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Team 38: Fuel Cell Monitor
Bi-Weekly Update 1

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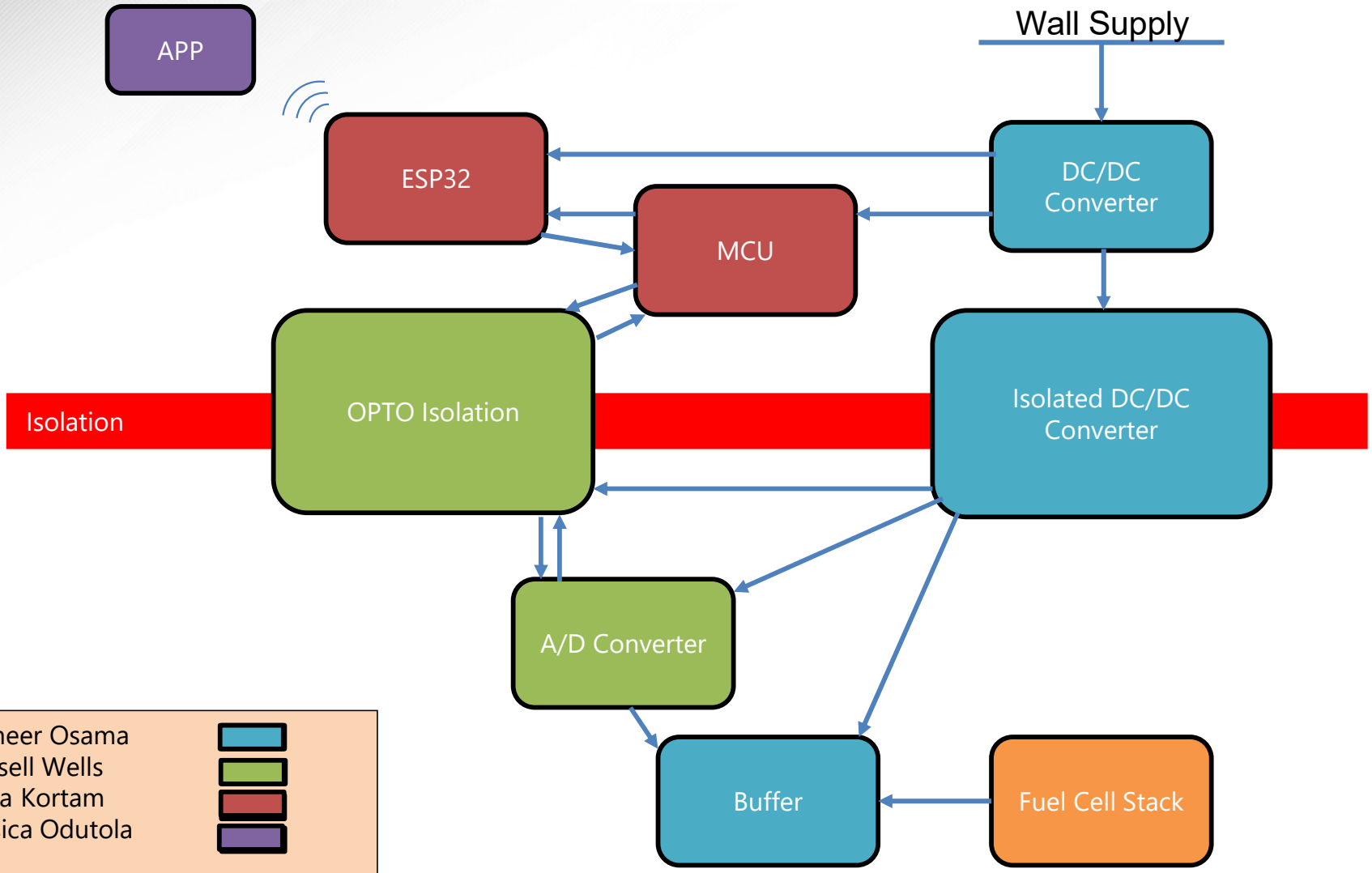
Project Summary

- Problem statement: A single fuel cell is an easy power source to monitor, but to achieve any level of real usable power they must be connected in a stack. Individual cell and the stack voltage must be monitored to ensure both safety and cell integrity.

