# Search And Find Emergency Drone
## "SAFE Drone"

# Team 4
# March 21, 2017

# Team Members

**Jamie Kline, EE**



**Serena Thomas, EE**



**Brad Marszalkowski, EE**



**Bjorn Galaske, EE**

# Review of Project

- Autonomous drone to search a predefined remote area for lost, missing, or injured people carrying cell phones.

- Detection of signal emitted by a powered-on cell phone searching for service/cellular tower.

- For use in remote areas with no reception.

- Download of GPS way points with associated signal strength to make a "heat map" of signal strength over the area in question.

# What were the proposed CDR deliverables?

1. Output of signal detection circuit compatible with the ADC; comparator portion of signal detection circuit designed/routed ("daughterboard") ✓
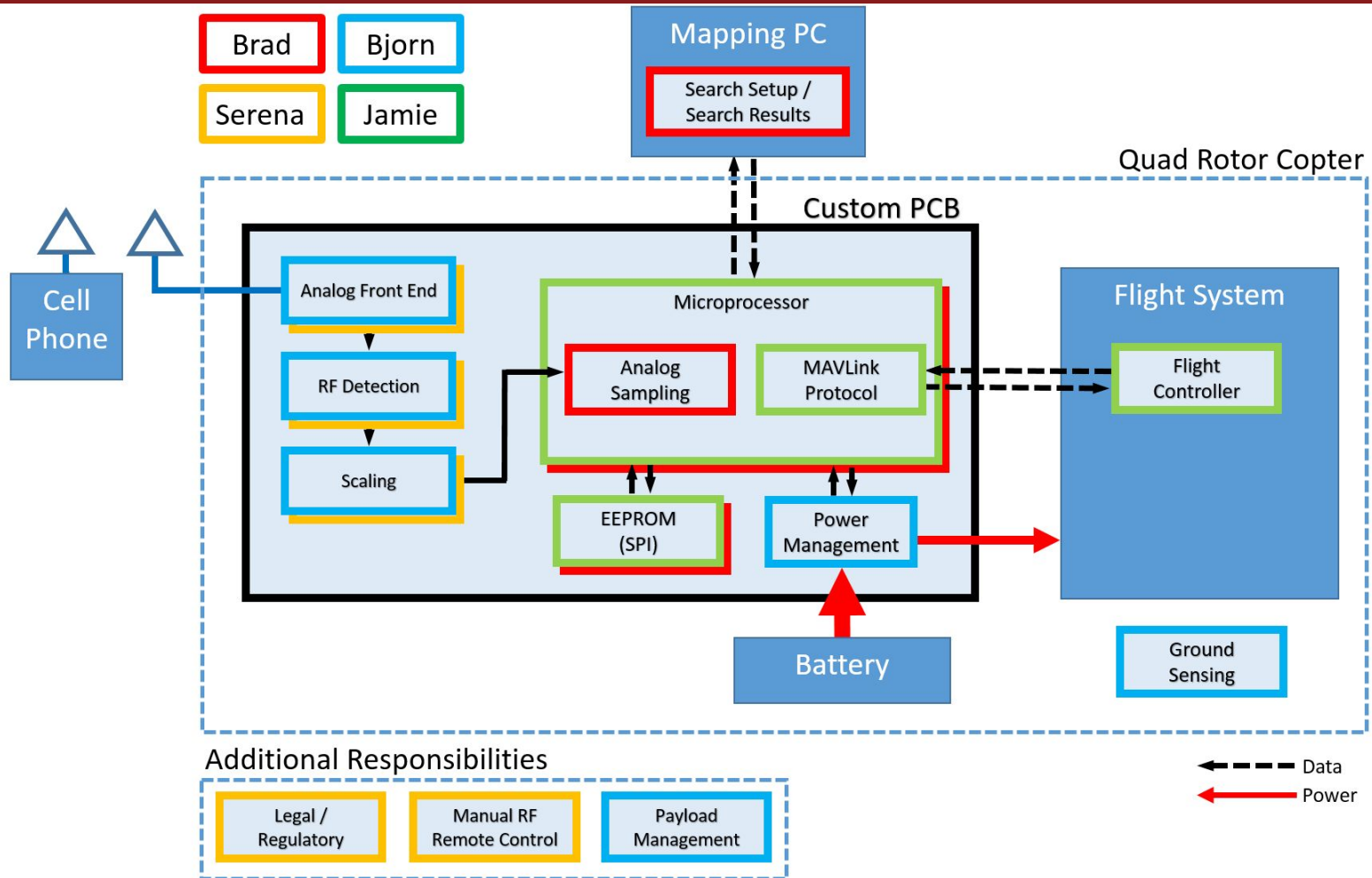
1. Microcontroller functions completed: Capability to write ADC and GPS data to EEPROM, Ability to output data from EEPROM to host PC, Sampling functions complete, Finite State Machine Complete. ✓
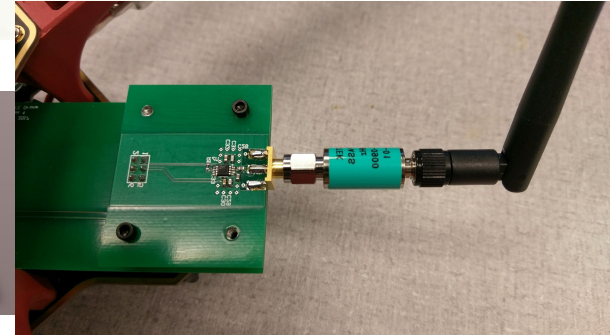
1. Main PCB routing complete: board/system mechanicals, microcontroller, PC interface, EEPROM, battery connections. Integrate "daughterboard" support and power supply routing (Bjorn). ✓
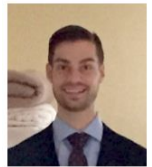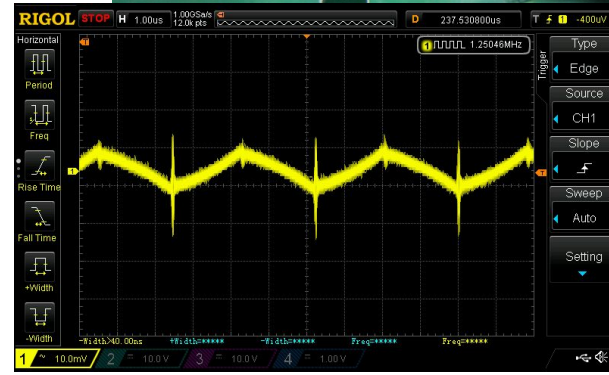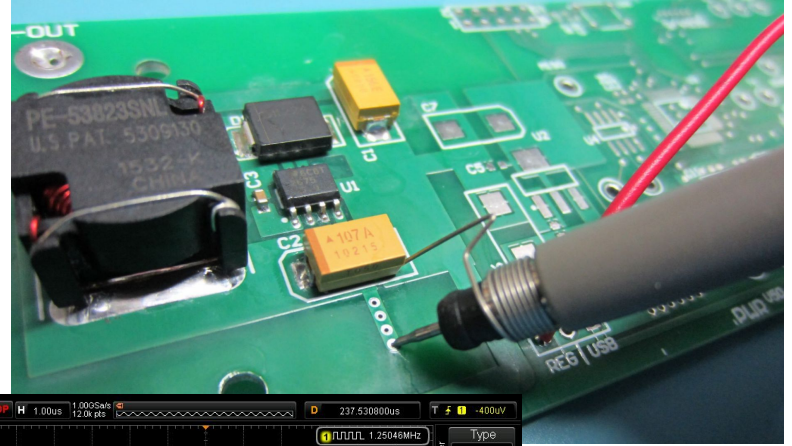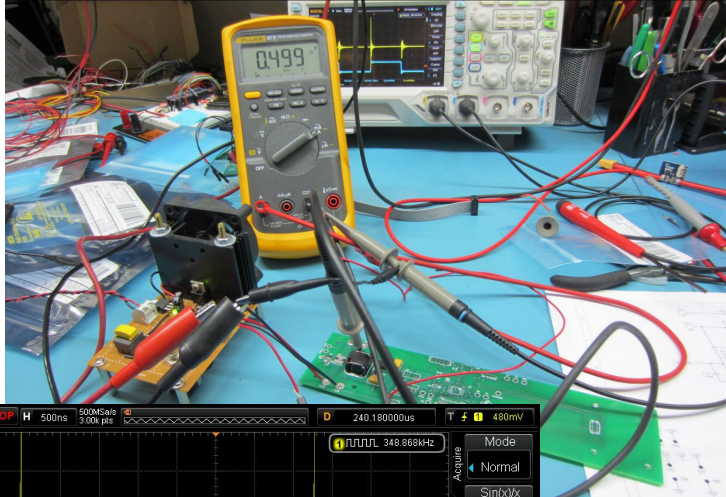
1. PCB power supplies and RF portion of signal detection circuit designed/routed ("daughterboard") ✓

