Hybrid solar/battery for electronic derailleur

DESIGN DOCUMENT

sdmay22-01
Client: Dr. Raj Raman
Advisor: Dr. Raj Raman
Team Members:
Aydin Bashich - Lead for resistance to vibrations and overlayer
Connor Davison - Co-lead of overcharge protection
Elba Estarellas - Lead for resistance to vibrations and PV cells
Mohamed Mohammed - Co-lead of overcharge protection
Seth Pierre - Lead for waterproof and attachment of derailleur
Rachel Vallier - Lead for temperature and attachment of derailleur
Jack Waskow - Technical Planning

sdmay22-01@iastate.edu
http://sdmay22-01.sd.ece.iastate.edu/

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Executive Summary

Development Standards & Practices Used

1679.1-2017: Guide for the Characterization and Evaluation of Lithium-Based Batteries in Stationary Applications: https://ieeexplore.ieee.org/document/8262521

> Our project will consist of charging and discharging a lithium battery safely. This standard will help guide us in how to take proper precautions while using the battery,

1562-2021: IEEE Recommended Practice for Sizing Stand-Alone Photovoltaic (PV) Systems: https://standards.ieee.org/standard/1562-2021.htm

> We need to make sure that our PV cell is the proper size for the system, both in terms of the client's constraints and to satisfy our electrical requirements.

Summary of Requirements

List all requirements as bullet points in brief.

- Solar cell replacement for the existing battery of an electronic derailleur
- Solar cell must be within ~2x2.5 in
- Must output sufficient power to fully charge the battery within 6 hours
- Battery must be of sufficient size to last 10 hours in low light
- System must be mechanically robust and weather-resistant

Applicable Courses from Iowa State University Curriculum

Below is a list of courses applicable to our project.

- EE 201: Electric Circuits
- EE 230: Electronic Circuits and Systems
- EE 303: Electronic Systems Design
- EE 491: Senior Design Project 1 and Professionalism

- English 314: Technical Communications

New Skills/Knowledge acquired that was not taught in courses

List all new skills/knowledge that your team acquired which was not part of your Iowa State curriculum in order to complete this project.

- Charge control/sizing for LiPo batteries
- Use of DC/DC converters
- Perf Boards and prototyping beyond a breadboard
- Testing for product durability

Table of Contents

1 Team

1.1 Team Members

1. Mohamed Mohammad
2. Jack Waskow
3. Seth Pierre
4. Aydin Bashich
5. Elba Estarellas
6. Connor Davison
7. Rachel Vallier

1.2 Required Skill Sets for Your Project

Circuit Fabrication

Mechanical Fabrication

1.3 Skill Sets covered by the Team

Circuit fabrication - Mohamed, Jack, Seth, Aydin, Elba, Connor, and Rachel

Mechanical fabrication - Jack, Seth, and Connor

1.4 Project Management Style Adopted by the team

Management shared by the team. Each week, the roles will be rotated so that each member is able to be on the administrative side and technical side.

1.5 Initial Project Management Roles

Administrative - Rachel, Mohamed, Elba

Technical - Jack, Seth, Connor, Aydin

2 Introduction

2.1 Problem Statement

The client has requested a device that can replace the battery of an electric derailleur (an electronic mechanism for shifting gears). The device should consist of a small battery and solar cell and be mounted onto the bike so that it will not be disruptive to riding or storing the bike. Ideally, this will eliminate the need to charge the battery.

Existing charging solutions for these batteries are expensive and require removing the battery to charge it before a ride. Our solution will solve those problems by not requiring an expensive external charger and passively charging the battery while riding.

2.2 Requirements & Constraints

Below is a list of all the requirements and constraints for the project.

Solar Cell must charge the battery in 6 hours of direct sunlight.

Battery must have the capacity to run for 10 hours in low light.

System includes a charge control circuit to protect the battery/prevent overcharging.

System must be mechanically robust.

- Solar cell is compact and attached firmly.
- Battery uses the existing battery's mechanism for attaching to the bike
- Circuits and batteries are built to be weather-proof

Battery and the solar cell must be one unit.

The device must use the existing battery's mechanism and be detachable from the derailleur.

