

Second Generation Bicycle Charging Station

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Progress Report

Document

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Abstract

Marilla Lamb, a member of the first generation bicycle charging team, has sought out to have a second generation charging station made. After being a part of the design and build of the first generation station, it has come to her attention that there are quite a few components that need to be addressed so as to make the bicycle generator more accommodating for users and more educational for students of all backgrounds.

The second generation bicycle charging station must be more easily moved around campus and beyond for demonstrational purposes. The final design must include a display that will provide users with information about power generation both graphically and mathematically. Additionally, the station must include various small electronics chargers and a three-prong AC outlet. Finally, the build must fit within the budget, granted through the NAU Green Fund, of \$1600.00.

The final design will implement an upright, three speed bicycle that will utilize a generator in contact with the rear wheel to harness the rotational energy and move it directly to the electronics in need of charge. The bicycle will be fully functional, thus providing human powered mobility, and use a front and rear wheel stand that will allow the user to engage for demonstration purposes and fold away for transportation purposes.

Recent changes to the design of the second generation charging station include redesigning the bike stand to better distribute the weight of the assembly as a whole.

1.0 Project Background

1.1 Project Summary

In 2012, a team of engineers designed and built a bicycle generator intended to power small

electronics and educate the public about electrical power generation. The purpose of this project is to design a second generation of the Bicycle Generator in the Engineering Building at Northern Arizona University. The current design, located on the second floor of the Engineering building, is limited in both its power output and ability to address user needs. The 2nd Generation Bicycle Charging Station project team aims to redesign the charging station in a way that improves the portability, efficiency, usability, and versatility of the assembly to better aid in the designs overall purpose.

1.2 Project Statement

Our team’s goal for this project is to “Provide students with a way to understand and compare the amount of energy required to power and charge electronic devices with the amount of energy produced by pedaling a bicycle.”

2.0 Design Updates

2.1 Bike Stand

In the original design for the bike stand, the unit was to be welded together as one piece using AISI 4130 steel. After meeting with our client and further analysis on the total weight of the second generation bicycle generator, our team will be redesigning the frame and utilizing a lighter weight steel. The original design consisted of a welded AISI 4130 steel frame. Our client has requested that the charging station be conducive to replication. A frame built from more common components, utilizing fasteners instead of welds, will allow for greater ease of duplication by eliminating the custom welding required for the original design. The second design change for the stand is the selection of a more lightweight, but comparatively strong, material for the rigid components. FEA on the new stand design will help determine the integrity of the stand and allow the team to choose a lighter steel based on imported material properties.

3.0 Individual Task Breakdown

Within our team of mechanical engineers, it has been decided to task certain individuals with various components of the build so as to maximize our time frame and allow for a sufficient testing period. A breakdown of the tasks and those assigned to each one can be seen below in **Table 1**.

Table 1: Individual Task Breakdown

Team Member(s)	Task
Kori Molever & Connor Kroneberger	Stand Redesign and Build
Jon Jerome & Michael Klinefelter	Gear Ratio, Bike Repair and Service
Rob Rosenberg	Housing for Electrical Components

The stand redesign and build phase entails redesigning the stand to customize it to the specified generator and donated bike. The redesign of the stand also entails selecting a new, lighter

material for the stand. This is to reduce the overall weight of the bicycle generator, leading to greater ease of travel for the rider.

The next task involves refining the gear ratio as well as tuning and repairing the bicycle. The shifters on the donated bicycle are of poor quality, so they will be replaced with trigger shifters salvaged from another donated bike. The bottom bracket bearing will also be replaced during this task, as well as the crank set to accommodate a larger chain ring. The tires will be replaced with a hybrid tire, allowing for maximum surface contact while maintaining traction during motion.

The third task is to design the housing for the electrical components. The electrical components that must be housed are the touch screen display, Raspberry Pi chip, various phone charging cables and miscellaneous small components. The NAU Green Fund has requested that the electrical components be visible to users in order to contribute to the educational aspect of the generator station. In order to satisfy this request, a transparent housing, mounted on the front handlebars of the bicycle will be utilized.

4.0 Project Timeline

Figure 1 shows the projected timeline for this semesters building process. The spring semester has been broken up into phases of collecting materials, bike and component assembly, testing, and presentation. Subsections have been fit together as to make the most efficient use of team members' time.

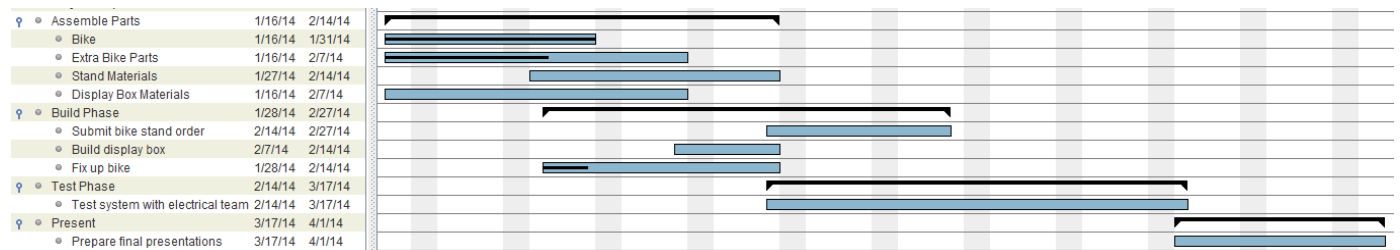


Figure 1: Semester timeline

5.0 Cost Analysis Update

The second generation bicycle charging station was given a budget of \$1600 by a grant from the NAU Green Fund. This budget will cover both electrical and mechanical components for the second generation charging station. For this report, only the mechanical components will be budgeted as can be seen in **Table 2** below. The cost of the bicycle and seatpost clamp have been eliminated because both were donated for the project. The cost of the stands have been reduced from \$350 to \$250 because our team will be fabricating the stands. The total estimated cost of the mechanical components for the project is \$425. The remaining funds will be used for electrical components and act as a buffer for material costs.

Table 2: Updated Budget

Material	Cost (\$)
Bicycle	\$0
Handlebars	\$50
Stands- Front and rear	\$250
Gear Cassette & Derailleur	\$50
Seatpost Clamp	\$0
Tools To Be Included	\$10
Fasteners	\$15
Display Box	\$50
Grand Total	\$425

6.0 Conclusion

The second generation bicycle charging station project is progressing on schedule. A geared bicycle has been acquired, tasks have been assigned and the generator and display have been specified. With the dimensions of the electrical components now known, frame design has begun. Small changes to the original design will entail using a lighter material as well as a simpler design to allow for ease of replication. The team will fabricate the stands in the campus machine shop.

The donation of a bike and other workable parts has reduced the expected expenditures. A new rear tire, gear shifter, and front gear cassette will still need to be obtained for a functional bike generator. The new display housing will be based on the previous design, keeping the transparent box to increase the potential for educational use. Design for the housing has begun and parts will be ready to order this coming week.