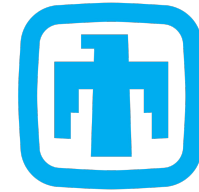# Portable High Energy Experiment (PHEE) DAQ

Team Members: Ethan Barnes
John Sabra
Sang Hoon Chung

Sponsor: Michelle Chatter
Sandia National Laboratories

TA: Logan Smith

Project Summary

Problem statement:

- The United States military possesses about 5500 nuclear weapons in its stockpile

- The security of these weapons and equipment is paramount when they are transported for storage and testing

- Sandia is interested in detecting explosive-type events in sensitive areas
   - Exact application for DAQ system may not be disclosed

The Portable High Energy DAQ System will:

- Protect government equipment by detecting and identifying explosives within a 100 ft range

    - Utilizes accelerometer and pressure sensor to classify if an explosive event occurred

- Write output to removable storage device

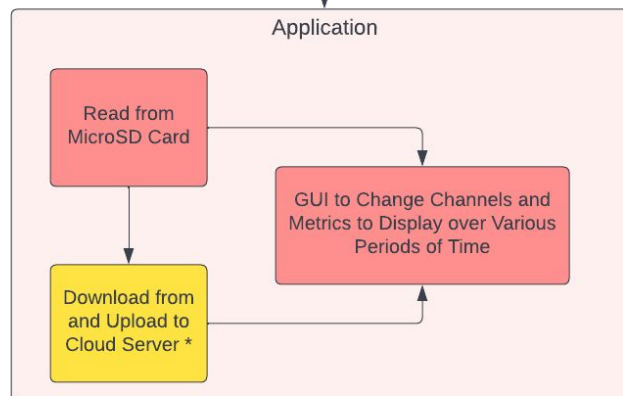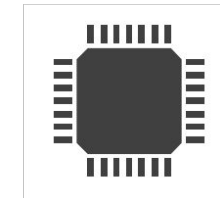   - User will be able to refer to and perform analysis on past data

Project/Subsystem Overview
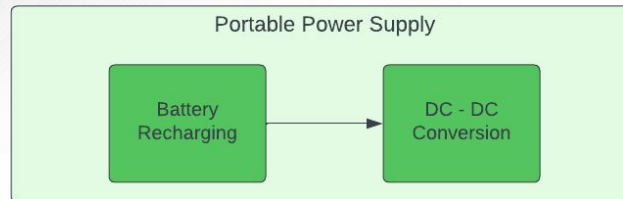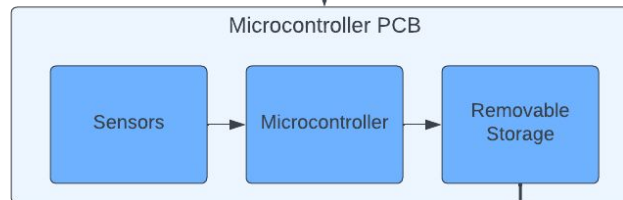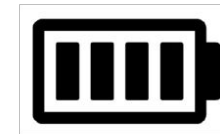
Major Project Changes for 404

Role Changes

Member	Before	After
Johnny	Assigned cloud storage connection	No longer working on cloud storage
Ethan	N/A	N/A
Sang Hoon	Not assigned cloud storage connection	Now working on cloud storage

Subsystem Changes

Subsystem	Before	After
Portable Power Supply	N/A	N/A
Microcontroller PCB	● Using sensors for sound, pressure, and acceleration	● No longer using sound sensor (only using pressure sensor and accelerometer)
Application	● Creating Android application ● Using Google Cloud ● Using Kivy framework	● Creating GUI application for PC ● Using Google Drive ● USing PyQt framework

Project Timeline

Subsystem	Status
Portable Power Supply	● PCB design is being finalized and made ready for ordering ● PCB must be validated
Microcontroller PCB	● Most microcontroller programming complete ● PCB needs to be designed and validated
Application	● The application is functional and shows the resulting values ● Need to get more accurate result and display multiple signals, change the framework, and add more metrics

