Solar-Powered Unmanned Aerial Vehicle

NAU SOLAR FLYERS

Final Presentation & Reflection

12.9.22

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Project Sponsor: Gore
Project Advisors: Venkata Yaramasu, Ph. D & Alexander Dahlmann, GTA
Project Partners: ME 486C Team

Solar UAV

Figure 1: Solar UAV Gantt Chart 12/9/22

EE (NAU) Solar Flyers

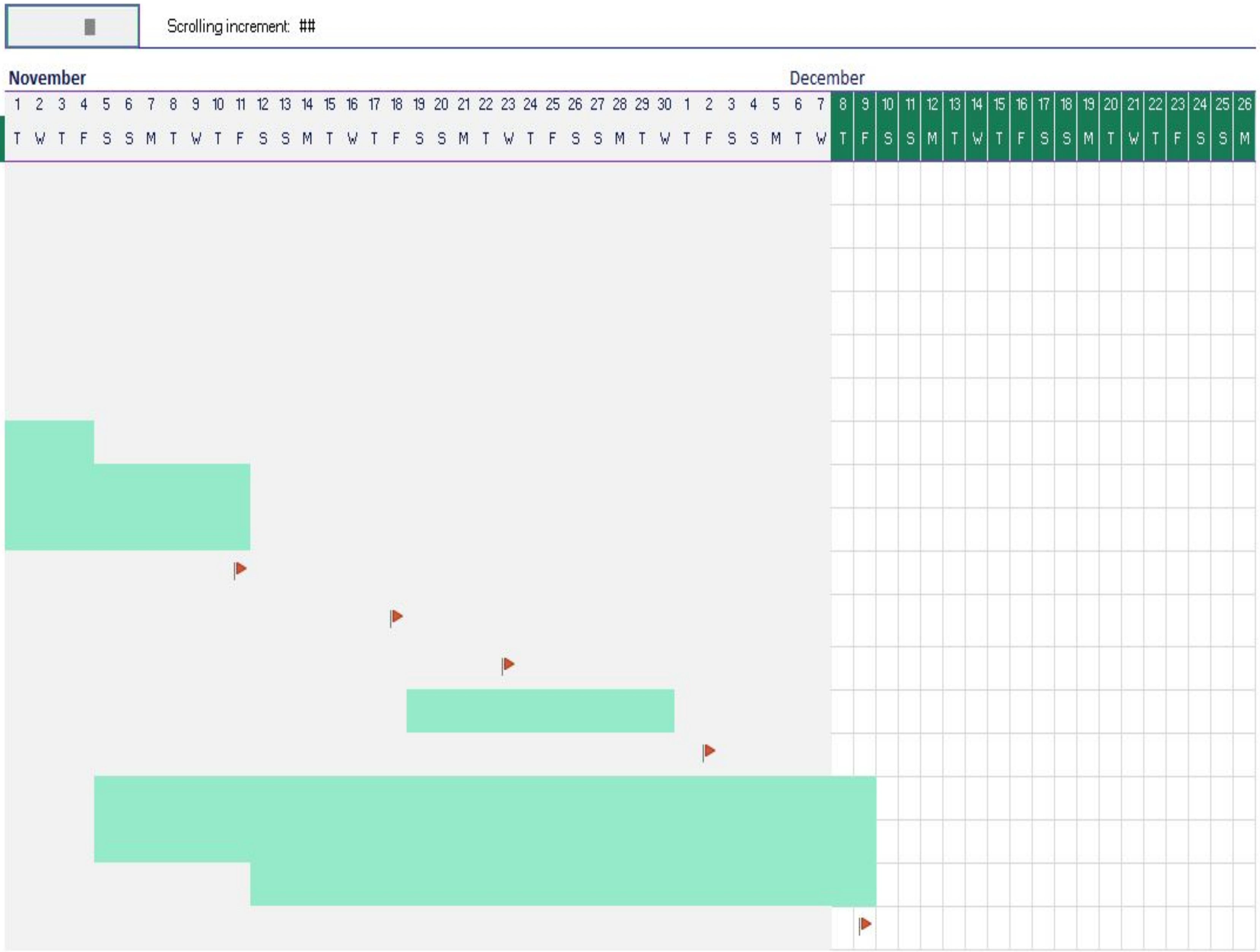
Gabriel Martin & Sultan Alhazawbar

Project start date: 1/10/2022

Milestone marker: 1

Milestones

Milestone description	Assigned to	Progress	Start	Duration (# Days)	Finish
EE476C					
EE486C					
Recap Assessment	G.M	100%	8/29/2022	10	9/9/2022
1/3 Build Assessment	G.M & S.A	100%	9/9/2022	37	10/14/2022
Individual Contribution Assessment	G.M & S.A	100%	10/14/2022	16	10/28/2022
Website Check I	S.A	100%	10/14/2022	16	10/28/2022
2/3 Build Assessment	G.M & S.A	100%	10/14/2022	23	11/4/2022
Team Design Document II	G.M & S.A	100%	10/14/2022	30	11/11/2022
Website Check II	S.A	100%	10/28/2022	16	11/11/2022
Prototyping Phase A: Array Assembly	G.M	100%	11/11/2022	1	11/11/2022
Prototyping Phase B: Charge Controller Configuration / Connection	G.M & S.A	100%	11/18/2022	1	11/18/2022
Prototyping Phase C: Full Integration	G.M & S.A	100%	11/23/2022	1	11/23/2022
UGRAD Poster	G.M	100%	11/18/2022	14	12/2/2022
UGRAD Symposium	G.M & S.A	100%	12/2/2022	1	12/2/2022
3/3 Build Assessment	G.M & S.A	100%	11/4/2022	37	12/9/2022
Team Design Document III	G.M & S.A	100%	11/4/2022	37	12/9/2022
Website Check III	S.A	100%	11/11/2022	30	12/9/2022
Project Completion	G.M & S.A	100%	12/9/2022	1	12/9/2022



Overview

Goal: To construct a solar assisted unmanned aerial vehicle (UAV) that will fly 1 ½ times the duration that a sole onboard battery would fly it for.

Progress Update Since 11.18.22 & Semester Recap

1) Full Integration
2) Concluding Analysis
3) UGRAD's
4) Reflection
5) The Future for Solar UAV's