System must be sleek and compact.

Total cost for project limited to $500

2.3 Engineering Standards

Below is a list of the engineering standards applicable to the project and a justification for the standard.

1679.1-2017: Guide for the Characterization and Evaluation of Lithium-Based Batteries in Stationary Applications: https://ieeexplore.ieee.org/document/8262521

> Our project will consist of charging and discharging a lithium battery safely. This standard will help guide us in how to take proper precautions while using the battery,

1562-2021: IEEE Recommended Practice for Sizing Stand-Alone Photovoltaic (PV) Systems: https://standards.ieee.org/standard/1562-2021.htm

> We need to make sure that our PV cell is the proper size for the system, both in terms of the client's constraints and to satisfy our electrical requirements.

2.4 Intended Users and Uses

The product is being designed to the direct specifications of our client, Dr. Raman, an avid cyclist who rides a recumbent bicycle. Ideally, our product will be compatible with most bicycles that the modified derailleur is compatible with. The price point of the standard derailleur likely excludes casual cyclists, so our focus will be on delivering a high-quality product that will appeal to the more serious and invested audience.

3 Project Plan

3.1 Project Management/Tracking Procedures

Here is an explanation of the management style we adopted for our project. The choices were agile, waterfall, or waterfall+agile.

We are going to use the waterfall+agile project management style. This will suit our project because it will allow us to pick the project management style that fits best for each step within our project.

Below is an explanation of how the team plans to communicate.

We will have weekly meetings to communicate our progress. If we need to communicate between meetings, we use email and discord. We will also have an excel spreadsheet to keep track of our progress.

3.2 Task Decomposition

1. Complete Individual Research with a write-up - November 8
2. Compile information with secondary write up - November 19
3. Design completed with schematic - December 10
4. Test on breadboards individual parts/components - February 14
5. Revisions as needed through the testing process
6. Revisit design to implement changes due to testing and have a discussion - February 28
7. Order printed circuit boards - Early March (as soon as possible)
8. Build and test with PCB update process with pictures/video and explanation - March 11
9. Implement design - end of April

3.3 Project Proposed Milestones, Metrics, and Evaluation Criteria

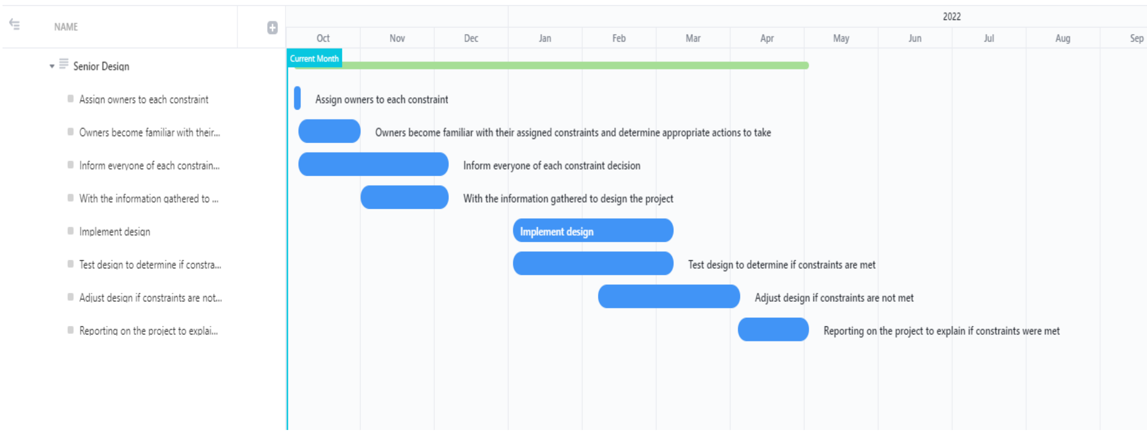
Below are the key milestones for the project. Under each milestone, we have also included evaluation criteria and metrics.

