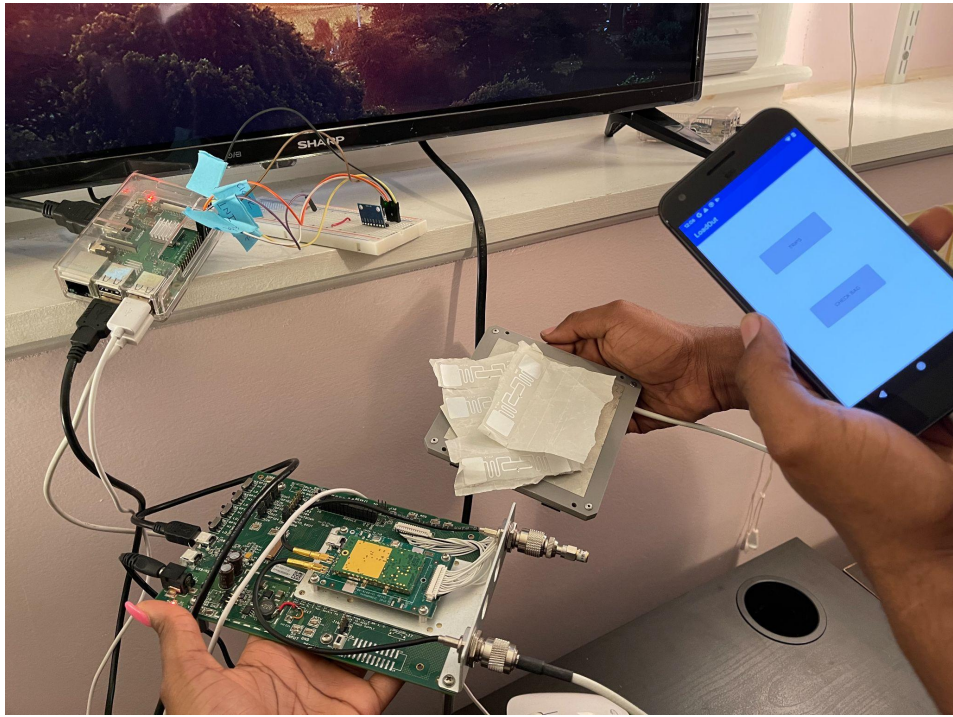




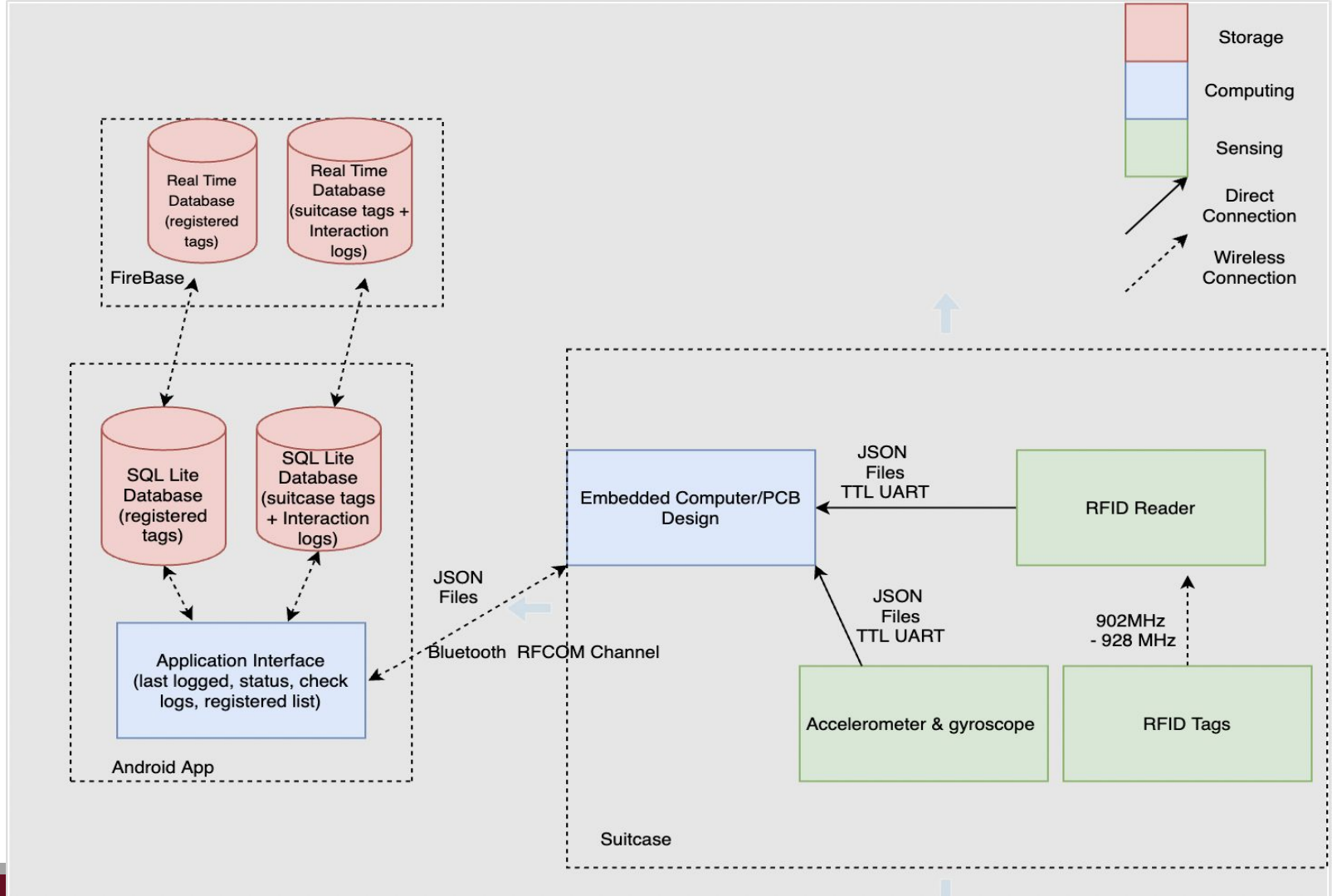


DESCRIPTION OF CURRENT PROTOTYPE

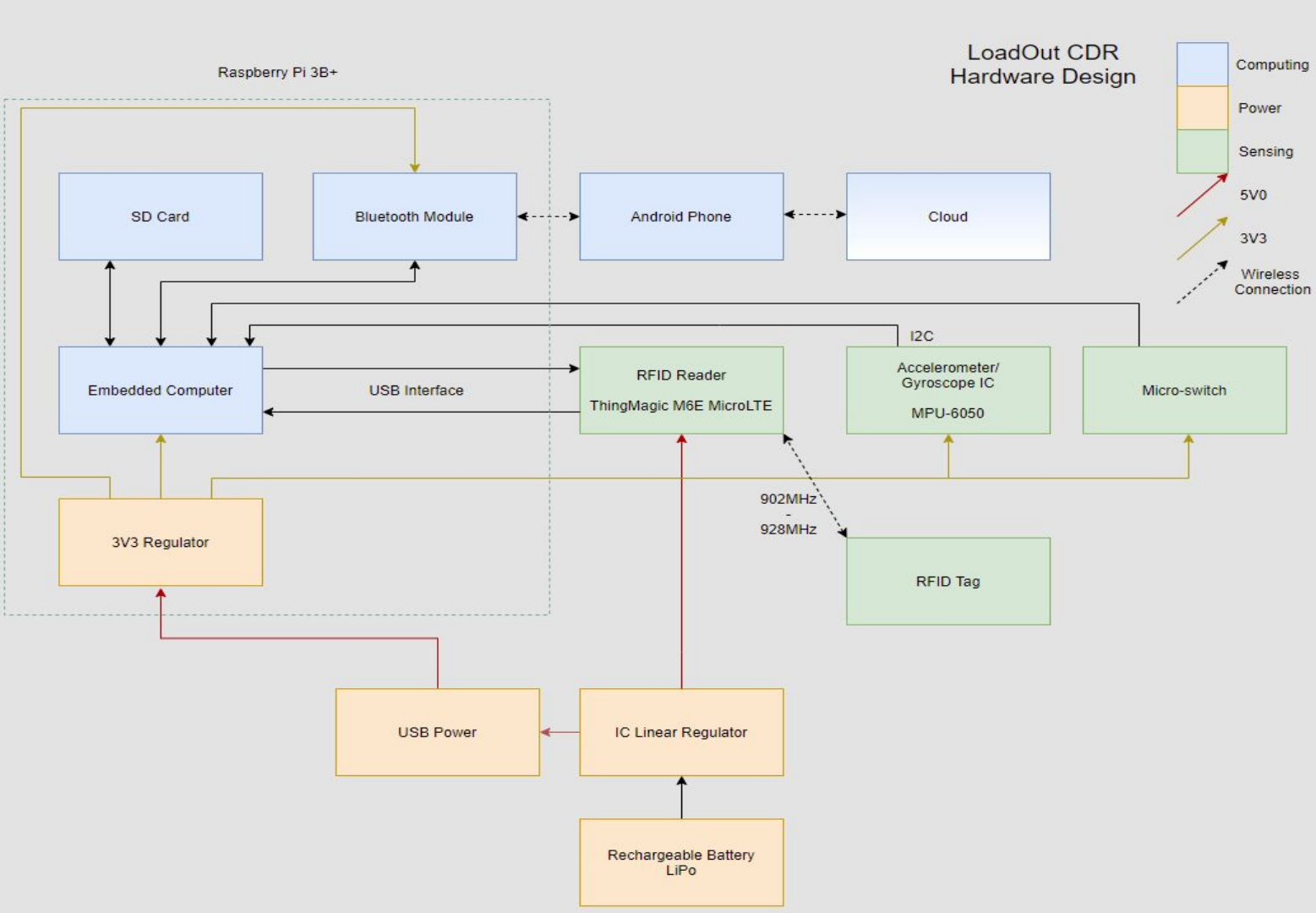
- Current prototype is three different but integrated parts
- Each subsystem is physically different than the final form, but is topographically identical
- Further work is needed to verify the PCB and thus transition to our FPR-ready final product



UPDATED SOFTWARE DESIGN FLOWCHART:



UPDATED HARDWARE DESIGN FLOWCHART:



LIST OF HARDWARE AND SOFTWARE

RFID Module (Josh):

- Hardware
  - Micro-LTE RFID Developer Kit
  - Raspberry Pi
- 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 Designer 21