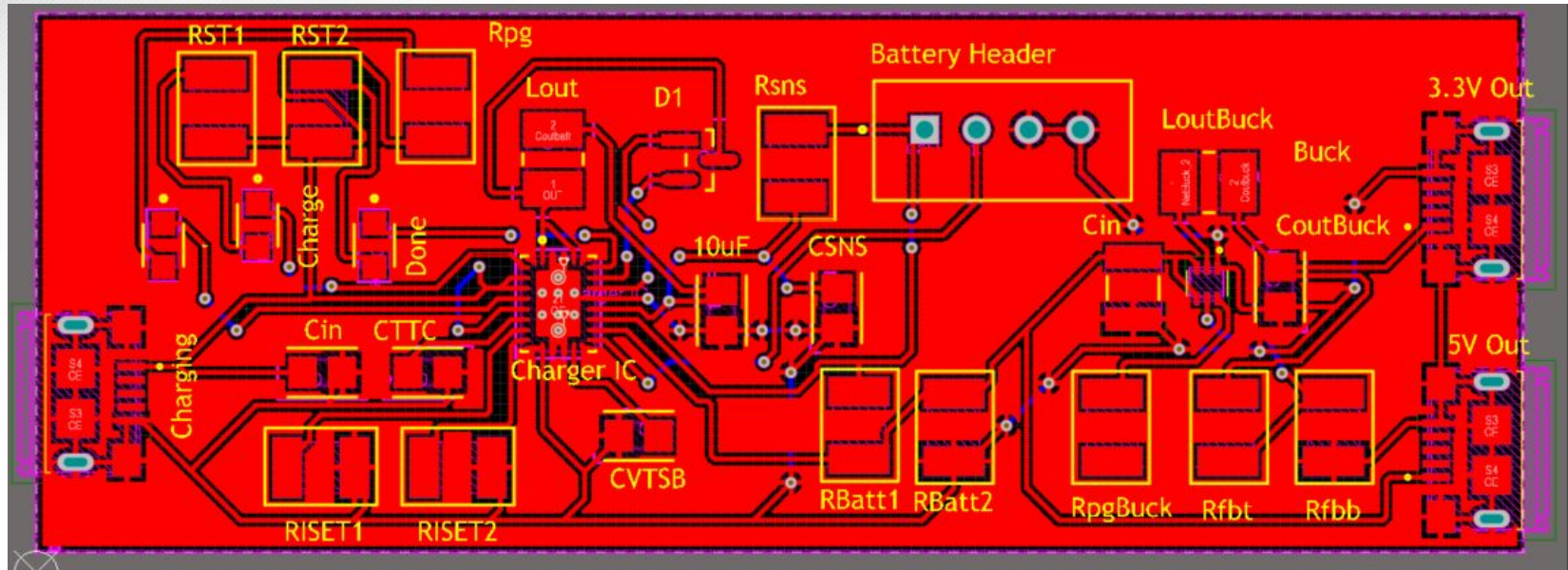# Portable Power Supply

Johnny Sabra

Accomplishments since 403 10 hrs of effort	Ongoing progress/problems and plans until the next presentation
● Remaining parts for the PCB have been ordered	● Net antenna via design rule violation is occurring between top and bottom layer on the battery charger IC footprint ● Order PCB layout and begin soldering parts for testing

Portable Power Supply

Johnny Sabra

Portable Power Supply Layout in Altium

PCB design tested on breadboard
- DC-DC Buck converter regulates voltage to 3.3 V at load current from 40 to 100 mA
- Battery Charger IC did not have correct footprint on breakout board
- Design was tested with equivalent 1-cell Lipo battery charger for validation
  - Charging status LED worked
  - Lipo-battery charged at a consistent rate