- The Fuel Cell Monitor System will give the operator real time voltages of both the individual cells and stack. The voltages will be monitorable from an android based mobile app. In case of over or under voltage, the app will notify the operator of the error.

Fuel Cell Monitor Subsystem Diagram



Sameer Osama
Russell Wells
Rana Kortam
Jessica Odutola

Figure 1: Fuel Cell Monitor Block Diagram

Project/Subsystem Overview

- **Power:** Converting of 120V AC from a wall outlet to 5VDC and 3.3VDC which will be used by internal devices.
  Sameer Osama;

- **Cell signal noise reduction:** Use of OpAmps to reduce noise from the fuel cell signal and get the voltage readings before internal transfer and conversion.
  Sameer Osama;

- **Internal Signal Transfer and Conversion:** Convert analog cell voltages to a digital signal before sending to MCU via Opto-Isolators. Transfer of MCU commands and clock signal to ADC's.
  Russell Wells;

- **MCU/ESP:** PIC32 will take voltage readings from the AD converter and will send it to the ESP32. The ESP32 will send the voltages into a database using wifi.
  Rana Kortam;

- **Mobile App:** Will display voltages in both graphical and table format. Will also send alerts to users when errors are detected.
  Jessica Odutola;

Major Project Changes for 404

No Major Changes.

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ECEN 403 Project Timeline and Completion

	9/5/2022	9/12/2022	9/19/2022	9/26/2022	10/3/2022	10/10/2022	10/17/2022	10/24/2022	10/31/2022	11/7/2022	11/14/2022	11/21/2022	11/28/2022	DATE
TEAM DELIVERABLES														
Understand Project Problem														
Project design Overview														Completed
Divide Into Subsystems														In Progress
ConOps Report														Not Started
Create Major Parts List														Behind Schedule
Status Update Presentation														
Final Presentation														
Final Demo														
Final Report														
POWER SUBSYSTEM														
Determine IC Components														
Design Schematics														
Order IC components														
Create PCB footprints in Altium														
Create PCB design in Altium														
Make Gerber files and send to FEDC														
Test components on circuit board														
INTERNAL SIGNAL SUBSYSTEM														
Determine IC Components														
Design System														
Order Components														
Create PCB Schematic														
Assemble and Test Demo														
Create PCB Design														
Order PCB														
MICRO CONTROLLER SUBSYSTEM														
Determine Microcontrollers in use														
Learn IDE to code microcontroller														
Implement "Hello World" on ESP32														
WiFi connection on ESP32														
UART on ESP32														
UART on PIC32														
Array code for PIC32														
AD Converter code														
Connect ESP32 to database														
APP SUBSYSTEM														
App Displays "Hello World"														
App Displays Home Page														
App Displays all pages needed														
Firebase Database Created														
Tables Populated in Database														
Connect Database to App														
App Sends Alerts to Users														
App Works with Test Data														

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Power Supply

Sameer Osama

Accomplishments since 403 40 hrs of effort	Ongoing progress/problems and plans until the next presentation
- Outputting 3.3V and 5V from DC/DC converters	- Ongoing: Passing 5V to the op amps - Future: Testing out the subsystem to make sure power is being supplied where need be

Power Supply

Sameer Osama

Works:

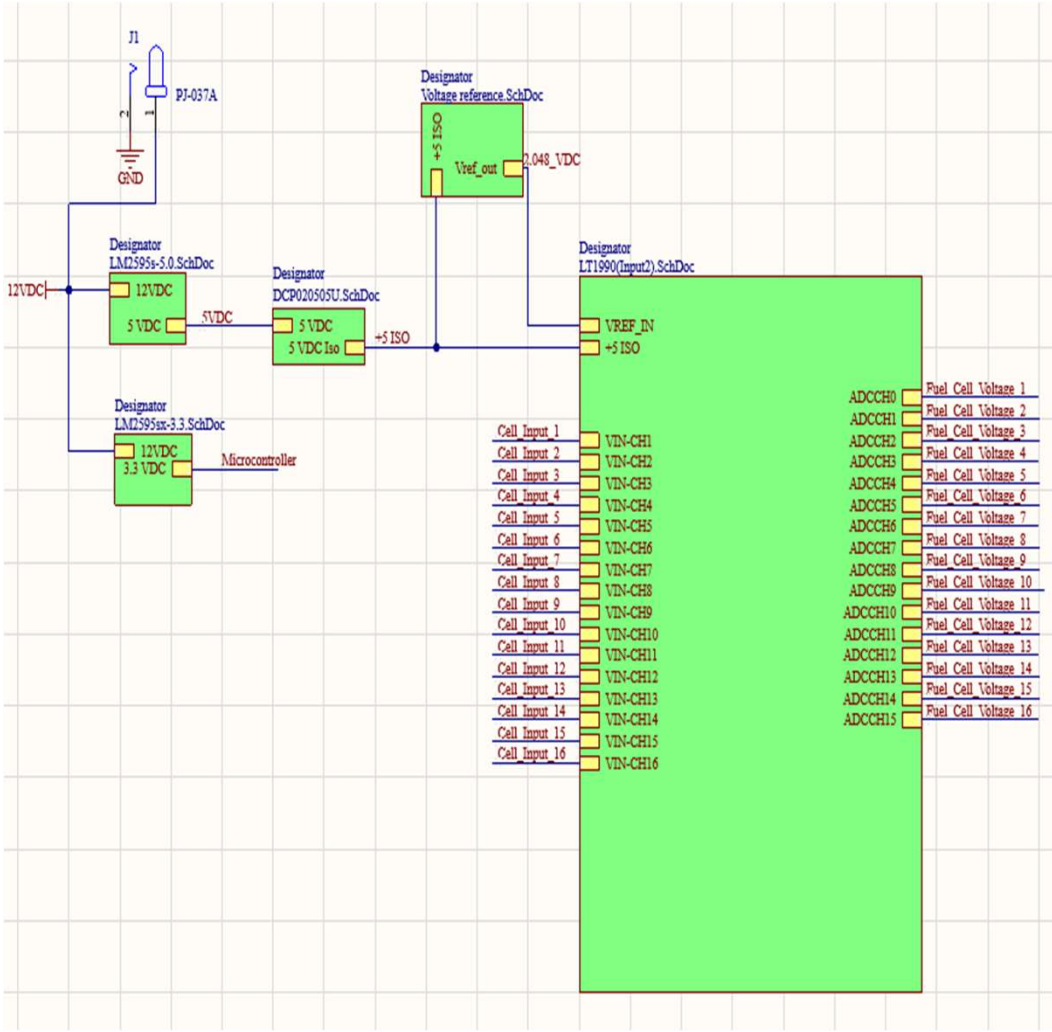
-3.3V outputs from DC/DC converter

-5V outputs from DC/DC converter

-5V outputs from isolated DC/DC converter

Doesn't work:

-5V stops outputting across a resistor



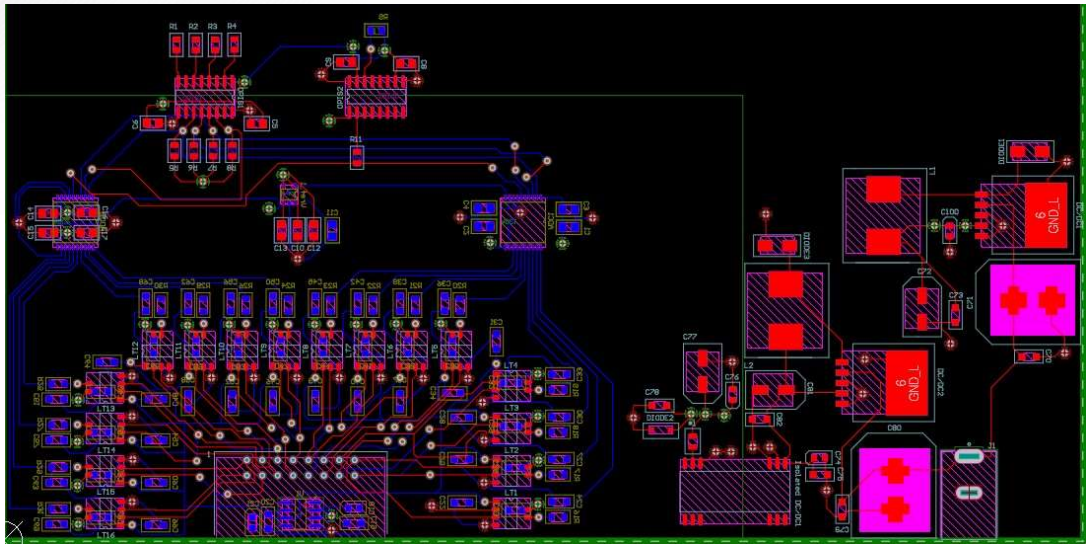
Internal Signal Transfer and Conversion

Russell Wells

Accomplishments since 403 50 Hours worked.	Ongoing progress/problems and plans until the next presentation
N/A	Ongoing: Fully integrated PCB design has been started and is on schedule to be ordered prior February 1st. Future: Follow BOM to ensure all parts are ordered or in inventory.

Internal Signal Transfer and Conversion

Russell Wells



- System is capable of passing digital signal across optoisolation at speeds up to 2MHz
- ADC did not respond but signal was digitally readable. Working toward PCB testing to alleviate noise from original breadboard circuit

PIC32 and ESP32

Rana Kortam

Accomplishments since 403 40 hrs of effort	Ongoing progress/problems and plans until the next presentation
N/A	Ongoing: SPI communication with the AD converter, PCB design for MCU Future: order PCB board, and order parts that are necessary

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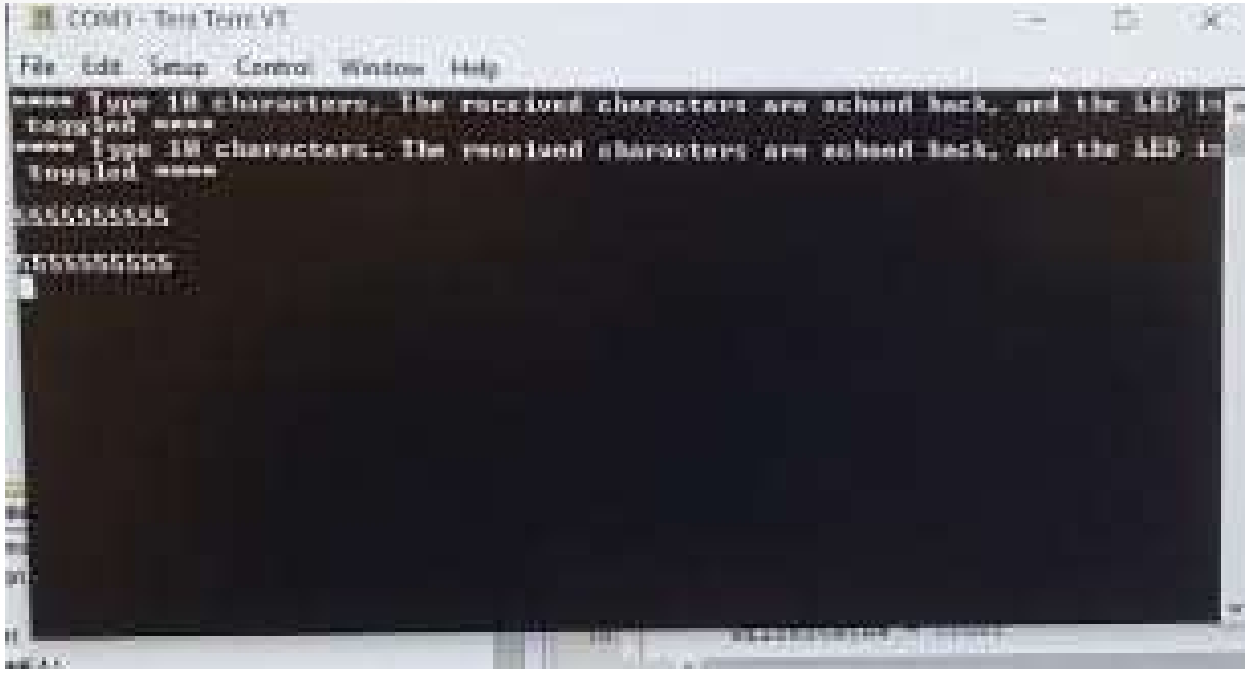
PIC32