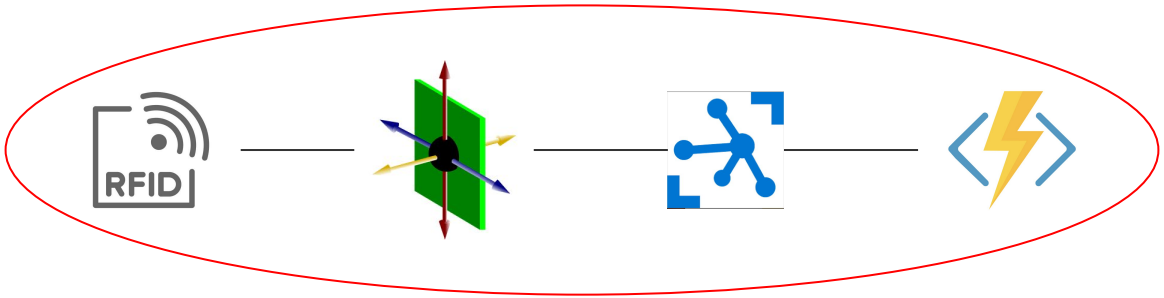
Processing Module (Smeel):

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

User Interface Module (Neyissa):

- Hardware
  - Phone (user owns)
- Software
  - Android Studio
  - Firebase

INTEGRATED SYSTEM



INTEGRATED SYSTEM DELIVERABLES

- Each of the group member's modules will be integrated such that a user can
  1. Create LoadOut list in the UX Android App
  2. RFID module will scan and detect items in the suitcase
  3. Sensing module will detect the case drop events
  4. These data points from (2) and (3) will be uploaded to the phones local database to be displayed on the App from (1)
- All of this in one implementation in real time with real data

CDR DEMO VIDEO

https://sdp-load-out-default-rtdb.firebaseio.com/

sdp-load-out-default-rtdb

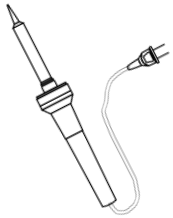
- **Items_table**
  - **laptop:** "E2004078410B01901140A4D7"
  - **pants:** "E2004078410B02161140A508"
  - **shoes:** "E2004078410B02151140A50F"
  - **toothpaste:** "E2004078410B02561140A558"
- **Logged_items_table**
  - **laptop:** "{\"Phase\": 67, \"RSSI\": -36, \"Readcount\": 17, \"EP..."
  - **pants:** "{\"Phase\": 171, \"RSSI\": -32, \"Readcount\": 17, \"E..."
  - **shirt:** "{\"Phase\": 104, \"RSSI\": -32, \"Readcount\": 17, \"E..."
  - **toothbrush:** "{\"Phase\": 135, \"RSSI\": -36, \"Readcount\": 17, \"E..."
- **Logs_table**
  - **09:29:32:** "{\"Temperature\": \"28.1064705882 Celcius\", \"Accel..."

Database location: United States (us-central1)