Microcontroller PCB

Ethan Barnes

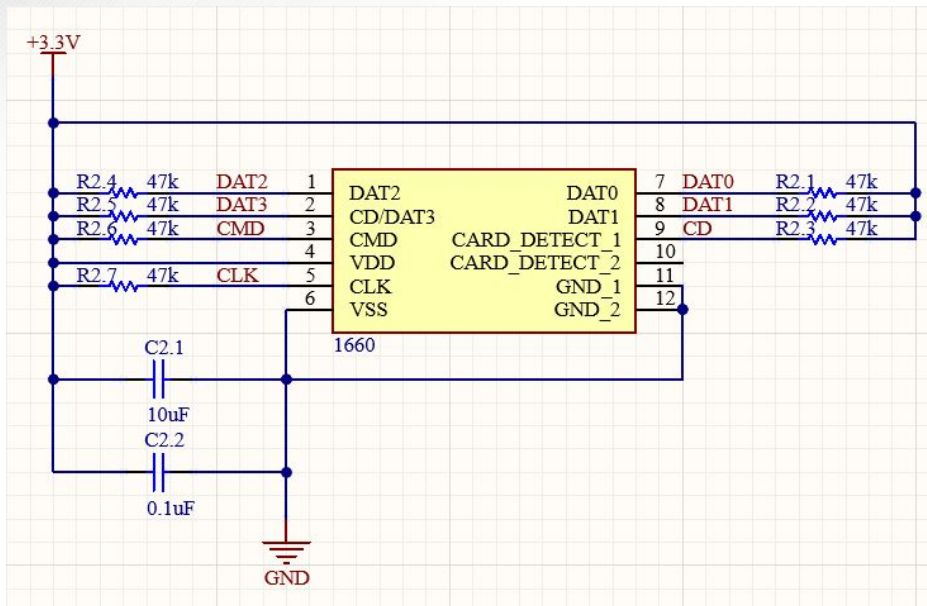| Accomplishments since 403 10 hrs of effort	Ongoing progress/problems and plans until the next presentation
No new accomplishments since 403	Working on PCB schematic in Altium • SD card reader schematic is in progress • Routing connections from sensors to MCU and MCU to SD card reader • Considering circuit for sensor inputs (voltage divider, unity gain buffer, etc.)

Microcontroller PCB

Ethan Barnes

SD Card Reader Schematic in Altium

Works:

- MCU can take inputs using built-in ADC

- MCU can write ADC inputs to SD card in desired format

Doesn't Work:

- Write speed to SD card is ~2 ksps and needs to be ~100 ksps

- SDIO currently one works with 1-bit data transfer rather than 4-bit

- Algorithm to detect explosive events is not robust (determines output based on threshold and not change in values)
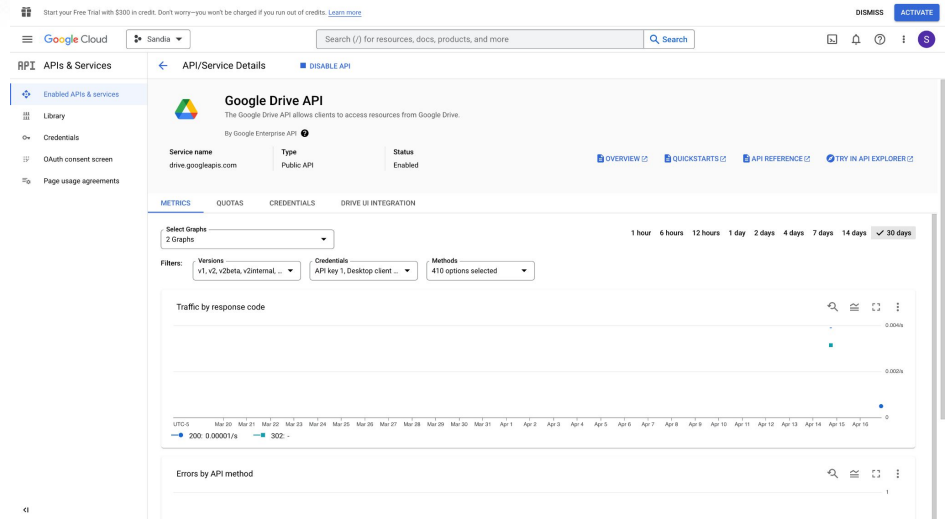
Application

**Sang Hoon Chung**

Accomplishments since 403 10 hrs of effort	Ongoing progress/problems and plans until the next presentation
- Read multiple signals from sensors - Upload the data from SD card to Cloud Storage and vice versa.	Change the Framework from Kivy to PyQt which can be used to create cross-platform mobile and desktop applications.