# PCB

# State Machine



HOST_LINK != 'g'
pcLinkFlag=HOST_LINK

IDLE

MISSION_COUNT || HEARTBEAT || MISSION_CURRENT.seq < 3

lastMissionWP=MISSION_COUNT.wpCount - 3
mission_request_list()
curMission=MISSION_CURRENT.seq

HOST_LINK == 'g' / 'h' , numBytes
pcLinkFlag=HOST_LINK

MISSION_CURRENT.seq>=3
curMission=MISSION_CURRENT.seq

HEARTBEAT.flightMode==(Return || Land)
|| MISSION_CURRENT.seq > lastMissionWP
currentFlightMode=HEARTBEAT.flightMode
curMission=MISSION_CURRENT.seq

addressCounter<(numBytes*11)*4
addressCounter++

GPS_RAW_INT
lat=GPS_RAW_INT.lat
lon=GPS_RAW_INT.lon
adc_value=adc_get_value()

LINKED

SAMPLING

MISSION_COUNT || HEARTBEAT
|| MISSION_CURRENT.seq < lastMissionWP
lastMissionWP=MISSION_COUNT.wpCount - 3
currentFlightMode=HEARTBEAT.flightMode
curMission=MISSION_CURRENT.seq

# Signal Strength Testing

| Distance (feet) | Output(Volts) |
|---|---|
| 0 | 1.7 |
| 1 | 1.5 |
| 2 | 1.3 |
| 3 | 1.2 |
| 4 | 1.1 |
| 5 | 1.1 |
| 6 | 1.1 |
| 7 | 1.1 |
| 8 | 1 |
| 9 | 1 |
| 10 | 0.9 |
| … | ... |
| 100 | 0.65 |

- Ambient level = 0.54V

- Output going directly into ADC, whose output is saved to EEPROM
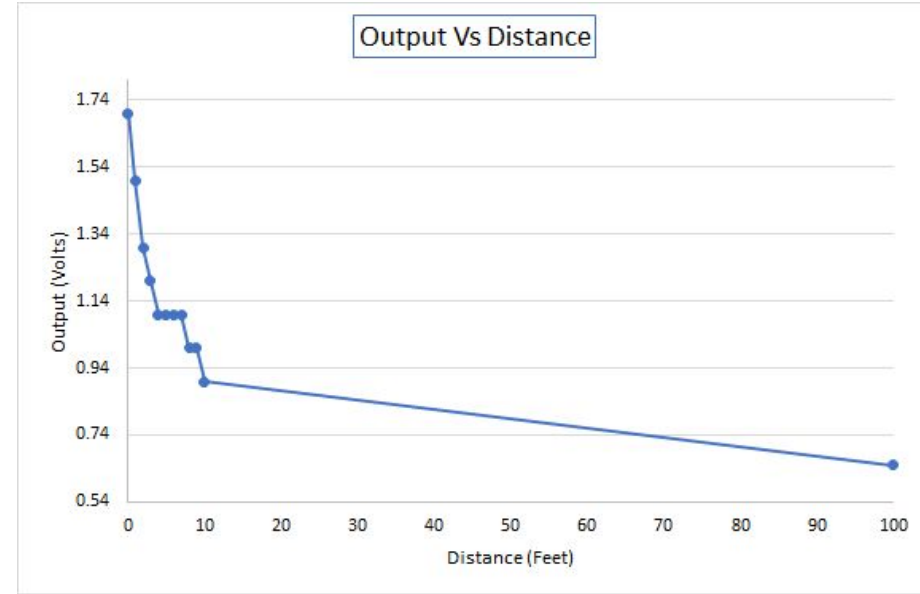
Signal Strength Measurements

# Antenna Directionality Tradeoffs

## Directional

*Pros:*
- Further reach than omni
- Pick up less noise when focused in one direction

*Cons:*
- Narrower field
- Weigh more and bigger than omni
- More expensive
- Harder to mount

## Omni-directional

*Pros:*
- Wider field
- Low cost

*Cons:*
- Less distance than directional
- Easier to pick up noise interference from all directions