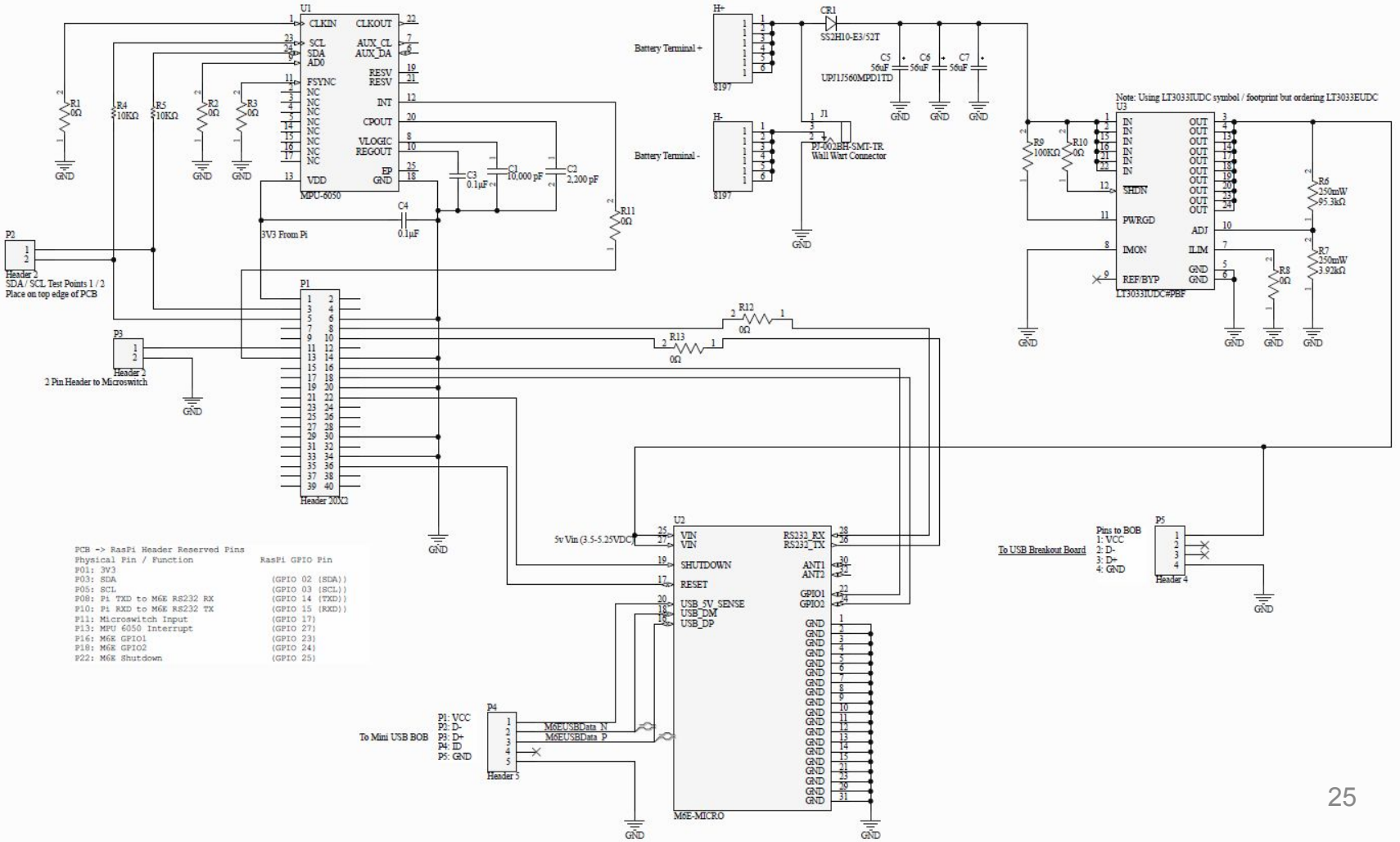
SYSTEM SPECIFICATIONS CURRENTLY MET

- Add/remove items from database and check if an item is in the bag when it is in close range
- Recording and storing information about the status of the items and bag while out of wireless range of the user
- Able to determine if the container has been opened,
  - Unable to determine if anything has been disturbed at this time
- Not battery powered, not built into a suitcase

