Project Plan & Product Specification

Team 7

<u>Personal Hydroelectric Generator</u>

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1 Introduction

There is currently a need for personal hydroelectric generators in the current market. These generators convert organic kinetic energy from the flow of rivers to produce a top necessity, electricity. This entrepreneurial project was proposed by Shane Radosevich who is the current Team Leader of this senior design group. The faculty approved the idea and the entrepreneurial faculty advisor became the sponsor for the development of this idea. The current small-scale hydroelectric generators do not produce enough power necessary for a comfortable camping trip or use in third-world countries. Therefore, the goal is to fill this void and design and build a personal hydroelectric generator that is affordable and produces a sufficient amount of power.

2 Project Definition

2.1 Background Research

The idea being proposed is not entirely original to the team. The gathered research suggests that there are a number of other companies which have built similar devices. One such product currently available for purchase is the StreamBee (Figure 1) available by The HydroBee Company. The device can use the flow of the water in a stream to create electrical power. Their idea is similar to Team 7's, however their device works on a smaller scale than the market Team 7 intends to influence. The power output of this device is a mere 10W. In order to power essential electrical equipment, as Team 7's device intends to do, the power output would have to be on a scale of 50 times that of the StreamBee's.[4] The team's device intends to produce anywhere from 50W to 200W. To account for this huge difference in output power, the device will be designed to charge a battery provided by the customer. The team intends to create the product that lets the consumer apply any battery he or she wants for the job.

Figure 1 - StreamBee, powers small electronic devices with a USB port

In addition to the StreamBee, another competition on the market exists for a similar type of portable hydroelectric generator. One more closely related to Team 7's design, is the Back Pack Power Plant (Figure 2). The Back Pack Power Plant designed by Bourne Energy of California, is a 30lb portable device carried on one's back. The product claims it can generate 600W. The Back Pack Power Plant needs to be anchored on both sides of a river for proper functionality. Additionally, it does not seem to have the common ports on it for easy access to US standard electric sockets.[5]

Figure 2 - Back Pack Power Plant: 3 feet in length and weighs 30lbs

2.2 Need Statement

This project is an entrepreneurial-based mission sponsored by FAMU-FSU College of Engineering, specifically through Dr. Michael D. Devine. Currently, there are few effective, simple, and quiet ways to get power in remote locations. These remote locations include campsites, mountainsides, and third world countries. In order to supply energy to items such as lights, heaters, or USB chargers, a gas generator is traditionally used. These types of generators are too loud and too heavy to be effectively used in remote locations.

"People in remote locations do not have access to electricity for powering their electrical devices."

2.3 Goal Statement & Objectives

Goal Statement:

"Develop a portable device that transforms organic kinetic energy into usable electricity."

Objectives:

- Produce enough power to satisfy the need of our target consumers.
    - Supplemental emergency power generation
    - Environmentally conscious recreational camper
    - Rurally indigenous communities
- Minimize the weight of the device to ensure portability.
- Produce a device that is safe to operate and leaves negligible ecological consequences.
- Produce a device that is conveniently set up and disassembled.

The desired wattage output of the system has changed from 1 kW to 200W due to background research of what is realistically achievable. Team 7 believes this wattage is capable of satisfying consumer needs because it has the ability to power several necessary components one might want in a remote location. This includes 5 LED lights that are equivalent to a 60W incandescent bulb and an electronic phone/GPS charger. These devices were shown to consume 50W and 50W respectively (totaling less than 200W). The main goal for the power output for our updated design is to effectively charge a battery hooked up to the system.

Portability is an important objective because a lightweight system is easier to transport in the naturally harsh conditions of remote locations. This device is trying to appeal to environmentally conscious individuals who want to use a power source that has no carbon foot print as well as individuals far from conventional power grids. The device also needs to be easy to set up and operate in order to appeal to a non-technical consumer and cut down on assembly time.

