2^{nd} Generation Charging Station

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Team 13

Progress Report for ME486c
Document

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1.0 Introduction

This year's capstone team was assigned the task of completing and improving the 2nd Generation Charging Station that was originally started by a previous year capstone team. After much analysis of the previous year's design work, this year's team has chosen to go a new direction with the power generation to improve reliability and simplicity. This year's team is building a charging station that uses a car alternator with a fly wheel that is spun via traction from the rear bike tire. This means that there is no gearing system and thus less parts that can fail or lower efficiency. The team has also chosen to use commercial capacitors as the storing and conditioning components of the electrical system. This combines the two roles into one and also saves time and effort in the design and build process. This progress report is categorized into three sections. The first is *Completed So Far* which talks about tasks that have already been completed so far. The second section is called *Tasks in Progress* and talks about the tasks that the capstone team is currently working on. The last category is *To Be Completed* and talks about the tasks that will be completed in the near future, after the tasks in progress have been concluded. A timeline has also been made that gives the deadlines assigned for each task in chronological order.

2.0 Completed So Far

This year's capstone team has made significant changes to the previous year's charging station concept. The bike has been partially disassembled of the gearing system and completely disassembled of the bike stand. Most of the bike parts have been selected and emailed to our client for purchasing, a list is given below and pictures can be found in Appendix A. Some parts still need to be ordered in the future but have already been selected and incorporated into current design plans.

2.1 Bike Disassembled

Since significant changes have been made to the previous year's design concept for the charging station, many parts required disassembly from the bike. Some parts that need to be removed but are still attached are the DC motor and mount and the rear gear. These will require more elaborate removal procedures and adjustments to the bike's structure once they are removed.

2.2 Parts Ordered

Four parts have been selected and emailed to the client for purchasing. These parts should arrive within the following week and once they do, the team will begin testing and building the charging station. The four parts the team has ordered are the Self-Exciting Alternator, Power Acoustik 2.0 Farad Digital Power Capacitor, Electric Barrier Terminal Block (4 pieces), and Bicycle Trainer Stand. The table below represents the purchase requisition submitted to the client.

Table 1- Purchase Requisition

Component	Cost ($)
Alternator	64.93
Capacitor	45.13
Terminal Block	6.81
Bicycle Trainer Stand	72.18

3.0 Tasks in Progress

With the parts ordered, some of them will require testing to ensure they function properly with the rest of the system. The items with the highest priority include the capacitor and alternator, the display screen programming, the retrofit mount for the alternator on the bike stand and the electric control system. These items must be tested, analyzed and designed before the project can move forward into the building portion.

3.1 Alternator and Capacitor Testing

The Alternator will require testing to find the average power output and minimum required start up speed. The alternator should output a voltage of 12-15 volts and the testing will ensure that this hold true. This will be done with the electrical tools and equipment found in the engineering building. The alternator will be set so that it can be quickly spun and a computer will read the outputs and display them for the team. The alternator also contains an internal voltage regulator. The alternator that we are purchasing, one-wire, self-exciting, is a more advanced type of alternator that does not require a battery to start up. This means that it can supply the necessary voltage itself as long as it is being spun at a high enough rate. Our testing's will find that required speed and ensure that it is easily attainable by the average riders speed and endurance. The capacitor will be tested to see if it can handle the inconsistent voltages coming from the alternator and conditioning it into a much more stable and safe current. The capacitor that we chose is used in automobiles to supply extra stable power to the car's audio system which is very sensitive to unstable currents. This means that it should work perfectly for our needs

3.2 Interactive Display Screen Design

The LabVIEW program will not work for this project. As an alternative, the design will go back to using an Arduino Microcontroller, which was the idea before the LabVIEW program was found. The Arduino uses C++ for programming. Team members will need to research C++ programming specific to the Arduino Microcontroller. The main goals for the display screen is for it to display useful data and information to the rider and for that data to be put in a type of format which allows the rider to manipulate what they are viewing.