1. Assign owners to each constraint
    a. We will discuss everyone's preferences and determine the owners for each constraint.
2. Owners become familiar with their assigned constraints and determine appropriate actions to take.
    a. Each owner will research and inform everyone of each constraint decision.
3. With the information gathered to design the project
    a. Report on their specific constraint to the group and our client.
4. Implement design
    a. Make sure the implementation follows the requirements and constraints provided by the client.
5. Test design to determine if constraints are met
    a. Compare the results with previously stated constraints.
6. Adjust design if constraints are not met
    a. If the constraints are not met, we will modify the design to make sure the constraints are met.
7. Reporting on the project to explain if constraints were met

   a. Compile a report at the end of the project to determine if the constraints were met.

3.4 Project Timeline/Schedule

Here is a project schedule along with a Gantt chart.



1. Assign owners to each constraint - October 6
2. Owners become familiar with their assigned constraints and determine appropriate actions to take.- October 6 - October 31
3. Inform everyone of each constraint decision - October 6 - December *weekly meeting
4. With the information gathered to design the project - November - December
5. Implement design - January - March
6. Test design to determine if constraints are met - January - March
7. Adjust design if constraints are not met - February - April
8. Reporting on the project to explain if constraints were met - April - May

3.5 Risks And Risk Management/Mitigation

We discussed the risk associated with the specific milestone below for each milestone.

1. Assign owners to each constraint
   a. No risks
2. Owners become familiar with their assigned constraints and determine appropriate actions to take.
   a. Possible that someone may have a constraint that requires more work or help from others. If this occurs, we will have someone help that person or re-assign the task to make the workload more appropriate.

3. Inform everyone of each constraint decision.
    a. Conflict may occur between constraints, so we will need to come together during those conflicts to find a middle ground to accomplish all constraints.
4. With the information gathered, design the project.
    a. Again, the conflict between constraints may occur, if this happens, we will determine different actions to take to meet all constraints.
5. Implement design
    a. The parts may not work together as we anticipate.
6. Test design to determine if constraints are met
    a. Certain constraints may not be met, so we need to determine how to change the design without compromising other constraints that are met.
7. Adjust design if constraints are not met.
    a. Again, need to determine how to appropriately change the design without jeopardizing constraints already met.
8. Reporting on the project to explain if constraints were met.
    a. No risk

3.6 Personnel Effort Requirements

The chart below gives a breakdown of the time required to complete the milestones/tasks discussed above.

Task	Hours
1	~1 hours
2	~5 weekly/person = 140 hours
3	~3 weekly = 30 hours
4	~5 weekly/person = 210 hours
5	~3 weekly/person = 231 hours
6	~2 weekly/person = 154 hours
7	~5 weekly/person = 420 hours
8	~2 weekly = 20 hours

3.7 Other Resource Requirements

Below are the parts required for the project .

- PV Array
- Battery
- Derailleur
- Electrical components
- Enclosure - depends on the prototype

4 Design

4.1 Design Context

4.1.1 Broader Context

Area	Description	Examples
Public health, safety, and welfare	How does your project affect the general well-being of various stakeholder groups? These groups may be direct users or may be indirectly affected (e.g., solution is implemented in their communities)	The bike can be used as a piece of exercise equipment. The derailleur assists. Additionally, the derailleur is run by solar power, which is good for the environment.
Environmental	What environmental impact might your project have? This can include indirect effects, such as deforestation or unsustainable practices related to materials manufacture or procurement.	Increases the use of renewable energy, which decreases the need for nonrenewable energy.
Economic	What economic impact might your project have? This can include the financial viability of your product within your team or company, cost to consumers, or broader economic effects	Maintains a comparable price for a mid to high-end battery. Our target audience is enthusiasts who are willing to spend more on a quality product.

	on communities, markets, nations, and other groups.	

4.1.2 User Needs

Our client needs a way to passively charge the battery for his derailleur because he does not want to charge the battery himself.

Electronic derailleurs are a product that largely appeals to Avid/Invested cyclists and appeals very little to the more casual crowd, so we have chosen to focus on the quality over the product's affordability.

4.1.3 Prior Work/Solutions

There are no known current products on the market like this. However, the client has done some high-level calculations to determine if the battery would be feasible, which he determined it would be.

4.1.4 Technical Complexity

The product will consist of a Photovoltaic array, a lipo battery, and a charge controller to protect the battery from overcharging. These components will be combined into a final assembly that will have to be waterproof, dustproof, and vibration resistant. Lithium-ion charge protection is a meaningfully complex circuit for the scope of this project.