# HAM radio license

FCC Federal Communications Commission

FCC Home | Search | Updates | E-Filing | Initiatives | For Consumers | Find

**Universal Licensing System**

FCC > WTB > ULS > Online Systems > License Search                    FCC

ULS License

**Amateur License - KC1GZC - Thomas, Serena L**

New Search   Refine Search   Return to Results   Printable Page   Reference Copy

| MAIN | ADMIN |
|------|-------|

| | | | |
|---|---|---|---|
| Call Sign | KC1GZC | Radio Service | HA - Amateur |
| Status | Active | Auth Type | Regular |
| **Dates** | | | |
| Grant | 02/08/2017 | Expiration | 02/08/2027 |
| Effective | 02/08/2017 | Cancellation | |

| **Licensee Information** | | | |
|---|---|---|---|
| FRN | 0026245266 | Type | Individual |
| **Licensee Name** | | | |
| Thomas, Serena L 39 West Brookfield Road North Brookfield, MA 01535 | | | |

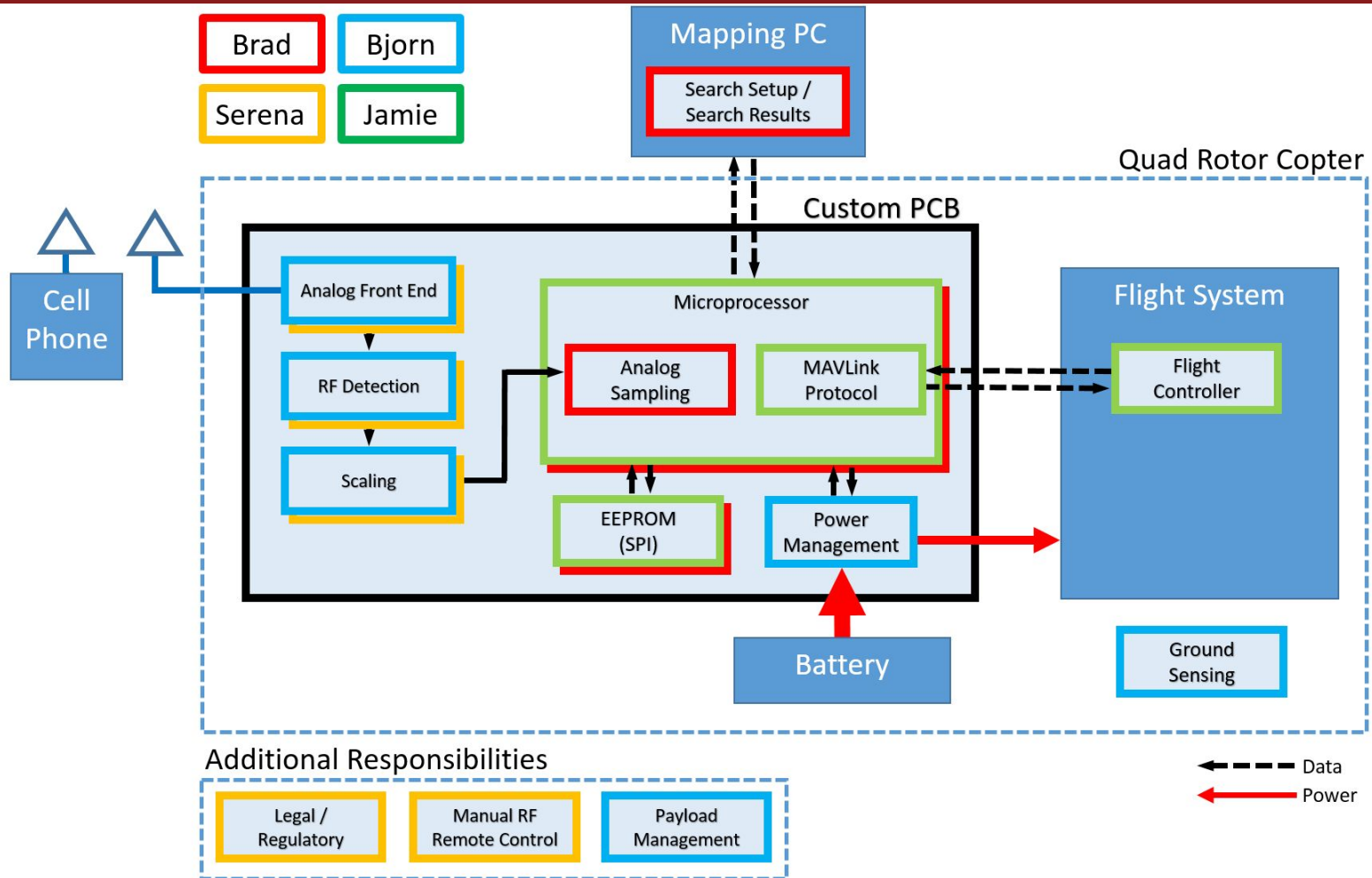| **Amateur Data** | | | |
|---|---|---|---|
| Operator Class | Technician | Prev. Op. Class | |
| Group | D | Prev. Call Sign | |
| Eligibility Code | | | |
| **Trustee/Custodian** (for Non-Individuals Only) | | | |
| Name | | Call Sign | |