3.3 Alternator Mounting System

A mounting system for the alternator will be built and tested to maximize stability and durability of the charging system. In order to maintain efficiency, the alternator will be attached to the bike stand near the rear of the tire. This will enable the alternator to be fastened to the stand and also be close enough to the rear tire to create the desired power. Wood will be used as the first material to generate a working prototype, then aluminum will later replace the wood to reduce the weight of the overall system. Engaging and disengaging the alternator is an important feature to ensure that the charging station is transportable. Therefore, a swivel and/or locking device will be built to support this constraint.

3.4 Electric Control System Design and Build

The electric control system will be completing mapped out so that it can be easily built into the designed enclosure. Attached is a diagram of the electric control system and how it will look once it has been completely put together.

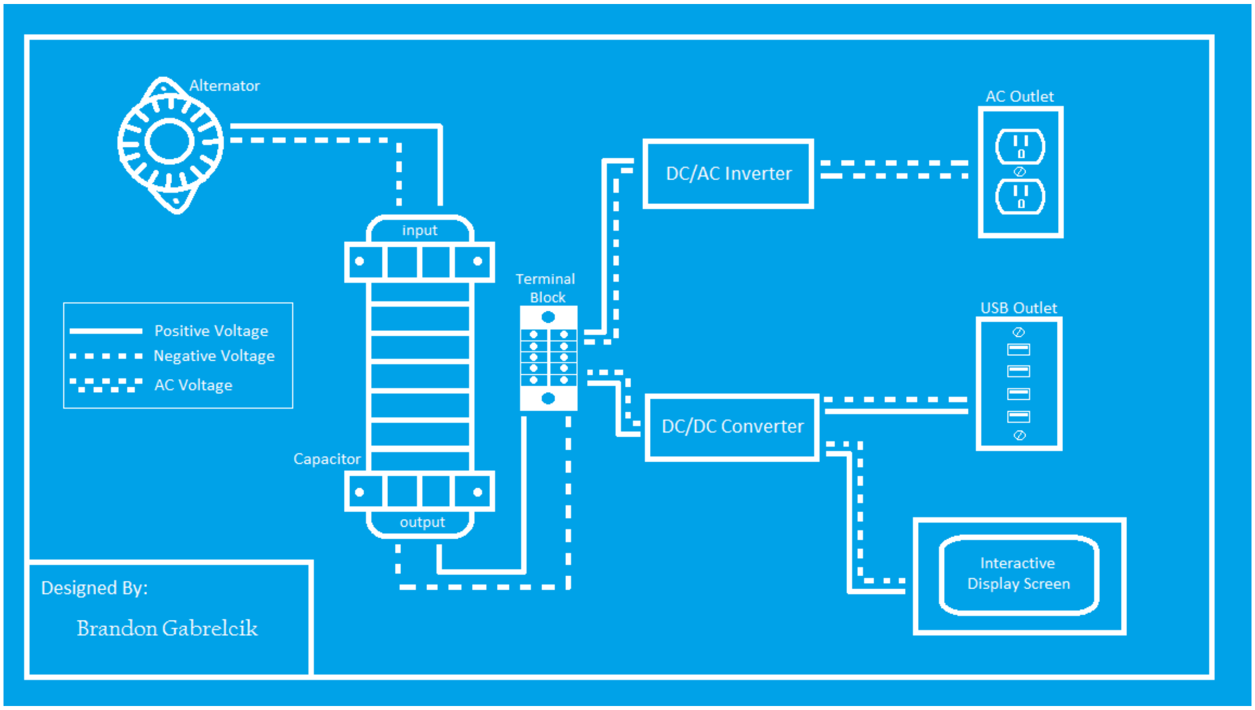


Figure 1 *- Electric Control System Diagram*

This diagram does not show the sensors that will be used to test voltage, current, and power output. Also, the power provided to the Interactive Display Screen is also assumed to be powering the Arduino Microcontroller as well. In this diagram, you can see how the power first start from the alternator that is being spun by the rear wheel of the bicycle. The voltage is then sent to the capacitor where it is smoothed out and some energy is stored. The current then flows to the terminal block that splits up the current to provide power to both the inverter as well as the converter. The inverter will be used to supply the rider with up to 200 watts of 120 VAC. The converter will drop the 12 volt DC current coming from the capacitor to 5 volts DC which is the desired voltage for charging almost all small electronic devices as well as the display screen.