2.4 Constraints

- Device weight must not exceed 70lbs
- Compact (less than 3 ft^3)
- Unidirectional flow
- Water proof to protect the electrical components within the housing
- Durable and corrosion resistant
- Complies with all safety standards and has little/no environmental and human impact
- Operates under 50 dB (moderate level of sound)

A comparison against the competition mentioned in Section 2.1, as well as the results from the created House of Quality, helped formulate many of the constraints found above. The device's desired weight is 70lbs, while the competitions are at 1lb and 30lbs. Although this is higher than the competition, the weight is still manageable to the average person with some assistance. The unit must be compact in order to be more streamline in the water as well as fit in the bed or trunk of a standard SUV. Waterproofing the housing is very important so submerged electrical components will not undergo damage while in use. Another important constraint pertains more to the marketability of the unit as an exciter, which includes operation under the sound level of 50 dBa. This was decided comparing moderate sound level of 50-65dB (equal to a normal conversation at 3ft) and unlike typical gas generators (70dB), would not be a nuisance to the user or the wildlife. Finally, our sponsor and the College of Engineering set the budget to be $1,500. This budget seems to be manageable throughout our research and does not appear to be a problem.

2.5 Customer Discovery Survey

Table 1 – Customer Survey

	< $350	$350 to $550	$550 to $750	>$750
If a generator could sustain all your lighting needs, run a small refrigerator, or power any TV, how much would you spend?	5	5	15	6
	Camping	**Hunting**	**Cabin**	**Fishing Trap**
Where would you mainly use this item?	13	16	4	10
	Power Output	**Price**	**Durability**	**Size**
What is the most important from the following: Power Output, Price, Durability or Size?	8	5	10	8
	Would buy	**Might buy it**	**Wouldn't buy**	**I don't know**
How likely are you to buy a hydroelectric generator if it meets your needs?	14	5	4	8

The table displayed above gives the results of a customer survey that was given while on a hunting trip by one of the members in the group. It is important to state that all of the numbers given above reflect all of the answers given during the survey and have not been tampered with in order to reflect a desired outcome. With that being said, the outcome of the survey was very successful in predicting the estimated market. These questions contributed to the characteristics made for the final product in order to add to the value proposition. In other words, these answers helped the team better understand what the customer wants so that it would sell if mass produced.