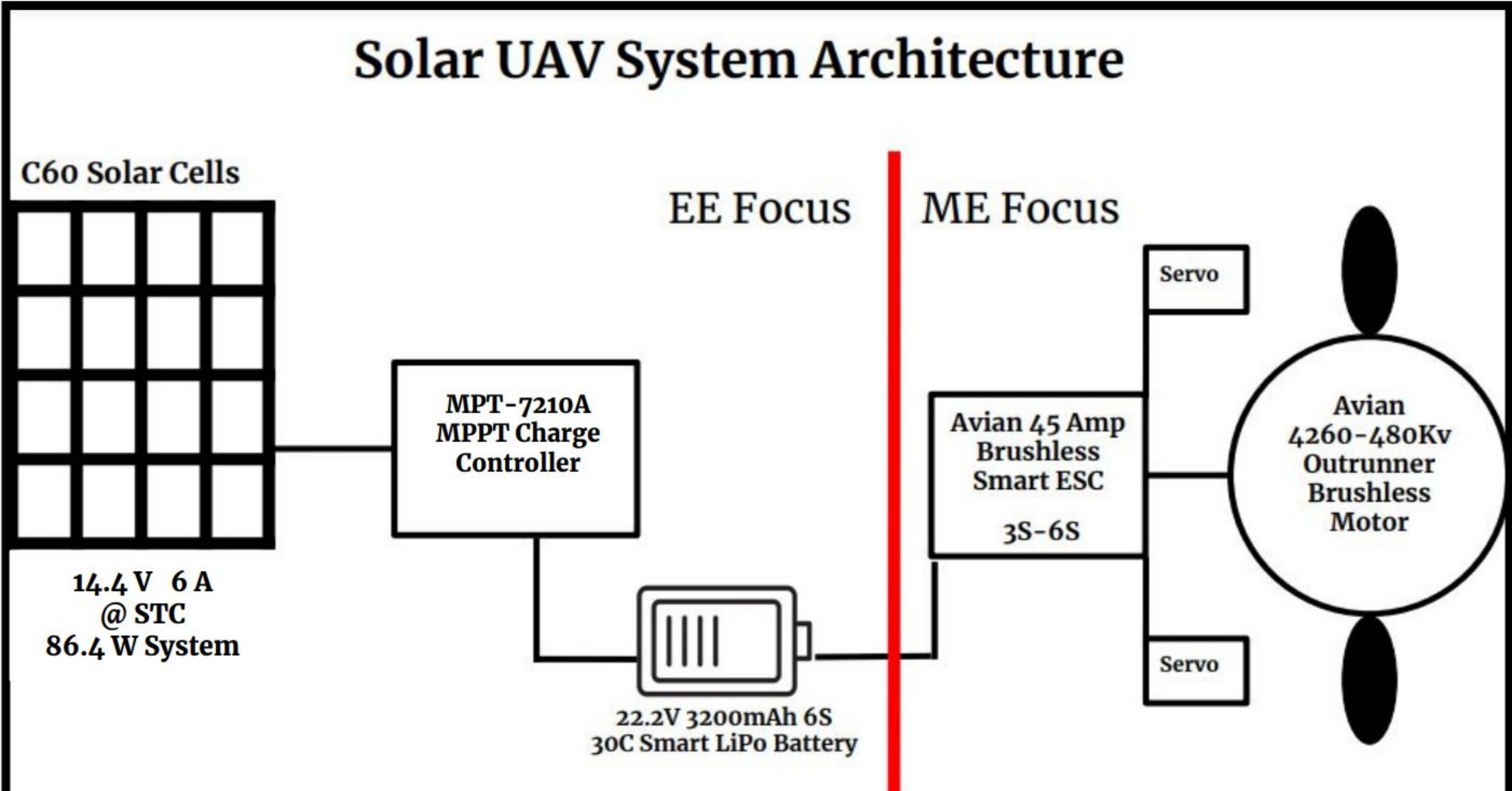


Figure 2: Solar UAV System Architecture

Full Integration

We integrated our solar system onto the mechanical engineering team's UAV.