The client has a list of requirements, most notably including a tight size requirement of about 1.5 times the size of the original battery (this must include both our battery and our PV array), including a lucite or epoxy coating, as well as strong weather and vibration resistance.

4.2 Design Exploration

4.2.1 Design Decisions

Below is a list of key design decisions.

1. Based on the client's requests for battery life and charge time, we have selected a battery of 7.4V and 180 mAh.

2. We have decided on a panel with an epoxy dip to satisfy the client's request for a rigid outer coating.
3. The panel will be mounted directly to the derailleur for a low-profile design, per the client's request to prioritize that aspect.

4.2.2 Ideation

Below is a description for one design decision for the project. For this design decision we included five options that we considered.

Decisions regarding the location of the solar panel:

1. Mount it directly to the derailleur
2. Mount it to a point higher on the bike and run a wire
3. Mount it to a rear-wheel guard
4. Mount it to handle-bars/frame
5. Make an attachment that would mount to the seat post

4.2.3 Decision-Making and Trade-Off

To decide the location of the solar panel, we weighed the option between putting the solar cell where the client preferred against where the solar cell would perform the best. The length required for the possible wire was also considered, especially when moving parts like the handlebars. Also, the client wanted to have minimal wires if the cell was not directly mounted.

We decided on mounting the solar panel directly to the derailleur, despite the loss in performance that location will cause. We believe that, based on the specifications of the panel and battery, even at roughly 60% efficiency, the panel will charge the battery within our target timeframe.

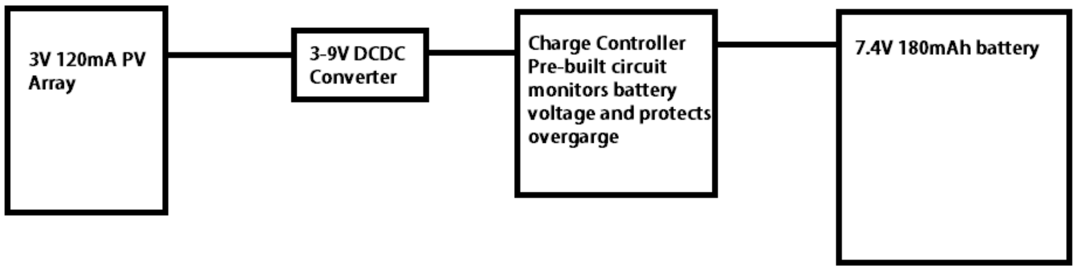
4.3 Proposed Design

Below is a description of what we have been able to implement/test so far.

Our ability to test so far has been limited by lack of access to the parts and derailleur, but we have a conceptual design and parts selected and on order.

4.3.1 Design Visual and Description

Here is a visual description of our current design. Additionally, there is an explanation of the design as well.



Our current design is a block diagram that helped guide our part selection and an idea of the physical construction of the project. Based on our clients requirements for charge time and battery capacity, we needed a minimum battery size of 100 mA and a solar cell that could charge the battery within 6 hours. Using a dc-dc converter to step up the PV voltage and a charge controller to protect the battery was achievable.

4.3.2 Functionality

Our design is intended to mount to the side of the bike with no wires and charge the derailleur battery during daytime riding while having the capacity to power long nighttime rides as well.

4.3.3 Areas of Concern and Development

One main concern with the current design is that we might not get enough sunlight to charge the battery within the time constraints our client requested. We will start by testing this in multiple different light levels and orientations to see if it really is a concern we need to worry about.

4.4 Technology Considerations

Here is a discussion of a design alternative.

Opting for a small solar panel to fit the client's priority for a sleek design has limited our possible power output for the circuit. Assuming roughly 60% efficiency we will still charge the battery in the requested 6 hours, but that still assumes fairly ideal conditions that we cannot guarantee. Using a larger panel in a better location would be ideal for functionality, but that clunkier design is something the client doesn't want.

4.5 Design Analysis

Below is a discussion of our proposed design from 3.3. In this discussion, we explain any modifications to the design.

