Solar Charging Subsystem

Executive Project Summary

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Small sustainable electronics are an important part of the emerging fields of IoT, sensing, and exploration. Electricity from solar power is a very important energy source in moving to clear energy production.

The scope of this project will be two fully functional designs for a solar charging subsystem: a low output current (100mA) design and a high output current (5A) design will constitute the main deliverables. Three team members have been assigned to a project where two members are working on the circuit design sections of the project and one member is working on the software section, dealing with the microcontroller and the coding.

The project will focus on developing a solar charging system that is as low cost and energy efficient as possible as 2W solar recharging. The design needs to be small, contain its own battery, and have an ability to turn off its output based on an enable signal that when it is disabled. Our project partner, Donald Heer, became interested in this project due to a lack of power subsystems other students can use for their projects. He wants a design where other students can easily build and replicate to power their own systems.

For this project we are designing a circuit, which will be built and tested. This circuit should be easy to read and copy. We must first develop a circuit design on paper, then simulate it using LTSpice. Afterwards, we will prototype the circuit and test it, making adjustments to the circuit as needed. Once the prototyping phase is completed, we will then move to designing and building the printed circuit board in KiCad, undergoing a final testing/debugging phase before submitting schematics to the project partner.

The solar charging subsystem capstone project incorporates both hardware and software side where design of charging circuit and interpretation of data via microcontroller are needed to make the entire system functional. The final significant result of this project as a whole will be two separate designs and KiCad schematics for a solar powered charging subsystem. Students next year will be able to assess whether one of the two designs can meet the requirements for their own project. They will also be able to print their own circuit board for this subsystem using the submitted KiCad files. This will allow next year's capstone seniors to implement solar powered solutions to their project quickly and efficiently without having to completely design a separate system from scratch.

Project Timeline

The purpose of creating a project timeline is to track the chronological order of events. This gives us an understanding of a project at just a glance, keeping the group informed. The reason why we’re choosing a gantt chart to create a project timeline is because it conveys information visually. This gives us an instant overview of a project, its associated tasks, and when these need to be finished. The project goal is to complete all of the required meetings, assignments, and any tasks before the due date, and have our project completed by May 12. We want to utilize this timeline efficiently to keep track of what’s coming and what’s being done.