- Can use for transmitting from microwaves lab to test drone
- Works for the 900MHz frequency

1) <u>Mission/scan area setup and download to craft</u> (here): *necessary*

2) <u>Person in scan area toggling airplane mode</u>: *simulates searching for tower with high power.*

3) <u>Flight</u>: *demonstrates proper mechanical integration of subsystems with craft*

4) <u>Retrieval of collected data</u>: *demonstrates PC subsystem communication*

5) <u>Analysis of data</u> (here): *demonstrates (indirectly) majority of subsystem integration: clean power supply, proper routing, analog front-end sensitivity, digital sampling, data storage, communication to flight controller, etc.*
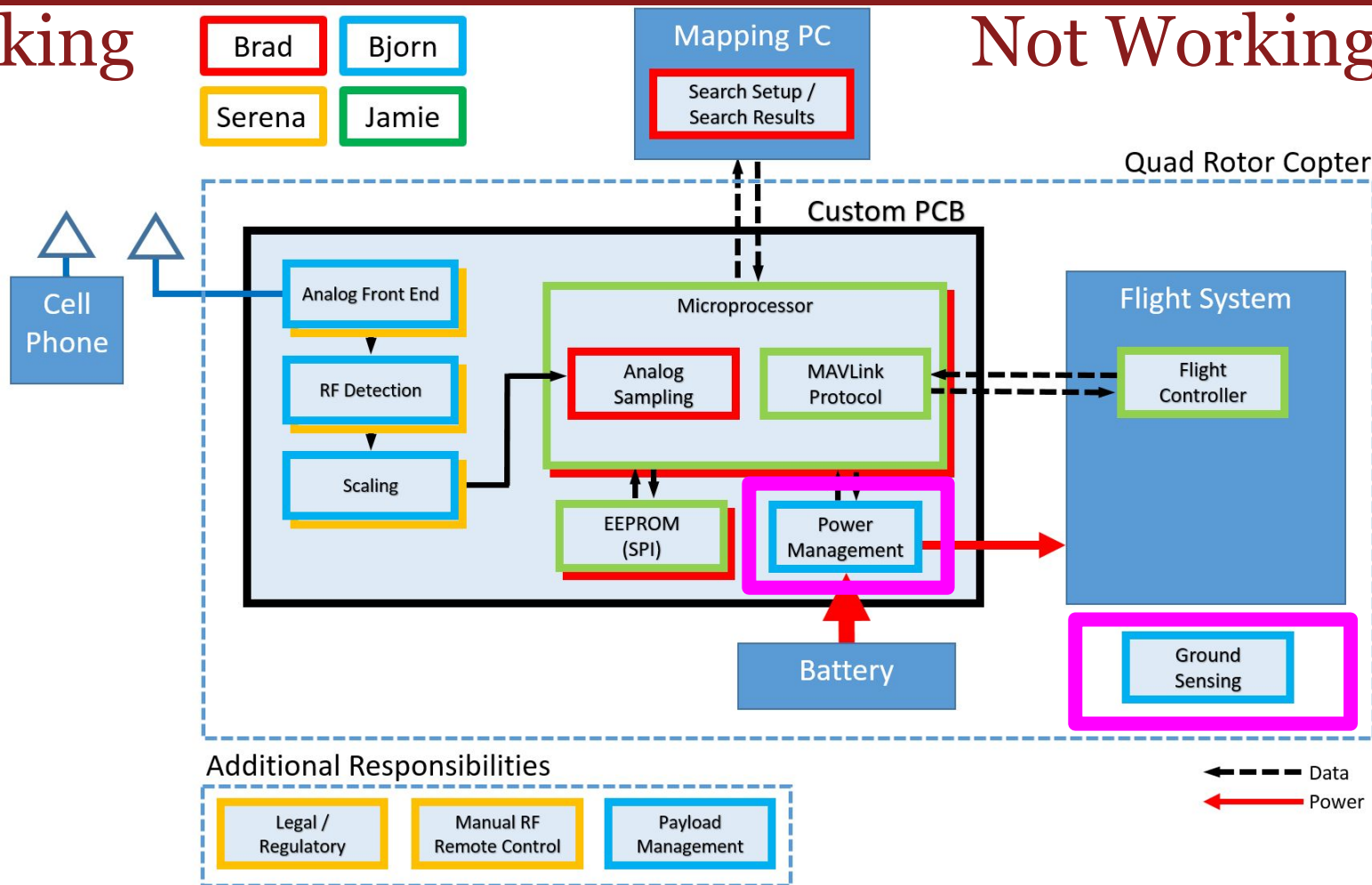
# What is not working?