Our proposed design from 3.3 was not successful, we needed to change it based on part availability and the requested profile and size of the final product. Solar arrays of the size requested did not put out the required voltage, so we had to use a dc/dc converter to step voltage up enough to charge the battery.

5 Testing

5.1 Unit Testing

1. PV panel
    a. Testing to ensure charges in 6 hours
2. Final Assembly
    a. IP 58 certification
    b. Resistant to vibration
    c. Operable Temperature Range from -10 C to +45 C
3. Battery
    a. Testing to make sure the battery is able to hold a charge
    b. Testing to make sure the battery is able to charge and discharge
    c. Testing to make sure overcharge protection is appropriate
4. Charging circuit
    a. Testing to make sure overcharge protection is appropriate

5.2 Interface Testing

Testing the interface between the battery and PV panel to make sure charging is appropriate. The voltage and current must be held at a constant value until the battery is fully charged to safely charge a lithium-ion battery.

5.3 Integration Testing

1. Testing to see if the battery we design is able to attach to the current structure properly.

2. Testing the solar panel to make sure it is attached seamlessly to the structure.

5.4 System Testing

Mechanical testing of the system to make sure the system is resistant to vibration, fully submersible to elements, including dust, rain, snow, etc. For 1 hour, and operable from -10C to 45C. Electrical testing to make sure the system is fully charged within 6 hours, able to run for 10 hours in the dark, and overcharge protection for the battery.

5.5 Regression Testing

Continuing to test the derailleur is working correctly without a lower performance than stock.

5.6 Acceptance Testing

Our client will be kept in the loop on the results of our tests during our weekly meetings. He will have input on any compromises we feel are necessary to pass or change those tests and will be able to offer his insight on what factors are most important to him.

5.7 Results

We do not have any results currently since we are still in the project's design phase. However, once we have results, we expect our testing initially will not to meet all the requirements of our project, so we will adjust the design accordingly. In the end, we expect our results to match the requirements.

6 Implementation

Described below is the implementation plan for next semester.

Our 3.3 design is largely obsolete, as we found that the solar cell required to make that design work is not available at the size we need, but the design in this document is the one we plan to implement next semester. We plan to first prototype and test the charging circuit with a bench voltage supply to get good data on its functionality before introducing the 'random' factor of the solar panel. We will also test the panel's output independent from the circuit to find which one, in our case, performs the best. Finally, we will combine the two and design an outer case for the full assembly, and create a connector to allow it to interface with the derailleur.

7 Professionalism

This discussion is with respect to the paper titled " Contextualizing Professionalism in Capstone Projects Using the IDEALS Professional Responsibility Assessment", *International Journal of Engineering Education* Vol. 28, No. 2, pp. 416–424, 2012

7.1 Areas of Responsibility

For this section we choose to look at the IEEE Code of Ethics and discuss the definition, NSPe Canon, and the specific code of ethics that applies to each area of responsibility.

Area of responsibility	Definition	NSPE Canon	Society-specific code of ethics
Work Competence	Perform work of high quality, integrity, timeliness, and professional competence.	Perform services only in areas of their competence; Avoid deceptive acts	IEEE Code 6 - This code focuses on undertaking tasks that match the professionals' competence. Additionally, it emphasizes that the professional must maintain and gain new knowledge in the field.
Financial Responsibility	Deliver products and services of realizable value and at reasonable costs	Act for each employer or client as faithful agents or trustees.	IEEE Code 3 - Honest and realistic communication is important to managing the finances of a project.
Communication Honesty	Report work truthfully, without deception, and are understandable to stakeholders.	Issue public statements only in an objective and truthful manner; avoid deceptive acts.	IEEE Code 3 - This code highlights being honest about the work done and communicating with everyone about your status.