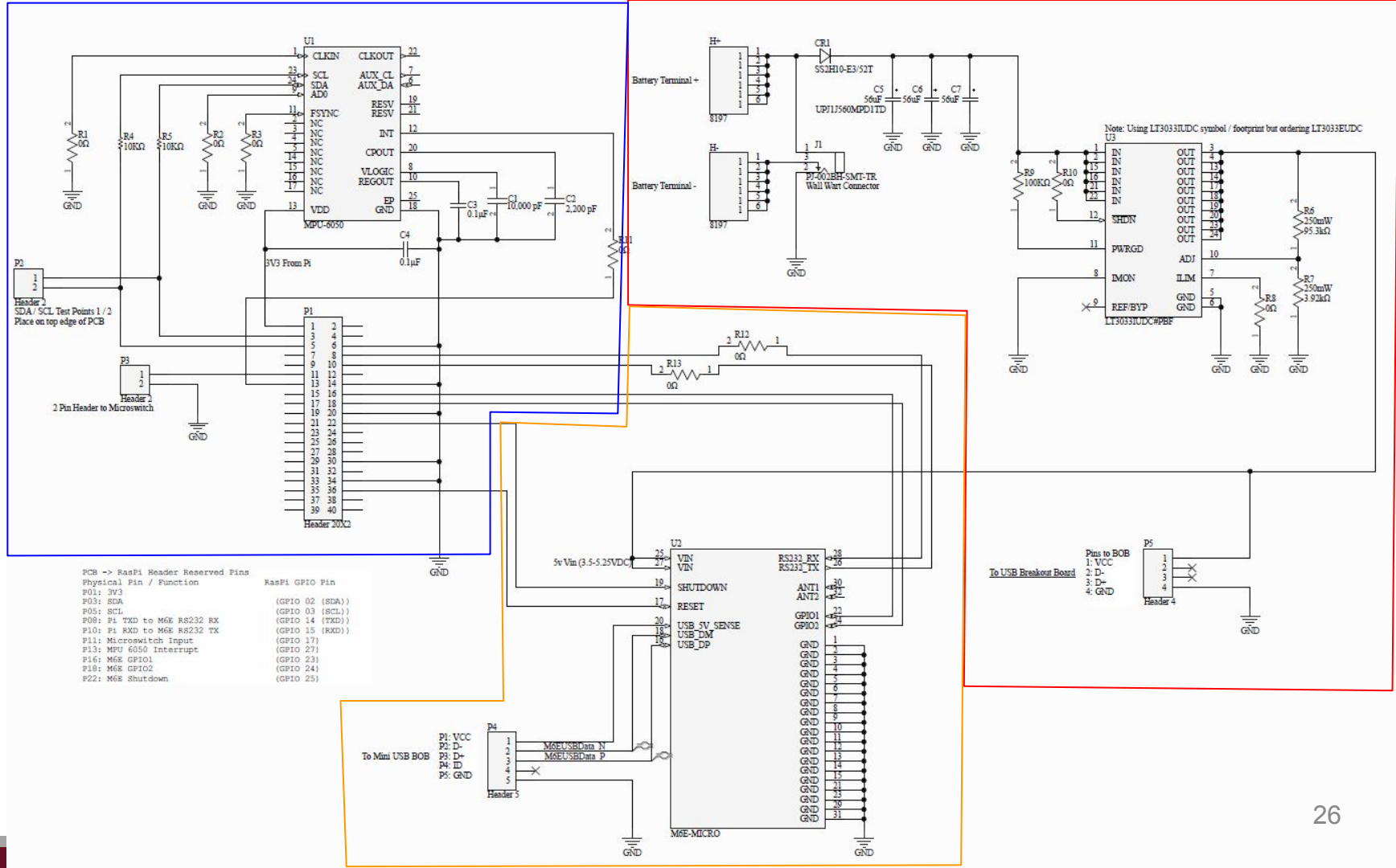
CUSTOM PCB STATUS UPDATE



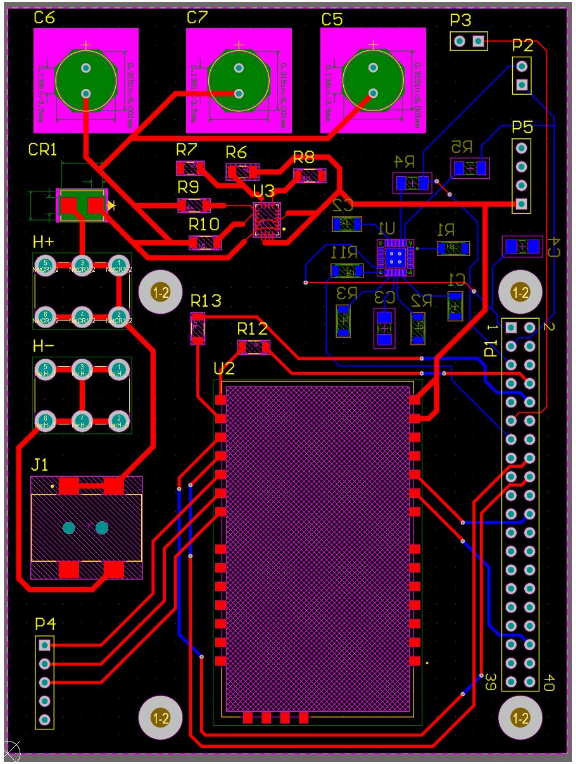
PCB SCHEMATIC

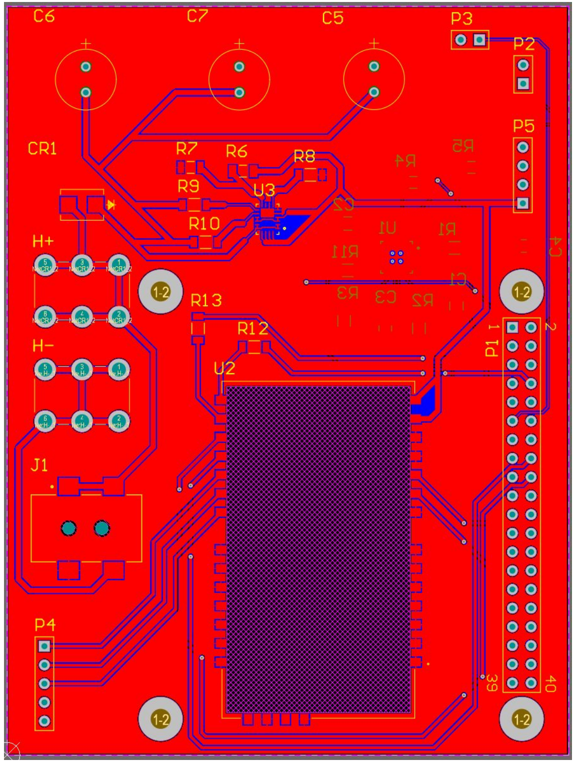


PCB SCHEMATIC



PCB LAYOUT


C6
C7
C5
P3
P2
P5
CR1