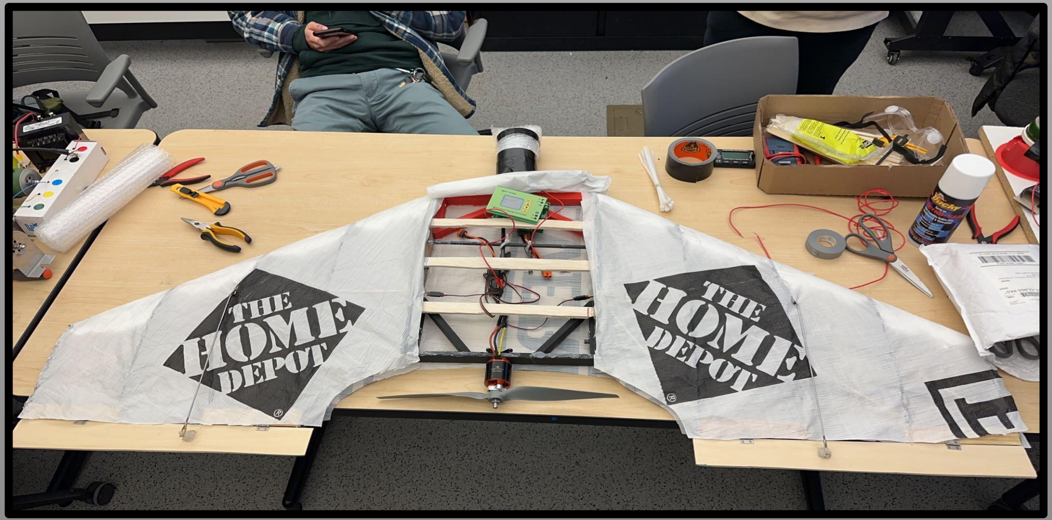


Figure 3: Exposed Fuselage Prior to Integration

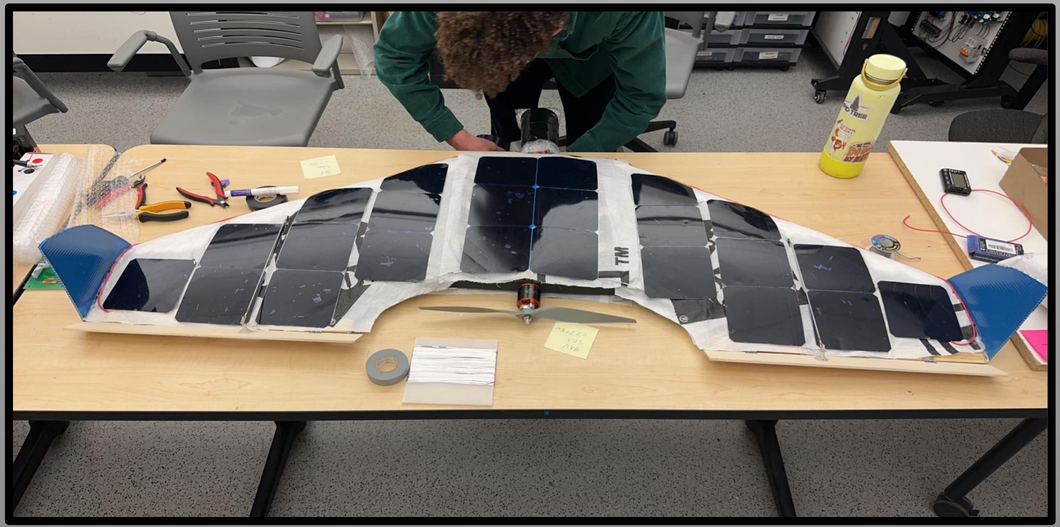


Figure 4: Full Integration of Solar System

- The UAV's plastic coating allows the easy installment of the solar array.
- The charge controller is hooked up to the solar array and the 22.2 V 6S battery inside the fuselage.
- The final product was 5.86 lbs / 2.66 kgs

Full Integration

We developed a charging scheme for our battery.

Our charge controller wasn’t a self-acting MPPT mechanism, that read real-time individual cell capacity, and delivered ideal charge. It was really just a configurable boost converter.

The charge controller only charged the battery with these particular charging specifications. In other words, we found the MPPT.

Our PV input never exceeded 5 Amps, which meant we were never going to be able to charge the battery efficiency enough to meet our goal.

Flight without solar was 6 minutes, flight with solar is just over 7 minutes. Our flight time was only extended 17 %.

Figure 4: Charge Controller Charging Specifications

Charge Controller Application	
- Solar Input Voltage	10.90 - 13.60 V
- Charging Voltage	24 V
- Charging Current	3 - 3.4 A
- Charging Power	70 - 80 W
- Wire Size Connection	Solar - 14 AWG | Battery - 12AWG
- Charging Performance	The charge controller over the course of 30 minutes charged the battery 8% in capacity. Against 45% throttle on ground , 1%.

Tabler 1: Charge Controller Charging Specifications

Concluding Analysis

<u>Not enough solar</u>. An increase of overall PV output allows:

- A higher charging current. A higher charging current allows:
    - The allowance of a better charge controller. A better charge controller allows:
        - A faster charge to our battery. This is where we fall short of our goal.

There are MPPT charge controllers that are used for residential PV systems, but most of them are rated over 100 watts of power, 15 Amps of current, etc.