Application

Sang Hoon Chung
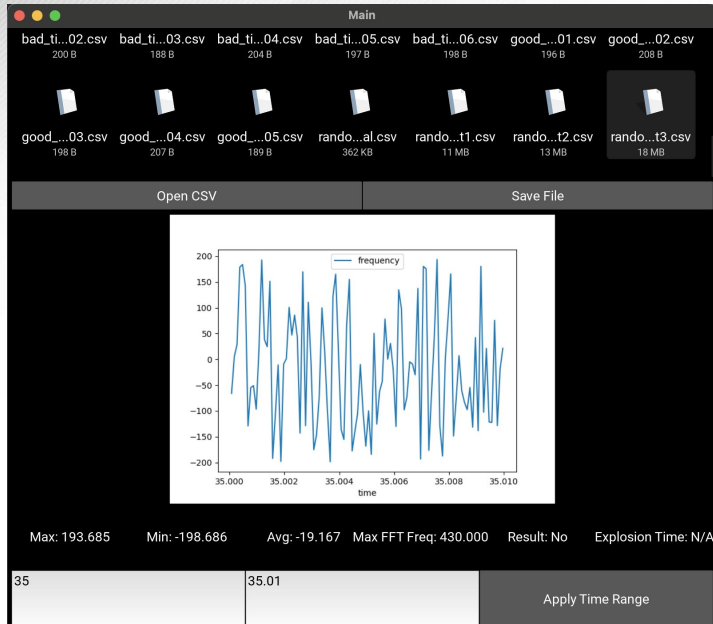
Works
- After run the application, the app connects to Google Drive and show the .csv files.
- When we select the available csv file to analyze it shows the signal.
- We can set the time range to look over it.
- App shows Max, min, avg points, FFT frequency, and presence of the explosion.

Doesn't work
- There were limitations to apply more functions and design the application for instance, show multiple signals(more than 2).
- Kivy Framework has a limitation for design(optimization for PC), so try to change PyQt for UI.