R7
R6
R8
R9
U3
R10
R4
R5
H+
H-
R13
R12
U2
J1
P4
P1


C6
C7
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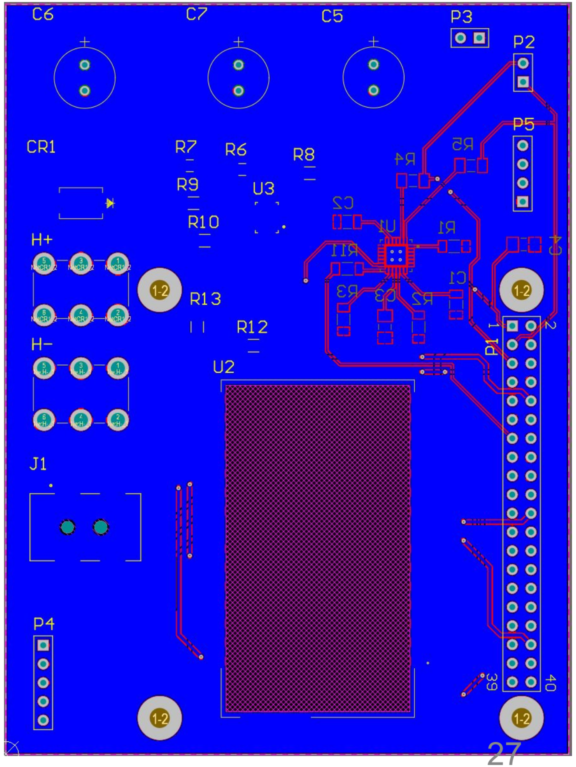
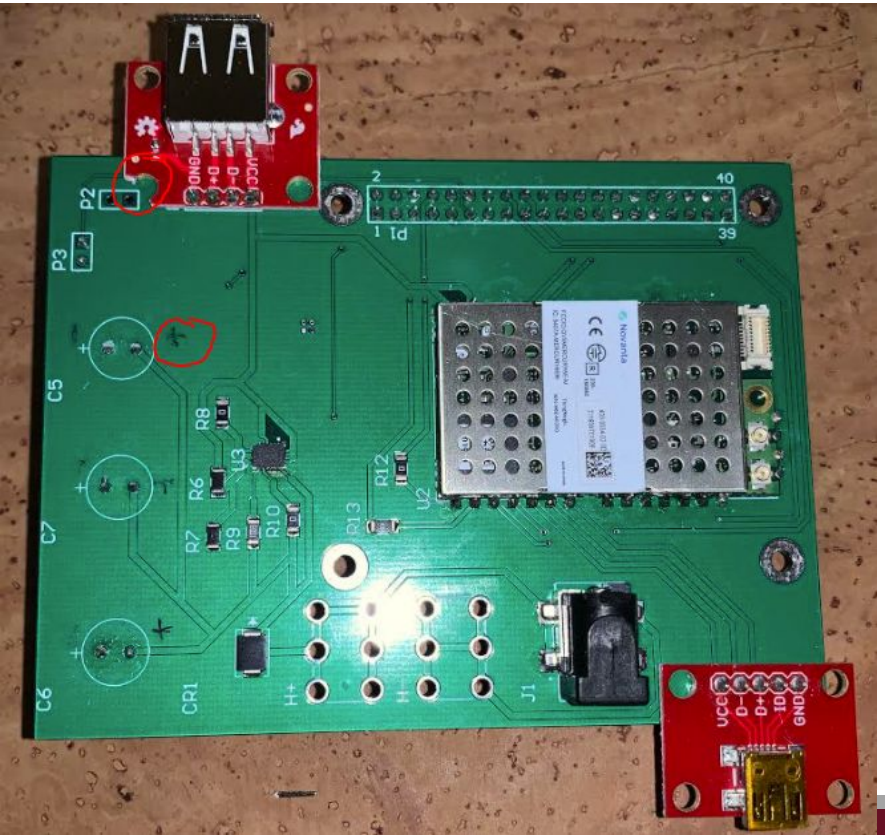
H+
H-
R13
R12
U2
J1
P4
P1