Rana Kortam

PIC32 UART communication



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ESP32

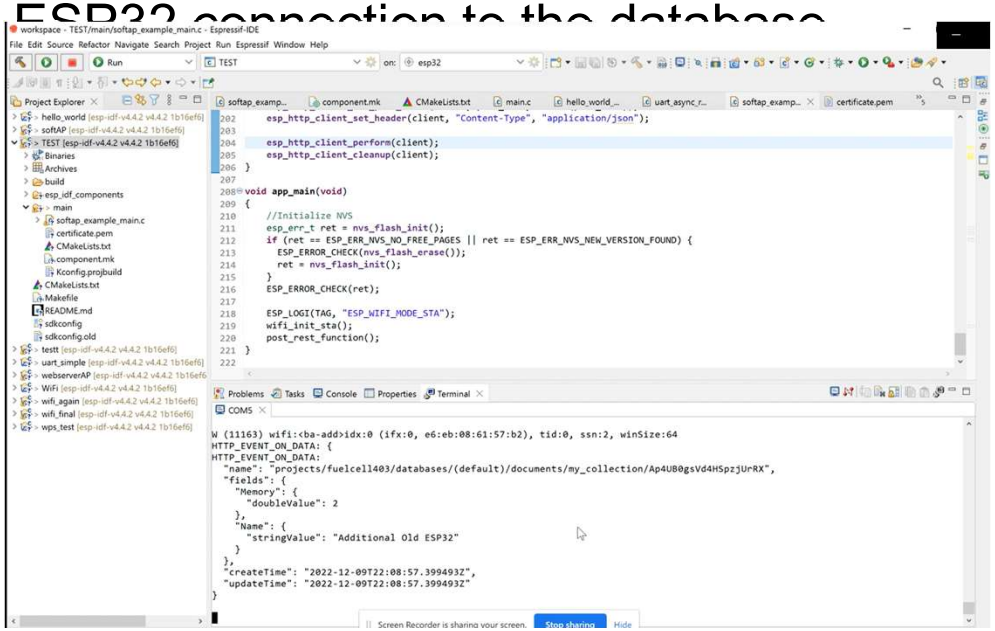
Rana Kortam

ESP32 connection to Wi-Fi

```
I (1148) wifi:connected with NETGEAR82, aid = 7, channel 11, BW20, bssid = b0:7f:b9:13:37:58
I (1148) wifi:security: WPA2-PSK, phy: bgn, rssi: -59
I (1158) wifi:pm start, type: 1

I (1238) wifi:AP's beacon interval = 102400 us, DTIM period = 1
W (1768) wifi:<ba-add>idx:0 (ifx:0, b0:7f:b9:13:37:58), tid:0, ssn:7, winSize:64
I (4558) esp_netif_handlers: sta ip: 192.168.1.15, mask: 255.255.255.0, gw: 192.168.1.1
I (4558) wifi station: got ip:192.168.1.15
I (4558) wifi station: connected to ap SSID:NETGEAR82 password:sillybug998
```

ESP32 connection to the database



Android Application

Jessica Odutola

Accomplishments since 403 8 hrs of effort	Ongoing progress/problems and plans until the next presentation
- N/A	- Ongoing: Reading from database returning null instead of expected values - Future: Reading correct values from the database and connecting to ESP32

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Android Application

Jessica Odutola

Parts Ordering Status

- All ordered Parts from 403 designs are currently available.
- Modifications in the integrated design have required adding components as well as changing certain IC's. These parts are being compiled for ordering.
- Final PCB design is still in progress. Following completion, The BOM will be compared to parts in inventory and missing parts will be ordered.
- All parts are expected to be available by February 7th 2023.