Stretch-goals (not deliverables):

- Ultrasonic distance sensor
  - Originally deemed essential for landing -- barometric sensor sufficient
  - A non-essential subsystem: terrain following

- Power Management (partially)
  - Current and voltage sensing circuit is designed, tested, and in place
  - Simply lacking coding/usage

# FPR deliverables/final product



1. Efficient search algorithm study (not necessarily implementation, but proof of concept to go hand in hand with possible antenna choices)
2. Band-pass filter and semi-directional antenna tests (less noise interference)



1. Develop / integrate interrupt-based EEPROM write routines
2. Refinements (usability, features) to host PC link software
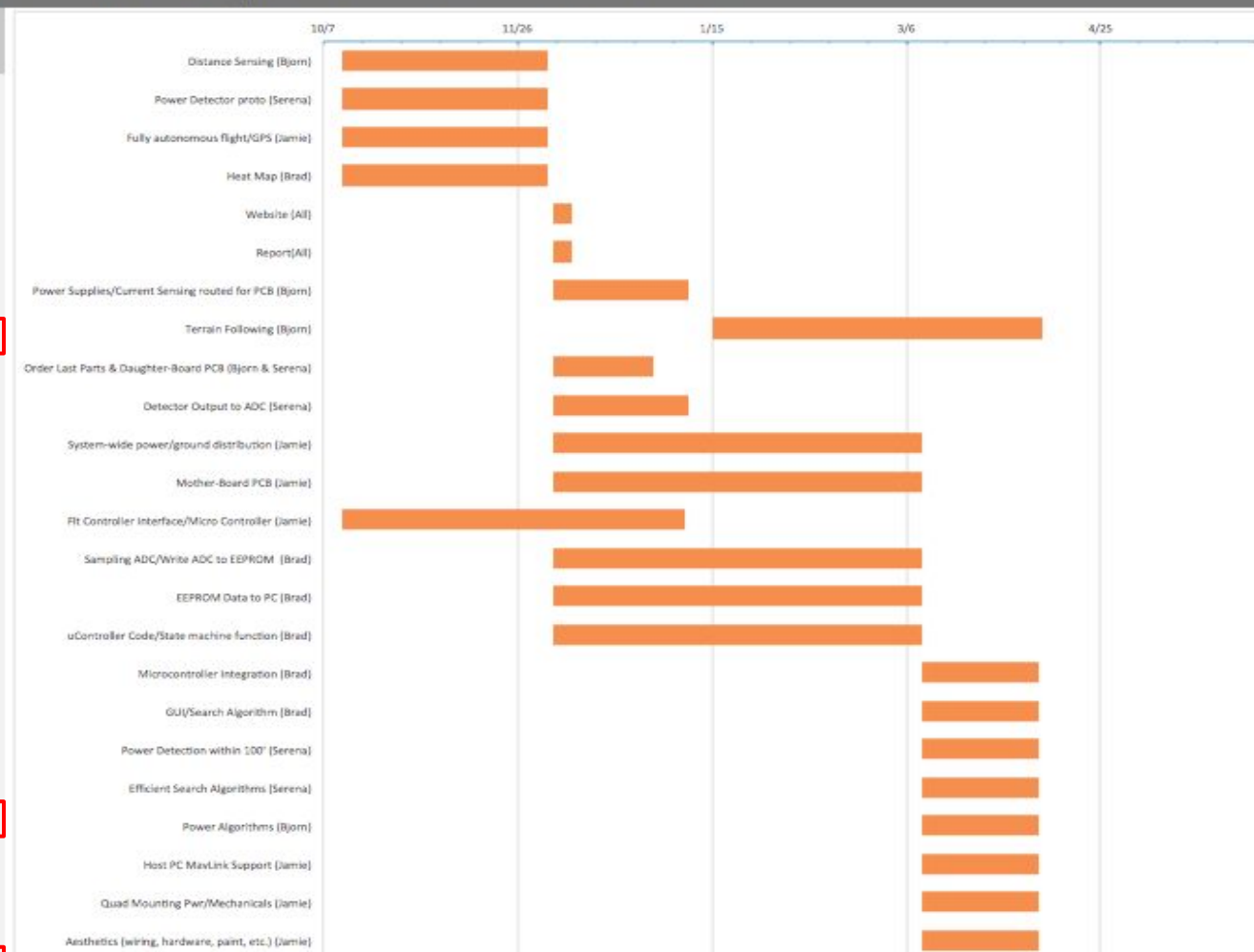