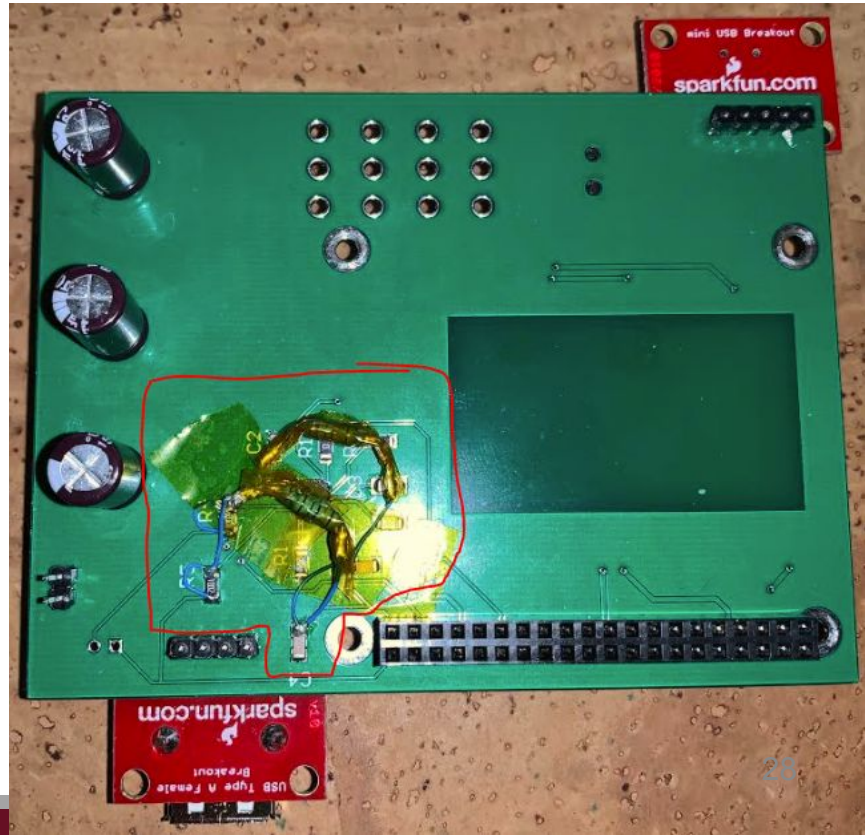

C6
C7
C5
P3
P2
P5
CR1
R7
R6
R8
R9
U3
R10
H+
H-
R13
R12
U2
J1
P4
P1

PCB IS IN HAND

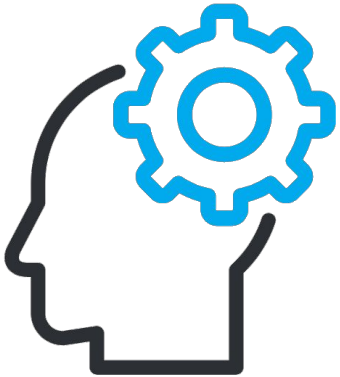
TOP



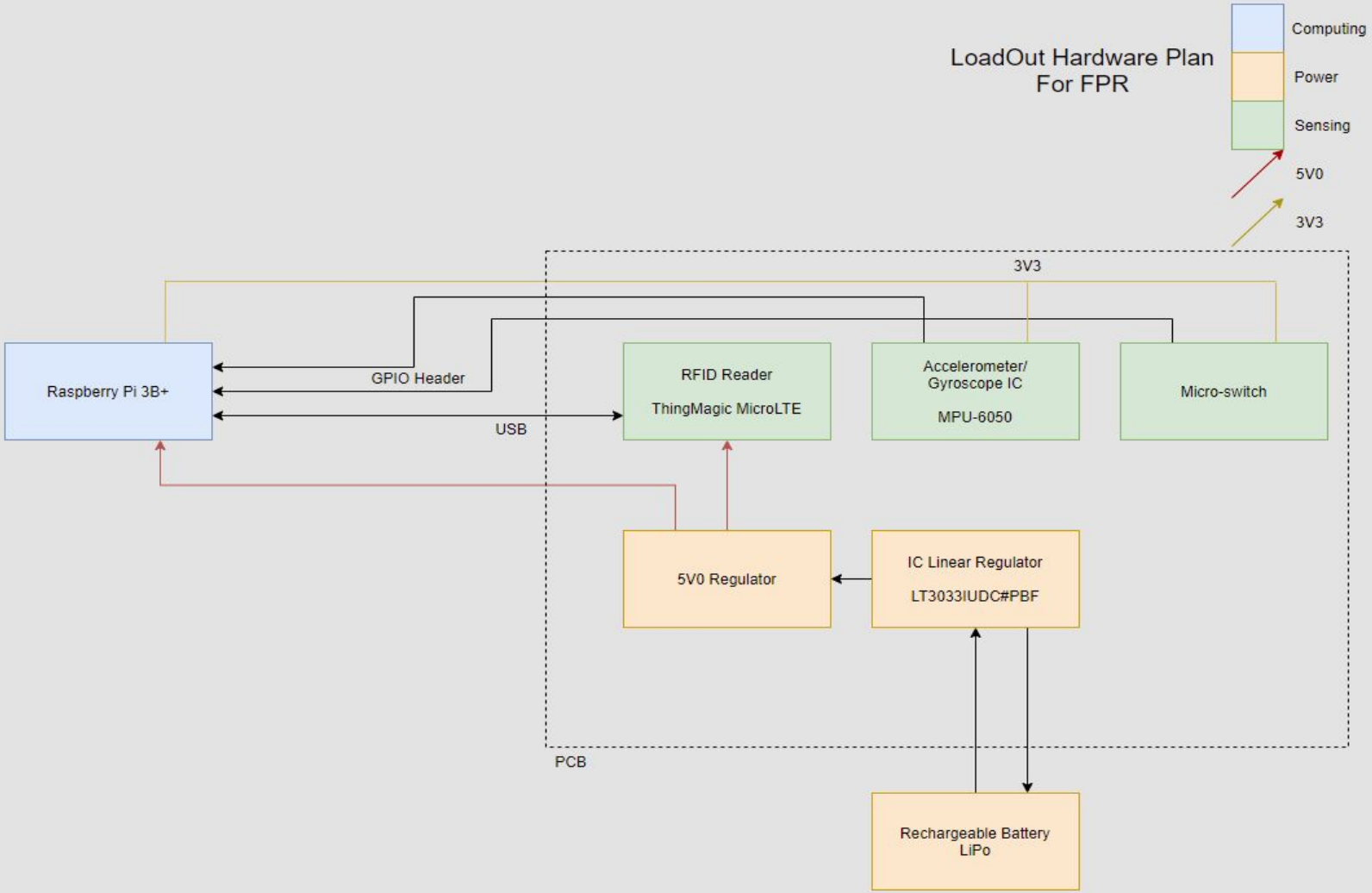
Bottom

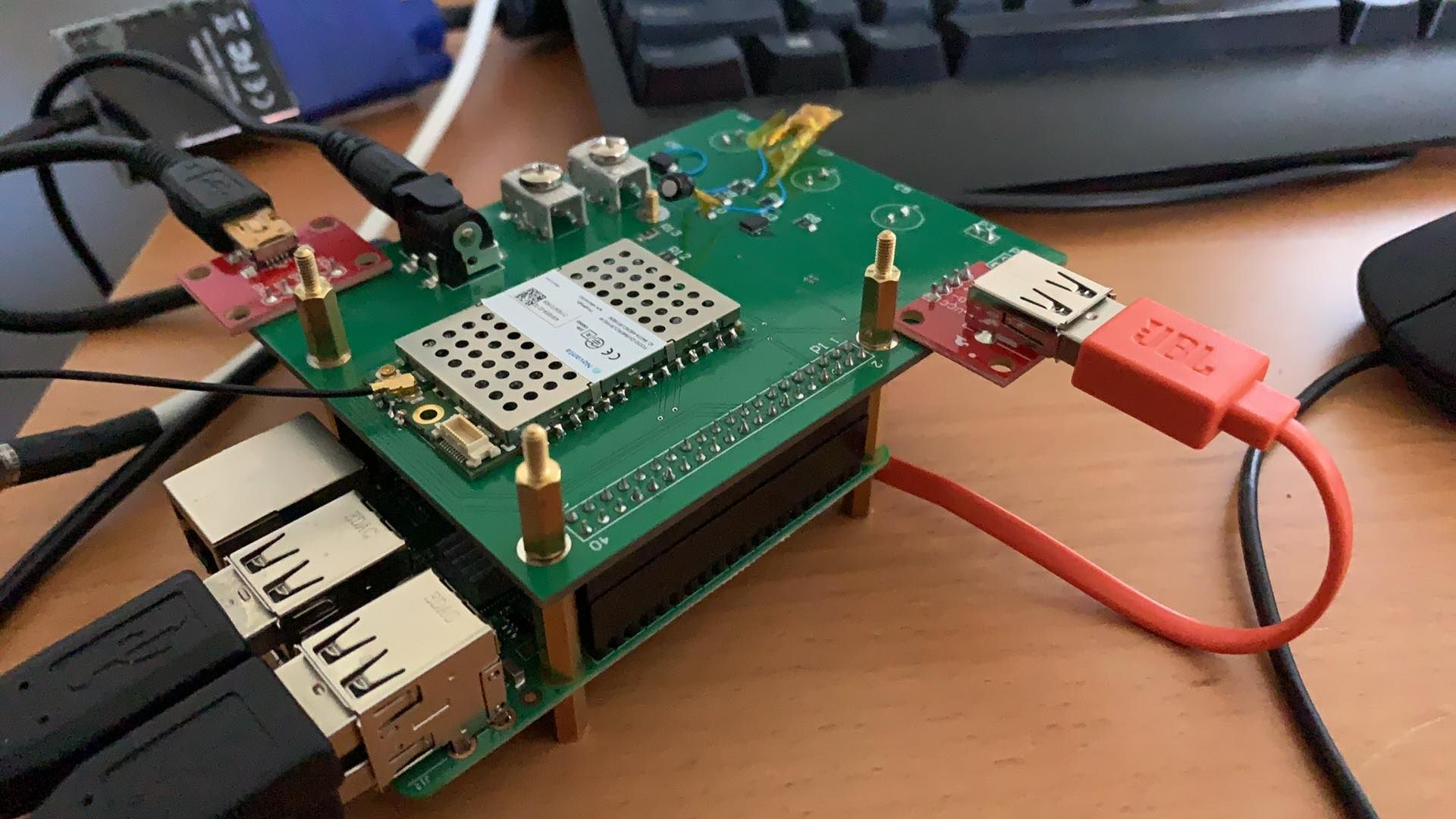


FPR PLAN



HARDWARE PLAN FOR FPR:





PLAN FOR TESTING SYSTEM SPEC. COMPLIANCE

- Weight
- RFID Interference
- Battery Life
- Number of Items Tracked
- Works in the Presence of Metals and Liquids
- Multiple Read and Log Events
- Register Mode

PLAN FOR PROTOTYPE HARDENING

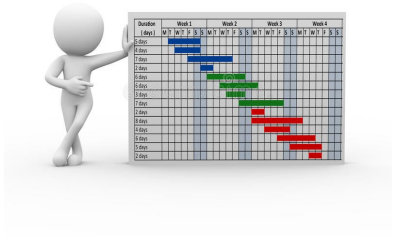
- Structural Supports

- Mechanical Suitcase Mounting

PLAN FOR FPR DEMO

- Final Product
- With Suitcase and example items
- Final PCB + Raspberry Pi mounted on suitcase
- Battery powered
- Full application with all features (i.e. register mode)

PROJECT MANAGEMENT



COST ESTIMATES

Items	Cost for QTY 1	Cost for QTY 1000
ThingMagic M6E Micro LTE UHF RFID Reader	$243.00	$201.89
Antenna	$96.04	$84.51
Development Board	$792.00	$0.79
RFID Tags	$5.64	$3.04
Capacitors	$2.89	$0.36
Resistors	$0.72	$0.16
Diodes	$0.49	$0.20
Headers and Connecters	$12.11	$1.57
ICs	$14.93	$6.95
Battery	$15.95	$10.05
Total	**$1,183.77**	**$309.53**

Loaned Items	Savings
Antenna	$96.04
Development Board	$792.00
RFID Tags	$5.64
Total	**$893.67**

Type	Orders	Item Costs	Tariffs	Shipping	Total	Sum Check
DigiKey	2020-10-02	$347.94	$1.14	$4.99	$354.07	$354.07
JLCPCB	2021-02-03	$18.70		$11.20	$29.90	$29.90
DigiKey	2021-03-05	$67.08	$0.26	$6.99	$74.33	$74.33
Mouser	2021-03-05	$27.64		$7.99	$35.63	$35.63