4.0 To Be Completed

Looking forward in the next few weeks, an enclosure for the electric control system must be built. This is crucial in protecting the wiring and cables that will go into the control system. The next step is to design and build the mounting system for the display. This will be made out of a light weight metal, such as aluminum, and will be fastened onto the handle bars of the bicycle. Aesthetics is imperative to the charging stations' success. A working product is not enough to bring appreciation to its consumers. Lastly, the team will test the overall design and reiterate over and over again to find any problems or issues. This prevention and appraisal is valuable because it will help avoid external costs in the long run.

4.1 Build and Install Both Enclosures

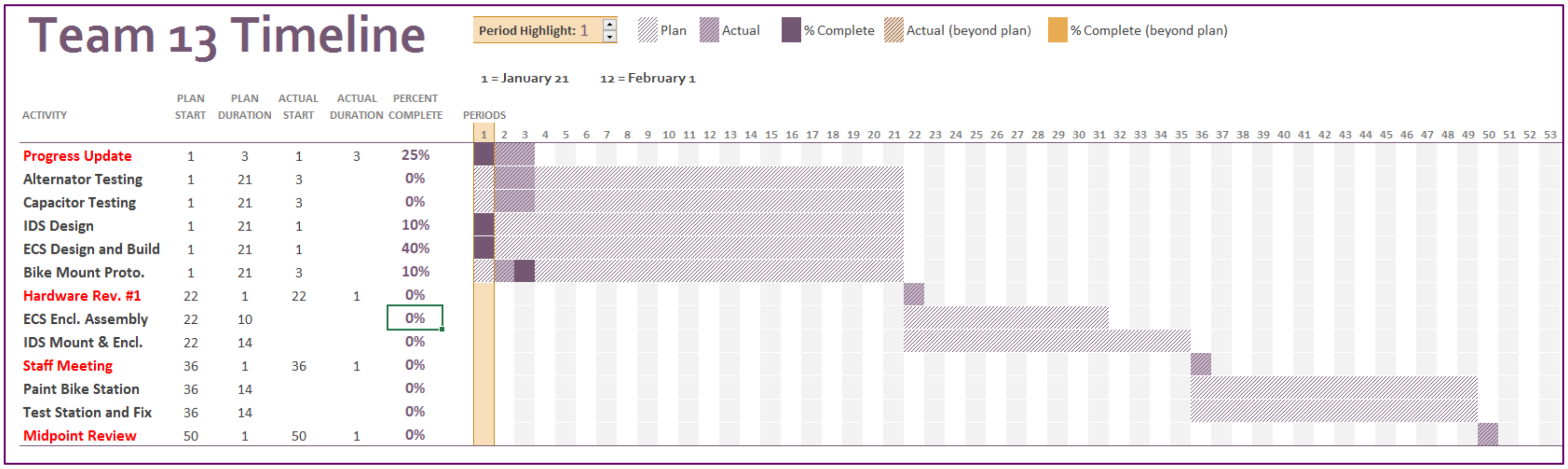
An enclosure for the components that will go in between the triangular framing of the rider has already been designed. Measurements have already been taken so the next step would be to purchase the materials (wood and fasteners), build, and install it. This portion of the project will not be completed until all components i.e. alternator, capacitor, display screen, cables/wires, have all been tested and are functioning appropriately.

4.2 Aesthetic Applications and Weatherproofing

In order to improve the aesthetics on the pre-existing bicycle, the frame and enclosures will be painted. Also, a water-proof coating will be used to make the charging station weather resistant. Proper handle bar tape will be used to protect the handle bars from continuous wear and tear. Both bicycle tires will be replaced due to the diminishing tread on the pre-existing tires to improve the stability of the bicycle. Lastly, the bike stand will be painted along with the framing and enclosure to produce a similar color scheme across the overall charging system.