1. Develop / integrate interrupt-based serial buffer routines.
2. Final mechanicals prep: tidying wiring, "prep/paint/polish"
3. Complete next PCB revision documents, update website

Misc:    1. Display and booth preparation for "Demo Day"

# SAFE DRONE Team 4: Serena Thomas, Jamie Kline, Bjorn Galaske, Brad Marszalkowski

## Voltage Regulator

| START DATE | END DATE | DESCRIPTION | DURATION (days) |
|---|---|---|---|
| 10/12/16 | 12/5/16 | Distance Sensing (Bjorn) ✓ | 53 |
| 10/12/16 | 12/5/16 | Power Detector proto (Serena) ✓ | 53 |
| 10/12/16 | 12/5/16 | Fully autonomous flight/GPS (Jamie) ✓ | 53 |
| 10/12/16 | 12/5/16 | Heat Map (Brad) ✓ | 53 |
| 12/5/16 | 12/10/16 | Website (All) ✓ | 5 |
| 12/5/16 | 12/10/16 | Report(All) ✓ | 5 |
| 12/5/16 | 1/10/17 | Power Supplies/Current Sensing routed for PCB (Jamie/Bjorn) | 35 |
| 1/15/17 | 4/10/17 | Terrain Following (Bjorn) | 85 |
| 12/5/16 | 1/1/17 | Order Last Parts & Daughter-Board PCB (Bjorn & Serena) ✓ | 26 |
| 12/5/16 | 1/10/17 | Detector Output to ADC (Serena) ✓ | 35 |
| 12/5/16 | 3/10/17 | System-wide power/ground distribution (Jamie) ✓ | 95 |
| 12/5/16 | 3/10/17 | Mother-Board PCB (Jamie) ✓ | 95 |
| 10/12/16 | 1/10/17 | Flt Controller Interface/Micro Controller (Jamie) ✓ | 88 |
| 12/5/16 | 3/10/17 | Sampling ADC/Write ADC to EEPROM (Brad) ✓ | 95 |
| 12/5/16 | 3/10/17 | EEPROM Data to PC (Brad) ✓ | 95 |
| 12/5/16 | 3/10/17 | uController Code/State machine function (Brad) ✓ | 95 |
| 3/10/17 | 4/10/17 | Microcontroller Integration (Brad) ✓ | 30 |
| 3/10/17 | 4/10/17 | GUI/Search Algorithm (Brad) ✓ | 30 |
| 3/10/17 | 4/10/17 | Power Detection within 100' (Serena) ✓ | 30 |
| 3/10/17 | 4/10/17 | Efficient Search Algorithms (Serena) | 30 |
| 3/10/17 | 4/10/17 | Power Algorithms (Jamie) ✓ | 30 |
| 3/10/17 | 4/10/17 | Host PC MavLink Support (Jamie) ✓ | 30 |
| 3/10/17 | 4/10/17 | Quad Mounting Pwr/Mechanicals (Jamie) ✓ | 30 |
| 3/10/17 | 4/10/17 | Aesthetics (wiring, hardware, paint, etc.) (Jamie) | 30 |

# Demo

## To the quad!

# Thank You

Questions?