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Execution Plan

	1/17/2023	1/24/2023	1/31/2023	2/7/2023	2/14/2023	2/21/2023	2/28/2023	3/7/2023	3/14/2023	3/21/2023	3/28/2023	4/4/2023	4/11/2023	4/18/2023	4/25/2023		DATE
TEAM DELIVERABLES																	
Update Presentation 1																	
Update Presentation 2																	Completed
Update Presentation 3																	In Progress
Update Presentation 4																	Not Started
Update Presentation 5																	Behind Schedule
Final Design Presentation																	
Final Project Demonstration																	
Order Major Parts																	
Status Update Presentation																	
Final Presentation																	
Final Report Due																	
Final Report																	
Solder and Test Power																	
Solder and Test Signal Transfer																	
Solder and Test Micro Controllers																	
PCB/System redesign and order for Test Problems and Pactec Enclosure																	
Full System Assembly and Testing																	
POWER SUBSYSTEM																	
Troubleshoot system																	
Order extra parts if need be																	
INTERNAL SIGNAL SUBSYSTEM																	
Integrated PCB Design																	
Order Integrated PCB																	
MICRO CONTROLLER SUBSYSTEM																	
SPI communication with ADC																	
Order for Test Problems																	
APP SUBSYSTEM																	
App Reads Values from Database																	
Integration with Microcontroller																	
Full System Assembly and Testing																	

Validation

Paragraph #	Test Name	Success Criteria	Methodology	Status	Responsible Engineer(s)	Notes
3.2.4.2	Power Devices On PCB	PCB transfers power without overheating or burnout	Power Board and watch, smell, listen	Untested	Russell, Sameer	
3.2.1.1	Opto Isolator Capable of Transfering Digital Signal	Opto Isolators are capable of transfering a digital signal at no less than 200kHz	Connect Arduino and pass signal across optoisolator	Passed	Russell	Signal successfully transferred a signal at frequencies up to 2MHz
3.2.1.1	Internal signal voltage range	System can properly handle the specified voltages with minimal difference between tests.	Introduce voltages of 0-4V and measure output signals	FAIL	Russell	Subsystem was tested on a bread board. Signal transfer was successful but ADC failed to convert. Will retest on PCB
3.2.1.1	Differential voltage tests	Pass a differential voltage through the Opamp buffer and receive the proper digital signal from the optoisolator	Introduce a range of voltages including edge cases and ensure proper output	Untested	Russell, Sameer	
3.2.4.4	Android application graphical functionality	Application can properly display accurate voltage levels to user.	Use application on android device and verify volatages are accurately displayed	Passed	Jessica	
3.2.4.4	Android application database read and write data functionality	Application can properly read and write data from Firebase Database	Graph uses data pulled from the database as values	Fail	Jessica	
3.2.4.4	Android application database connectivity	Application can connect to Firebase Database	Verify connection status within application	Passed	Jessica	
3.2.4.4	Android application alarm functionality	Application send alarm to user when voltage goes above or below ranges	Add set points to app and introduce alarm level voltages	Untested	Jessica	
3.2.4.2	Power system functionality test	Power is applied from wall outlet and proper power transfer is read at outputs	Apply power to system and read voltage output at device trace	Untested	Sameer	
3.2.4.1	Opamp system functionality test	Differential voltages are passed to the opamp and expected voltage is seen on the output	Power opamps and apply varrying differential voltages and read output voltage	Untested	Sameer	
N/A	PIC32 Microcontroller functionality test	The code for recieving the voltage signal for data acquisition	PCB board and coding on IDE	Untested	Rana	
N/A	ESP32 Microcontroller functionality test	The code for communicating with the application	PCB board and coding on IDE	Tested	Rana	

Thank you!

Questions?