5.0 Team Build Timeline

In order to ensure that the team stays on track during the entire build process, a Gantt chart has been created that details important milestones in the build process as well as the lengths of time given to each task. Below is a screen shot of the timeline created for this project.



ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Progress Update	1	3	1	3	25%
Alternator Testing	1	21	3		0%
Capacitor Testing	1	21	3		0%
IDS Design	1	21	1		10%
ECS Design and Build	1	21	1		40%
Bike Mount Proto.	1	21	3		10%
Hardware Rev. #1	22	1	22	1	0%
ECS Encl. Assembly	22	10			0%
IDS Mount & Encl.	22	14			0%
Staff Meeting	36	1	36	1	0%
Paint Bike Station	36	14			0%
Test Station and Fix	36	14			0%
Midpoint Review	50	1	50	1	0%

Figure 2 *- Team Build Timeline*

The timeline is shown in a period format where each period is equivalent to one day. Day one starts on January 21st, the day of the teams presentation.

6.0 Conclusion

In conclusion, there is still very much to be done in order to complete this capstone project in time. The Interactive Display Screen must be designed as well as built, the Alternator Mounting System also need to be analyzed in order to fit the bike stand properly as well as fit the constraints defined. Electrical components must also be tested to ensure they properly fit with the rest of the components. And there are many more things that need to be done. In order for the team to complete the project on time, the timeline must be followed stringently and problems that may arise must be resolved in a quick manner.

Appendix A – Pictures of Ordered Items

Figure A: Farad Digital Power Capacitor

Figure B: Bicycle Trainer Stand (pic #1)

Figure C: Bicycle Trainer Stand (pic #2)

Figure D: Bicycle Trainer Stand (pic #3)

Figure E: Bicycle Trainer Stand (pic #4)

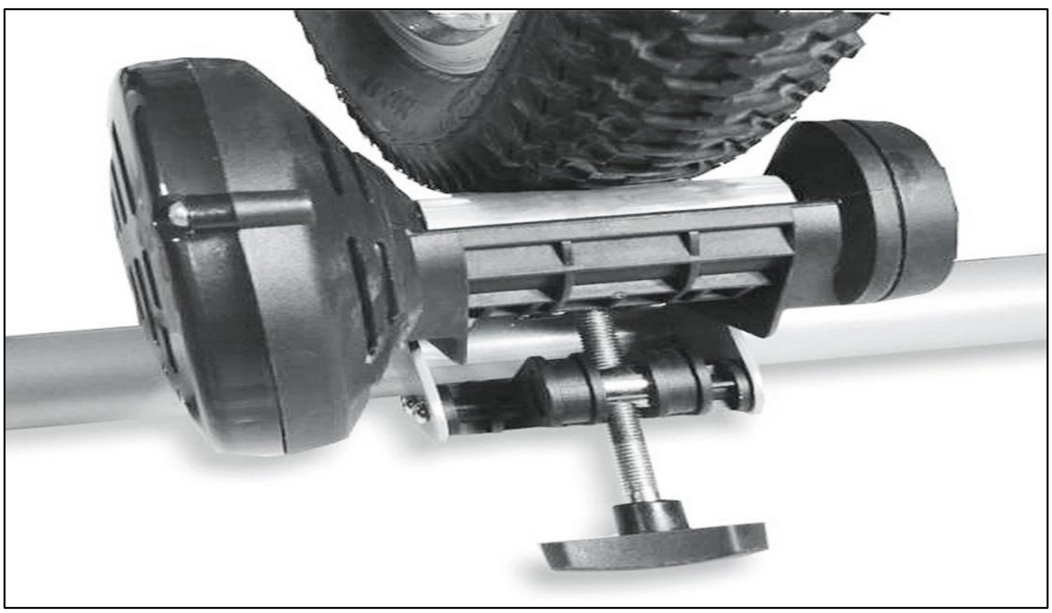


Figure F: Bicycle Trainer Stand (pic #5)

Figure G: Alternator

Figure H: Electric Barrier Terminal Block