Property Ownership	Respect property, ideas, and information of clients and others.	Act for each employer or client as faithful agents or trustees.	IEEE Code 9 - This code emphasizes the ethic that we have respect for property and the reputation of clients. Additionally, it focuses on not damaging client property.
Health, Safety, Well-being	Minimize risks to the safety, health, and well-being of stakeholders.	Hold paramount the safety, health, and welfare of the public.	IEEE Code 9 - This code focuses on avoiding injuring others, their property, reputation, or employment.
Sustainability	Protect the environment and natural resources locally and globally.		IEEE Code 1 - This code focuses on striving to comply with ethical design and sustainable development practices.
Social Responsibility	Produce products and services that benefit society and communities.	Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.	IEEE Code 1 - This code is focused on considering public health and wellbeing in the design of products, which covers being socially responsible toward society and communities.

The IEEE code of ethics is focused more on the technical side of ethics. However, NSPE code of ethics is more general and could be applied to any field.

7.2 Project Specific Professional Responsibility Areas

For this section we explained how each area of responsibility applies to our project. If the area of responsibility did not apply, we also noted that.

Area of Responsibility	If / How it Applies

Work Competence	This area applies to our project because it encompasses a wide spectrum of 'doing our job well. Work competence means understanding our technology, performing high-quality work, and being on time and professional with our client, all of which are important to any project.
Financial Responsibility	This area applies to our project because we have been given a specific budget for our project that we have to meet for the client.
Communication Honesty	This area applies to our project because we have to maintain honest communication between all of us. To have a more acquired knowledge of the progress we are making and what needs to be finished.
Property Ownership	We are working on modifying the device belonging to the client, and respecting that in our testing and building prototypes, and not treating the device carelessly.
Health, Safety, Well-being	This area does not apply to our project.
Sustainability	This area applies to our project because we are using the solar cell as a source to charge a battery.
Social Responsibility	This area does not apply to our project since our final product will only benefit one user.

7.3 Most Applicable Professional Responsibility Area

The area of professional responsibility that is important to our project and team is work competence. This is important because this responsibility focuses on working in a timely manner with integrity to deliver high quality to the client. For our project specifically, we have mapped out a timeline for the client with key deliverables and dates associated with the deliverables. This allows the team to stay within an appropriate timeframe and allows the client to have an understanding of when to expect key tasks to be accomplished.

8 Closing Material

8.1 Discussion

Below is a discussion of the results of our project.

For the time being, we do not have a physical product to discuss, our results are the valuable notes and design we have from our routine meetings with our client, and a very clear vision for the project moving forward. We plan to move into more robust design and physical construction in the spring semester, and have parts on order to do so.

8.2 Conclusion

Below is a summary of the work that has been completed on the project so far.

As we laid out in our project plan, our goals for this timeframe were to have research done on the various constraints of the project and have a strong understanding of the requirements the client has. We hoped to have a more robust electrical design by December, and currently only have a block diagram detailing our plan for the circuit. This was made difficult by the time it took us to get a clear understanding of our client's vision for the project and could be made much more efficient in the future with better initial questioning and early design mock-ups to more clearly express ideas.

8.3 References

"Environmental Testing- Part 2-27: Tests - Test Ea and Guidance: Shock." Cloudflare-Ipfs.com, https://cloudflare-ipfs.com/ipfs/bafykbzacea2053qv6fbdbexwfi5sbt346cwxlmtulhl3wgutnevqg50zdzxwi?filename=IEC%20-%20IEC%2060068-2-27%20ed4%2C0%20Environmental%20testing%20-%20Part%202-27_%20Tests%20-%20Test%20Ea%20and%20guidance_%20Shock%20%282008%29.pdf.

Niclas, "Measuring the temperature coefficient of a PV module," *Sinovoltaics*, 12-Feb-2016. [Online]. Available: https://sinovoltaics.com/solar-basics/measuring-the-temperature-coefficients-of-a-pv-module/. [Accessed: 11-Oct-2021].

8.4.1 Team Contract

Team Members:

1) Mohamed Mohammad 2) Jack Waskow

3) Seth Pierre 4) Aydin Bashich

5) Elba Estarellas 6) Connor Davison

7) Rachel Vallier

Team Procedures

1. Team Meetings
    a. Monday at 1:10 with the client, Dr. Raman (over zoom).
    b. Monday at 2 with TA, Christopher (over Webex).
    c. Wednesday at 2:10 team meeting (over discord).
2. Communication
    a. The main form of communication between the team is discord and email.
    b. Communicate with the professor and TA over email.
3. Decision-making policy
    a. Mainly consensus if there are disagreements we will use majority vote.
4. Record keeping
    a. Keep a record of each meeting, what is discussed, and questions.
    b. A folder in google drive will store all the records.

