Sleep Apnea Therapy Device – Progress Report #6

Client: Dr. John Webster
Advisor: Dr. Megan McClean
Team Members: Calvin Hedberg, Taylor Karns, Jen Rich, Ben Mihelich
Date: Feb 24th – Mar 2nd , 2017

Problem Statement

Clinically significant sleep apnea is a sleep disorder characterized by interference of breathing during sleep. Those who suffer from sleep apnea experience interrupted sleep which develops an increased risk of heart attack, high-blood pressure, arrhythmia, stroke, and diabetes. Continuous Positive Airway Pressure (CPAP) machines are the current standard for treatment. However, approximately half of all patients suffering from sleep apnea do not adhere to it well due to complications such as nasal congestion, headaches, and continued tiredness. Continuous dead space rebreathing is an alternative that has been researched and shown to stabilize central respiratory output in patients with mild to severe obstructive sleep apnea without the complications of CPAP. Thus, our team has been assigned the task of designing and fabricating a variable dead space device based on guidelines and research conducted by our client Dr. John Webster. This includes developing an algorithm such that the device can detect sleep apnea and consequently regulate the amount of dead space for proper respiration.

Last Week's Goals

- Order parts for prototype
- Research power options
- Make Apnea Detection Algorithm more power efficient

Summary of Team Role Accomplishments

- Calvin (Leader) - filled out the week's progress report
- Taylor (Communicator & BPAG) – purchased prototyping parts and logged project expenses
- Jen (BWIG) – updated the team website
- Ben (BSAC) – attended BSAC meeting Friday Feb 24th

Summary of Design Accomplishments

This week the team focused on deciding on which parts to order for prototyping and on placing these orders in order to have physical materials to begin working with. Upon feedback and recommendations from our client we have chosen to have our device return to a hard body design. The concern was in the ability for a soft body to hold a constant dead space volume and in overall durability of the device. Some comfort will be lost but this is seen as a necessary change. With this we went with an ergonomic water bottle that would fit better lying on a patient's sternum. This container is longer and has a smaller diameter than the previous prototype which will make it feel less bulky.

The next part that required attention was the stepper motor that the device was to utilize. Our original choice was a 12V (350mA) bipolar stepper motor. However, after researching the functionality and options in stepper motors we decided against this option. Bipolar motors are used in situations where larger torque is necessary and require power sources with reversible polarity. Instead, our team opted for a smaller 5VDC unipolar motor that can be driven by a small, breadboard compatible driver. With this choice it will be easy for the motor to be driven directly from our Arduino microcontroller, using a transistor to provide power to the motor only when necessary. The parts have been ordered and should arrive by Monday. Any other parts for the prototype should be available through local hardware stores or the student shop (such as PVC pipe or tubing).

The plan for improving the Arduino power consumption will involve having the script only run for the ten seconds it needs to collect data followed by a certain period of inactivity (Arduino sleep/standby mode) if no apnea is detected. This period of inactivity has yet to be determined and may warrant additional research. If apnea is detected the script will continue to run until the situation is remedied by breathing returning to normal. The algorithm will continue to be developed as we include code to run our stepper motor.

This Week's Goals

- Install and Test Stepper Motor
- Create Circuit for Stepper Motor and Test Algorithm

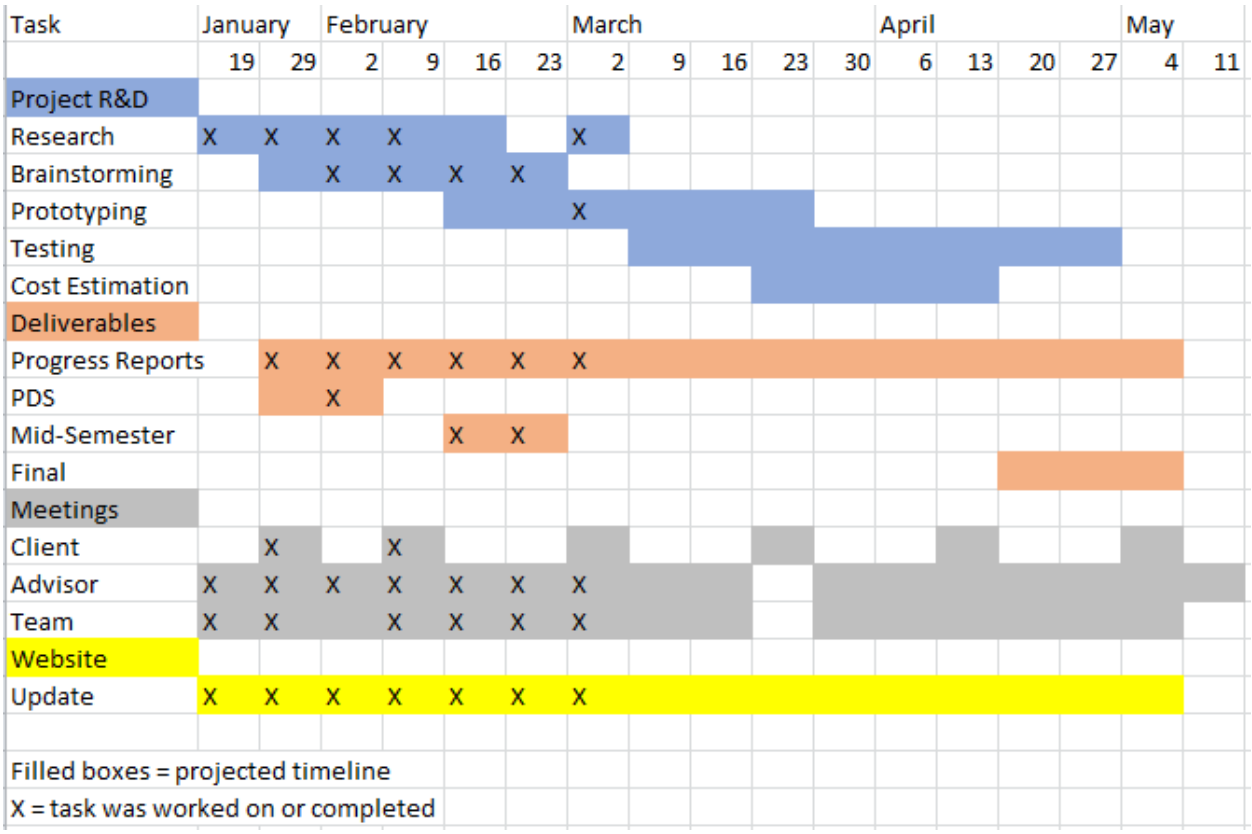
Difficulties with Project

The largest difficulty for our group is trying to take into account power efficiency for the device. Battery powering this device is simple but choosing the power source that will maximize its run time is the challenge. Li-Ion batteries last long but have low and variable voltage outputs as they drain. Alkaline batteries last long by are bulky and low voltage requiring there be more of them in series. Coin batteries put out good voltages but don't last long. We may need to consult professors or Mehdi for advice.

Activities

Date	Person(s)	Task	Time (hrs)	Semester Total
2/28/2017 3/1/2017	Calvin	Research Power Options Research Stepper Motors (Place final orders)	1.0 2.0	5.0
	Taylor			1.5
	Jen			2.0
	Ben			2.5
2/28/2017	Team	Meeting – Order parts and Research Parts	1.5	11.5

Project Schedule



Expenses

Part	Cost	Supplier
Body – Tupperware water bottle	17.51	Tupperware
5V Stepper Motor and Driver	13.04	Amazon.com
Total	30.55	