3 Project Plan

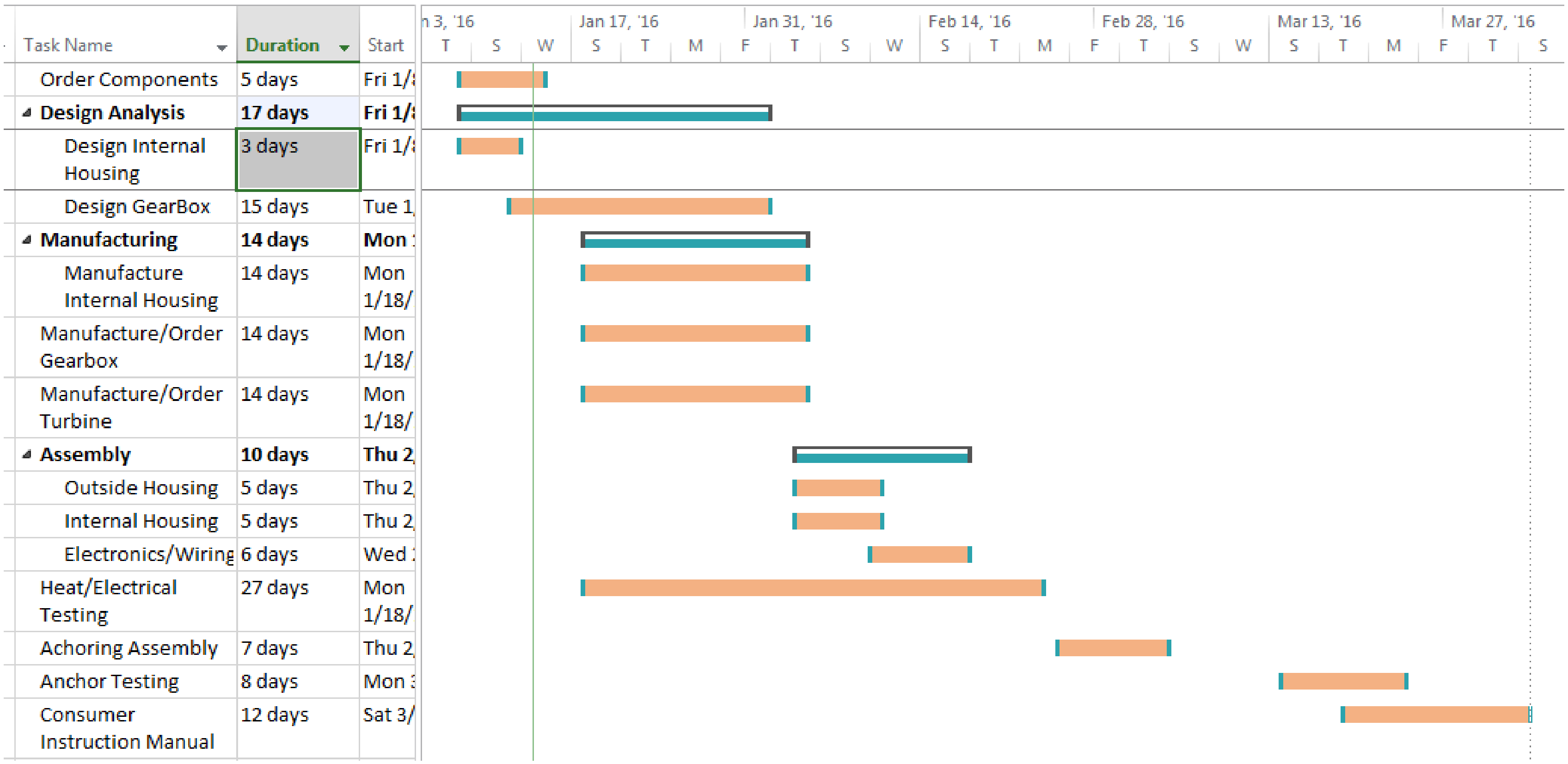

Figure 3 - Gantt Chart

3.1 Gantt Chart Overview

Before the end of the Fall 2015 semester, the team was able to order a few parts. These parts which included the alternator, charge controller, and watt meter from WindBlue have currently arrived at the beginning of the Spring 2016 semester. Other parts such as the external housing and the waterproof bearing were ordered in the beginning of the Spring 2016 semester. The gearbox must be designed before the design analysis of the internal housing that holds the gearbox as well as the alternator. After this stage, manufacturing and ordering of the internal housing, gearbox, and turbine will commence as well as testing of the heat and electrical output of the alternator. Electrical wiring of the system will be done as the internal and external housing are assembled. Once the main section of the device is thoroughly tested, the anchoring arm of the product will be designed, manufactured, and tested. After the product is completed, drafts of the customer instructional manual will be created.

4 Conclusion

This team has been tasked with developing and marketing an effective method of getting clean electricity into remote areas. For the environmentally conscious outdoorsmen, hydroelectric energy can be an appetizing alternative to burning fossil fuels. Currently, the only viable way of producing hydroelectric energy is by installing permanent fixtures that can be costly, labor intensive, and damaging to the environment. After a semester of research, the team has decided upon a conceptual design that has been divided into several distinct components. These components have been selected and placed into the final CAD design that was discussed earlier in the paper. The critical parts included in this design have either been ordered and are in the process of being shipped, or we have at least contacted the vendor about our order and are in the process of purchasing the part needed. Team 7 has currently developed a Gantt chart that will guide the team through the majority of the remainder of the project. With an apparatus to test, more important data will be noted through various testing and the results will be dealt with accordingly. Finalizing the turbine so that the gearing may be designed and purchased is our main objective at this point in time. Lastly, Team 7 will be following through in the next steps of the InNolevation Challenge in hopes to be a top contender.

5 References

[1] Dieter, G. E., & Schmidt, L. C. (2013). Engineering Design Fifth Edition. New York, NY: McGraw-Hill.

[2] Water Turbine Design for Small Scale Hydro Energy. (2015, October). Retrieved from Alternative Energy Tutorials: http://www.alternative-energy-tutorials.com/hydro-energy/water-turbine-design.html