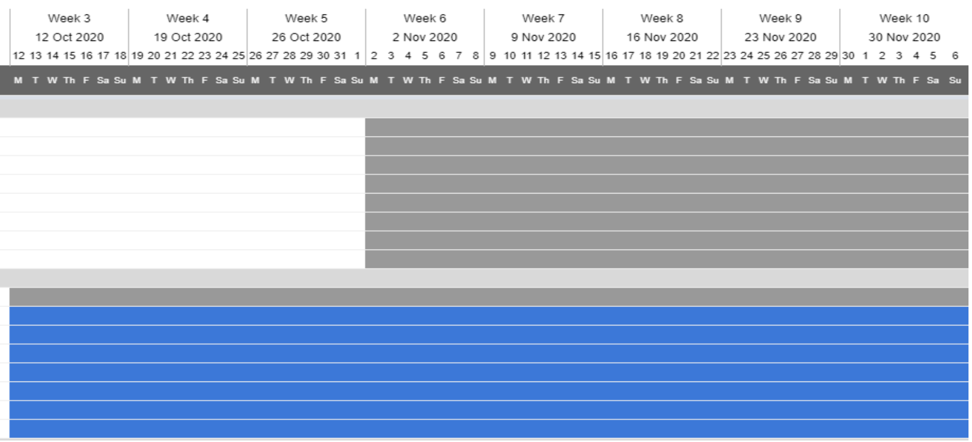
Solar Charging Subsystems Timeline

Oregon State University

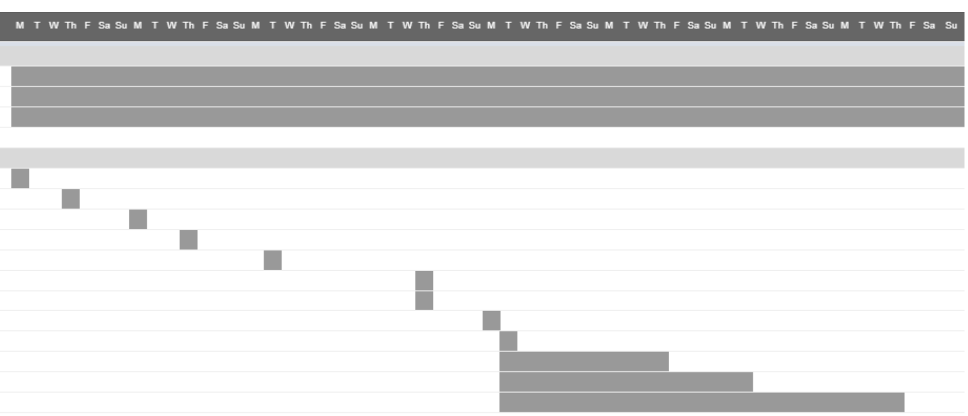
Project Start Date: 9/30/2020 (Wednesday) Display Week: 3

Project Manager: Donald Heer

WBS	Task	Lead	Start	End	Days	% Done	Work Days
1	**Benchmarks**	[Name]					
1.1	Prototype	Field, C	Mon 11/02/20	Fri 12/11/20	39	100%	30
1.2	BOM Selection	Kim,J.	Mon 11/02/20	Fri 12/11/20	39	100%	
1.3	Circuit Design	All	Mon 11/02/20	Fri 12/11/20	39	100%	
1.4	Circuit Simulation	All	Mon 11/02/20	Fri 12/11/20	39	100%	
1.5	PCB Fabrication	All	Mon 11/02/20	Fri 12/11/20	39	100%	
1.6	PCB Testing	All	Mon 11/02/20	Fri 12/11/20	39	100%	
1.7	Code Debugging	Field, C	Mon 11/02/20	Fri 12/11/20	39	100%	
1.8	Order Parts	Kim, J.	Mon 11/02/20	Fri 12/11/20	39	100%	
2	**Milestone**	[Name]					
2.1	Tech Demo Check	All	Mon 10/12/20	Fri 12/11/20	1	100%	45
2.2	Block 1 Check-off	All		Week 13	1	100%	
2.3	Block 2 Check-off	All		Week 16		100%	
2.4	Final Block Check-off	All		Week 19		100%	
2.5	Initial System Check-off	All		Week 24		100%	
2.6	FInial System Check-off	All		Week 27		100%	
2.7	Senior Expo	All		Week 29		0%	
2.8	Party	All		Week 30		0%	



WBS	Task	Lead	Start	End	Days	% Done	Work Days
3	**Technical Demonstration**	[Name]					
3.1	Circuit and Layout	Field, C	Mon 10/12/20	Fri 12/11/20	1	100%	45
3.2	Circuit and Layout	Kim, J.	Mon 10/12/20	Fri 12/11/20	1	100%	45
3.3	Circuit and Layout	Chen, J	Mon 10/12/20	Fri 12/11/20	1	100%	45
3.4	[Insert new rows above this one, then hide or delete this row]						
4	**Meetings**	[Name]					
4.1	Introductory Meeting w/Proje	Kim, J.	Mon 10/12/20	Mon 10/12/20	1	100%	1
4.2	Biweekly Progress Video #1	Field, C	Thu 10/15/20	Thu 10/15/20	1	100%	1
4.3	Scope and Requirements M	Kim, J.	Mon 10/19/20	Mon 10/19/20	1	100%	1
4.4	Biweekly Progress Video #2	Field, C	Thu 10/22/20	Thu 10/22/20	1	100%	1
4.5	Meeting with Project Partne	Kim, J.	Tue 10/27/20	Tue 10/27/20	1	100%	1
4.6	Team Communication Evalu	Kim, J.	Thu 11/05/20	Thu 11/05/20	1	100%	1
4.7	Biweekly Progress Video #3	Field, C	Thu 11/05/20	Thu 11/05/20	1	100%	1
4.8	Instructor System Architectu	Kim, J.	Mon 11/09/20	Mon 11/09/20	1	100%	1
4.9	Meeting With Project Partne	Kim, J.	Tue 11/10/20	Tue 11/10/20	1	100%	1
4.10	Biweekly Progress Video #4	Field, C	Tue 11/10/20	Thu 11/19/20	1	100%	8
4.11	Meeting with Project Partne	Kim, J.	Tue 11/10/20	Tue 11/24/20	1	100%	11
4.12	Biweekly Progress Video #5	Field, C	Tue 11/10/20	Thu 12/03/20	1	100%	18