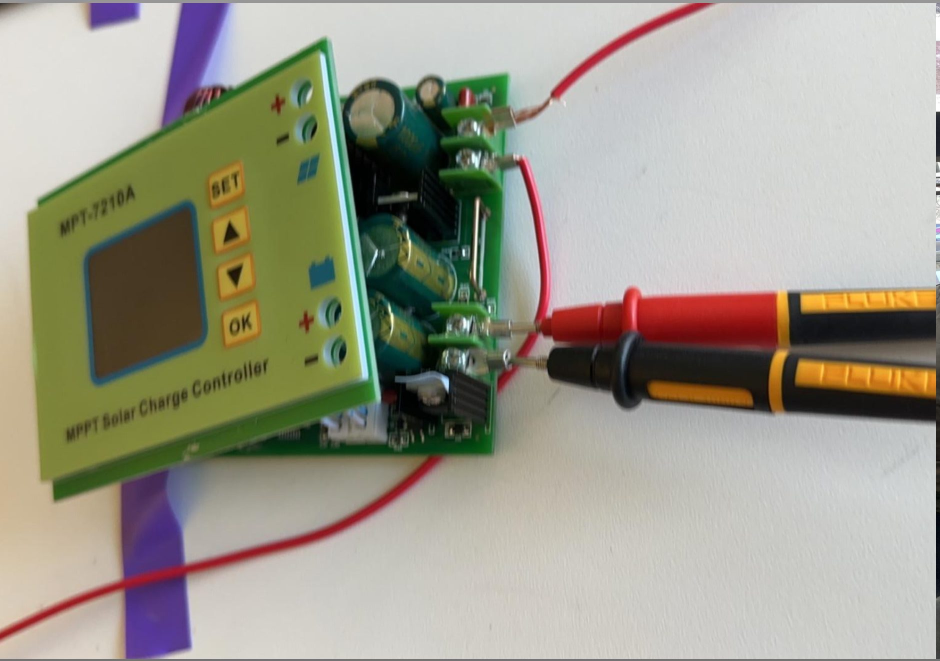
These charge controllers will adequately read PV voltage and overall battery capacity, and output the most efficient charging current. However, they are too heavy or they exceed our PV's compatibility.

There is a heavy restriction for our PV system size because the amount of surface area we were allotted, and the weight we had to stay in bounds of.

Concluding Analysis

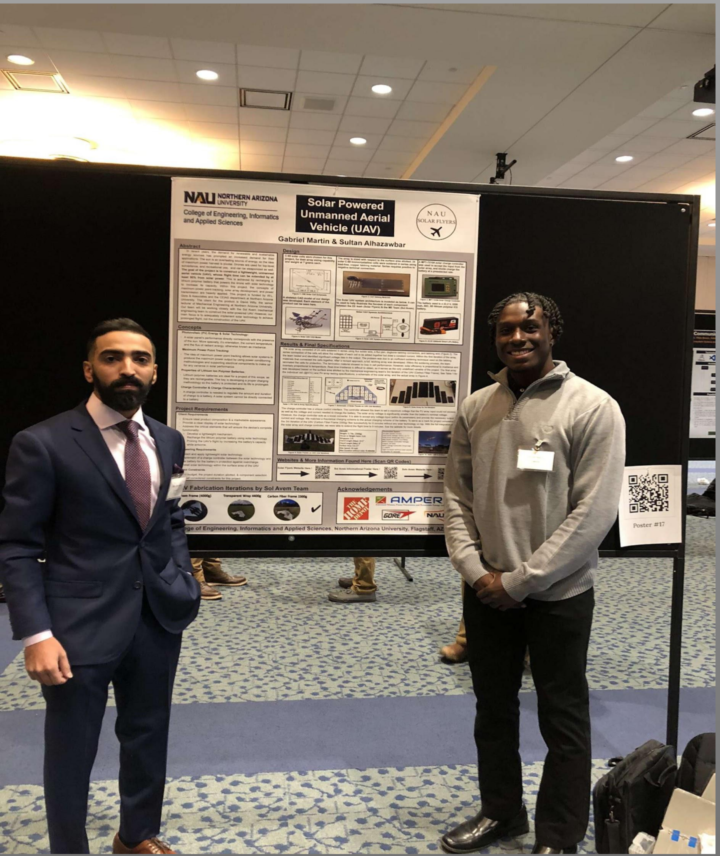
We were still able to recharge the battery, which is the essence of our project. If we can extend the flight time of the UAV even a little, we can develop a new plan to ultimately meet our goal.

We assembled a functional product at most, with all the elements of our system architecture working, separately. We built a working PV array, chose the right charge controller, and installed the entire system on the UAV with everything working as intended.