Participation Expectations

1. Individual expectations
    a. Arrive on time for meetings, if you will be late let others know.
    b. If unable to attend, let the group know before the meeting starts.
    c. Everyone can contribute ideas during meetings.
    d. If someone is not contributing/engaging we can talk to the individual.
2. Responsibilities
    a. Everyone should contribute accordingly to their specific task to accomplish their goal.
    b. Make sure each individual completes their task on time.
    c. If something comes up and a deadline can not be met let the team know.
3. Communication
    a. Let the group know at least a few hours before a meeting if unable to attend.
    b. Be honest with each other on the progress of the project.
4. Commitment
    a. We will work together to achieve the tasks.

Leadership

1. <u>Roles for team members</u>
    a. 2 members will focus on meeting minutes, communication, and administrative tasks.
    b. 4 members will focus on the technical aspects of the project.
    c. 1 member will be a “floater” which will depend on the needs of that specific week.
    d. We intend to rotate through the roles throughout the project.
2. <u>Supporting and guiding each other</u>
    a. Keep an open mind and don’t be afraid to ask questions.
    b. Be willing to ask for help.
3. <u>Recognizing contributions</u>
    a. When specific milestones are hit, acknowledge the member(s) that were responsible for that work.
    b. Give a “shoutout” within the team if someone does something above what is expected.

Collaboration and Inclusion

1. <u>Skills, expertise, and unique perspectives</u>
    a. Mohamed Mohammad - Power systems
    b. Jack Waskow - Analogue & Digital electronics
    c. Seth Pierre - Communications & Signals and Systems, knowledge with soldering and bike parts/maintenance
    d. Aydin Bashich - Power and control systems
    e. Elba Estarellas - Semiconductors Materials and Circuits
    f. Connor Davison - Circuit Design and VLSI Design
    g. Rachel Vallier - Control Systems
2. <u>Strategies for encouraging</u>
    a. Have an open team environment.
    b. Make sure multiple ideas and perspectives are shared.
    c. Make sure everyone’s voice is heard.
3. <u>Resolve collaboration or inclusion issues</u>
    a. If you are comfortable with speaking through the issue, share it during the team meeting on discord. If not, you can send an email or message to the team separately.
    b. If a team member is suddenly not engaged we can check in to make sure everything is okay.

Goal-Setting, Planning, and Execution

1. <u>Team goals for the semester</u>
    a. Have the design for the project completed.

   b. Have a good understanding of how to communicate and work together as a team.
   c. Rotate roles to determine the best roles for each team member.
2. <u>Strategies for planning and assigning individual and teamwork</u>
   a. Determine individual strengths and assign tasks based on strengths.
   b. Discuss in team meetings to determine individual assignments.
3. <u>Strategies for keeping on task</u>
   a. At our weekly meetings on Wednesday, we will all discuss our accomplishments during that week.

Consequences for not adhering to team contract

1. <u>Handle infractions</u>
   a. Initially handle the issue amongst ourselves, if it is a repeated issue then we can escalate the issue to the TA and then professors.
   b. If 2 individuals are having issues initially discussed amongst each other, but then escalate to the team setting if it becomes a bigger issue.
2. <u>What if infractions continue</u>
   a. Initially talk during the team meetings.
   b. After several attempts of working through the issue, we will then address the issue to the professors or TA.

****

a) I participated in formulating the standards, roles, and procedures as stated in this contract.

b) I understand that I am obligated to abide by these terms and conditions.

c) I understand that if I do not abide by these terms and conditions, I will suffer the consequences as stated in this contract.

1) Rachel Vallier	DATE: 9/16/2021
2) Connor Davison	DATE: 9/16/2021
3) Seth Pierre	DATE: 9/16/2021
4) Elba Estarellas	DATE: 9/16/2021
5) Mohamed Mohammad	DATE: 9/16/2021
6) Jack Waskow	DATE: 9/16/2021
7) Aydin Bashich	DATE: 9/19/2021