WBS	Task	Lead	Start	End	Days	% Done	Work Days
4.12	Biweekly Progress Video #5	Field, C	Tue 11/10/20	Thu 12/03/20	1	100%	18
4.13	[Insert new rows above this one, then hide or delete this row]						
5	**Group Assignment**	[Name]					
5.1	Engineering Requirements [	All	Wed 10/14/20	Thu 11/26/20	1	100%	32
5.2	Team Protocols and Standa	All	Wed 10/14/20	Thu 10/15/20	1	100%	2
5.3	Risk Register Assignment	Field, C	Wed 10/14/20	Thu 10/15/20	1	100%	2
5.4	Risk Register Assignment	Kim, J.	Wed 10/14/20	Thu 10/15/20	1	100%	2
5.5	Risk Register Assignment	Chen, J	Wed 10/14/20	Thu 10/15/20	1	100%	2
5.6	Block Diagram Draft	All	Wed 11/04/20	Thu 11/26/20	1	100%	17
5.7	Project Charter Assignment	All	Tue 11/10/20	Thu 11/12/20	1	100%	3
5.8	[Insert new rows above this one, then hide or delete this row]						
6	**Professional Development**	[Name]					
6.1	Professional Development A	Field, C	Thu 10/15/20	Sun 11/29/20	1	100%	32
6.2	Professional Development	Kim, J.	Thu 10/15/20	Sun 11/29/20	1	100%	32
6.3	Professional Development A	Chen, J	Mon 10/12/20	Sun 11/29/20	1	100%	35

Key Lessons

Some of the technical lessons that we learned from this project are:

1. Test and simulate circuits as early on in the design process as possible (fall-winter terms). There will be issues with your design that will not be discovered until you actually physically build your circuits. Waiting too long to do this will result in an extremely heavy workload and unavoidable time constraints.
2. It is preferable to use high side P-channel FETs for battery protection and load switching, as the on resistance of low side N-channel FETs can cause ground voltage issues that will disturb the other circuits in the system.
3. Do not use components with small metrics, they are extremely difficult to solder and electrically verify. Dropping them on the ground on accident is not fun, they are impossible to find when lost.
4. Keep the design as simple as possible. Do not use fancy IC chips when you can avoid them with simpler circuits that you design yourself. Often these multi use IC chips come in packages that are extremely small and are thus very difficult to solder and debug.
5. Build your circuits completely on protoboards (not breadboards) before designing and ordering a PCB. Having to order multiple PCBs is very expensive and time consuming, this can be avoided by triple verifying all circuits on protoboards prior to PCB design.

Some of the group lessons that we learned from this project are:

1. Communicate as much as possible. We believe that a key to success when working in a team is being able to communicate clearly and effectively with each other. When one of the members misinterprets an information, it can fall apart, wasting time and resources.

Luckily, our team had great communication skills. Everytime we met or worked on something, we talked about: what we did, any issues encountered, and the next goal.
2. Share and discuss your design with your teammates in detail. There is a good chance that you might have missed something obvious that a fresh perspective from a teammate will immediately expose. This will only help the project move forward.
3. Help others when needed. Senior design isn’t individual work. Instead, it's teamwork. What makes a great teamwork is when each member goes through any suggestions, work together, and move together to create trust and happiness. For example, because we’re in a remote environment setting due to COVID, when there’s a problem or need help, just hop on Zoom to explain and discuss with the group members. Ask the team’s inputs and agree or disagree with the team, then decide as a team. This is the best way to proceed.
4. Group members are more important than projects. Senior students are busy with other classes and have a lot of work to do besides senior design. It is important to finish and be as productive as possible, but what’s more valuable is each member’s condition and other things that are going on in their life. Taking the time to be there with the groups and listening to each other is more important than the project.