Parts Ordering Status

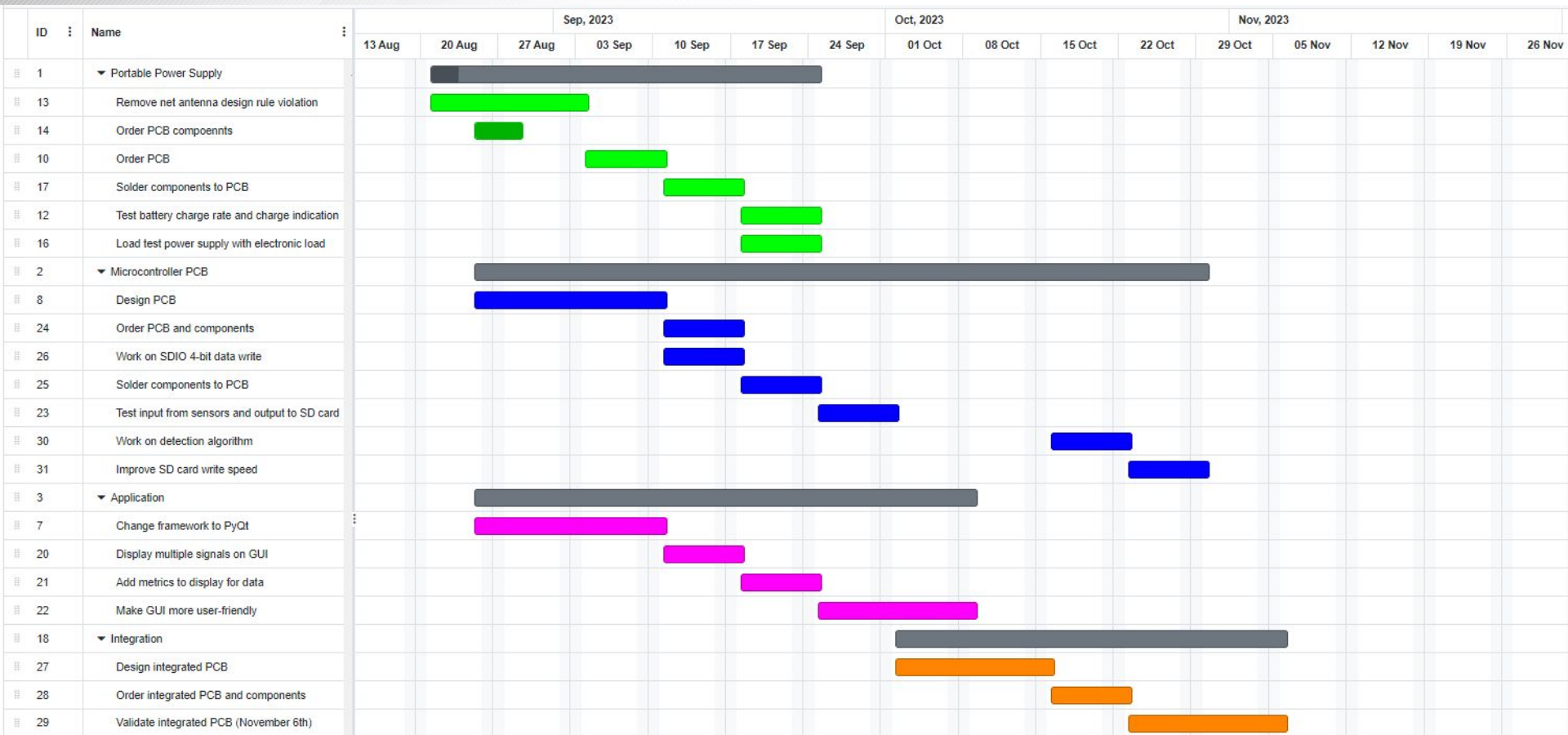| Subsystem	Ordered and Not Received	Need to Order
Portable Power Supply	● Most components for PCB ● Resistors, capacitors, etc.	● PCB
Microcontroller PCB	● Bare MCU	● PCB ● Resistors, capacitors, etc. ● Components for sensor input circuit

We expect to receive the Portable Power Supply components as well as the bare MCU within a week

The Portable Power Supply PCB is expected to be ordered by the end of this week, so we should receive it within 2 weeks

The Microcontroller PCB and its components are expected to be ordered within 2 weeks, so we should receive it within 3 weeks

Execution

	9/10	9/24	10/8	10/22	11/5
Johnny	PCB Ordered	Power supply PCB validated	Charging feature validated	Integrated PCB design complete	Integrated PCB is functional
	Zero design violations in Altium	Regulates 3.3 V under 40mA load and 5 V under 120 mA load (estimated load current of MCU)	Can charge a 3-cell lipo battery at 1C rate		
Ethan	PCB design complete	SDIO 4-bit works	PCB is functional	Zero design violations in Altium	Can be powered with 3.3V source and can read from sensors and write to SD card at more than 2 kHz
	Zero design violations in Altium	All 4 SDIO data pins write 1 bit each	Powered with 3.3 V source, can write to SD card at ~2 kHz Accelerometer tested against gravity (100 mV/g), Pressure sensors test pending		Integrated PCB is portable with power supply regulating battery voltage to 3.3 and 5V under load
Sang Hoon	Change Framework to PyQt and Design multiple signals on GUI	Add more metrics to display for data	Make GUI more user-friendly	Finalizing the program and adopting the software	Validate and test communication between subsystems
	Check the application shows whole sensors data	Add more metrics and check availability of the result Display via the application at next column	Ask opinions to other people about the design of GUI	Check the software works when we download the software itself as .exe file	Application can read data from SD card in desired format (time, explosion, pressure, acceleration)

Thank you!

Questions?