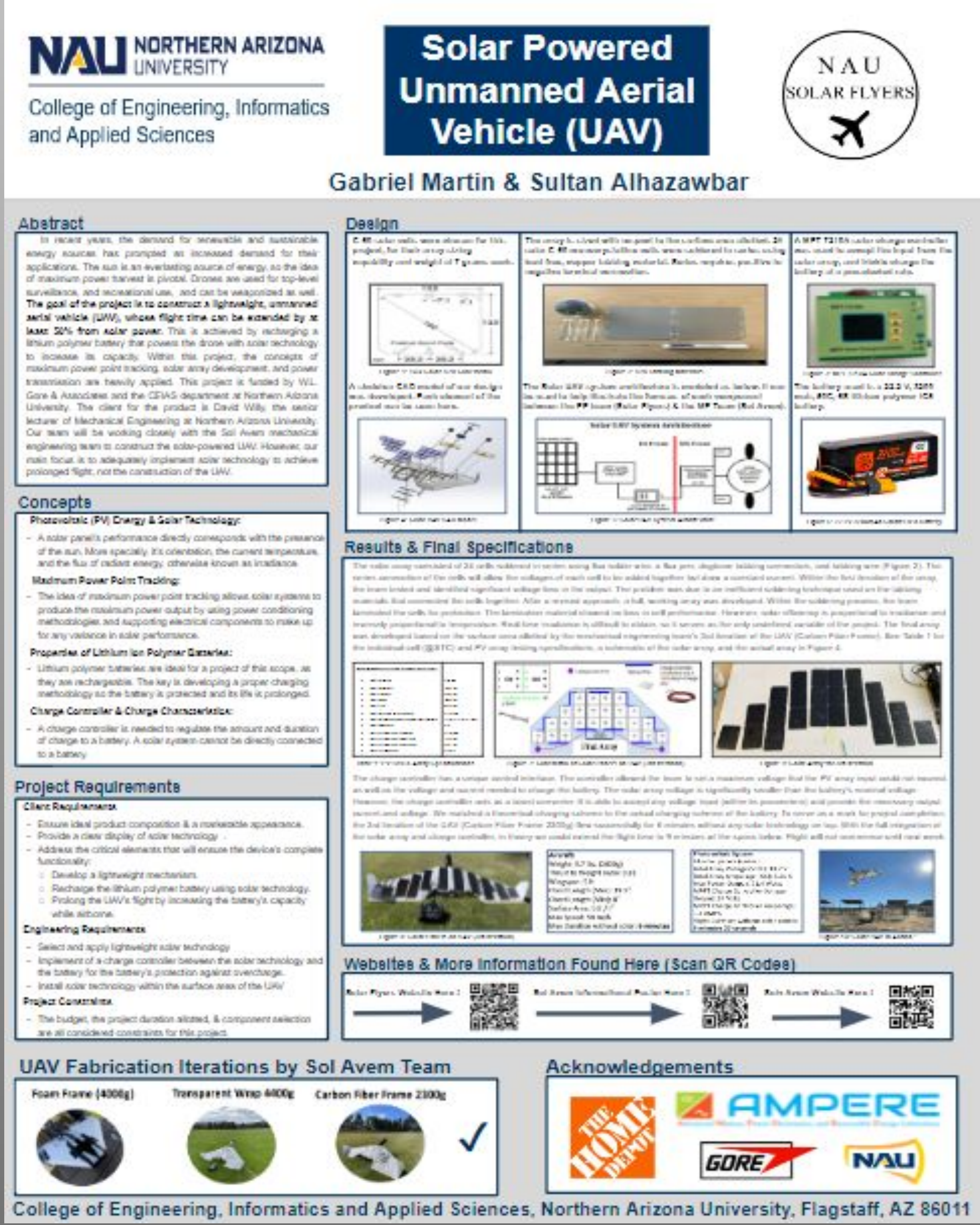


UGRAD’s Festival

We attended the UGRADs Symposium, and spoke with students, professors and surrounding engineering community members about our project.



We received 2nd place in the Electrical / Computer Engineering Category and took home a $600.00 prize



Reflection

Challenges of a multidisciplinary project

Weather & flight testing

Budget allotted

Motor choice

Project flow

5 iterations of the UAV

The Future for Solar UAV’s

Why Solar UAV’s ?

1) Inspiration for similar renewable energy applications

2) Optimal use of a UAV as a tool

3) Prolonged or indefinite Flight

Questions ?