Totals		$461.36	$1.40	$31.17	$493.93	$493.93

GANTT CHART


Week Of:
04/04
04/11
04/18
04/25
05/02
Mid
Task
CDR
FPR
Final Project Due
GRAD
CDR
- Integrated System Prototype
- Create Slides
- Film and Submit Video
FPR
- PCB Based FInal Prototype
HARDWARE
- Populate PCB
- Verify MPU6050 Circuitry
DONE
- Verify LT3033 Circuitry
- Verify MPU6050 and M6E Functionality
- Polish Prototype (harden, support features, ...)
SOFTWARE
- Handle Multiple Read / Log Events
- Integrate Register Mode
SDP Report
DRAFT DUE 2021/04/09
- Design Section
- Alternatives
DONE
- Specifications
DONE
- Block Diagrams
DONE
- Tests / Experiments
- Refined Prototype
- PCBA Design, Population, Testing
- Performance and Functionality Testing (graphs, visuals)
- References
- Appendixes
- Alternatives in Detail
- Technical Standards in Detail
- Testing Methods
- Project Managment
DONE
- Expenditures
- "Beyond the Classroom" (each members' gained skills)

PROJECT MANAGEMENT: CDR->FPR Responsibilities

- Josh
  - Will continue to test and rework, if necessary, the PCB
    - (e.g. “verify LT3033 circuit”)
  - Will support prototype integration onto the PCB platform
- Neyissa
  - Add register mode
  - Finalize and test the user interface
- Smeel
  - Update website
  - Handle multiple read/log events
  - Test System
- Wilson
  - Assist Joshua in testing and populating the PCB
  - Assist Smeel and Neyissa with sensor integration and debugging
- Entire Team
  - Will support PCB-based integration
  - Will support SDP report writing

Thank you!