Sleep Apnea Therapy Device – Progress Report #8

Client: Dr. John Webster
Advisor: Dr. Megan McClean
Team Members: Calvin Hedberg, Taylor Karns, Jen Rich, Ben Mihelich
Date: March 10th – Mar 16th, 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

- Test stepper motor code with Apnea Detection Algorithm
- Purchase parts for inner breathing tube and begin fabrication
- Design comfort level test for device

Summary of Team Role Accomplishments

- Calvin (Leader) - filled out the week's progress report
- Taylor (Communicator & BPAG) – documented prototype part expenses
- Jen (BWIG) – updated the team website
- Ben (BSAC) – prepare for BSAC meeting Friday March 31st

Summary of Design Accomplishments

Additional parts for fabricating the prototype were purchased on Monday (3/13/17). The parts included 1” diameter PVC piping and 2 x 1” inner diameter connector pieces. The plan is to use the 1” adaptor pieces to house the stepper motor and connect the breathing tube from the mask to the 1” piping that will be placed inside of the fixed 1L container. The 1” PVC pipe inside the container will contain the holes that are used to vary dead space. In order to properly fit the motor into the adaptor piece (without blocking the breathing tube) it will have to be lathed to have a reduced thickness (approximately < 1mm) and then a rectangular hole will be cut in the bottom of the adaptor to fit the motor. This way the motor’s rotational piece will be placed closer to the tubes center, allowing for easier rotation of a cover piece about the holes placed in the tube. This also allows the motor to be fixed in place with all of its wiring on the exterior of the tubing. The cover piece that is to be rotated will be custom cut from a cylinder of high density polyethylene (HDPE) to fit the attachment to our motor and the to properly match the arc of the PVC tube it rotate about.

Design for a comfort test is currently being worked on. Other models from similar studies are being researched and once this is complete our own test will be developed with our unique design in mind. This will include protocol for how to rate comfort and for how long the device must be worn and breathed through and in what conditions. Testing of the motor with the sleep apnea algorithm has been postponed this week and will be completed in the following weeks.

This Week’s Goals (During and Post-Spring Break)

- Finish designing comfort test
- Test stepper motor with sleep apnea algorithm
- Begin prototype fabrication

Difficulties with Project

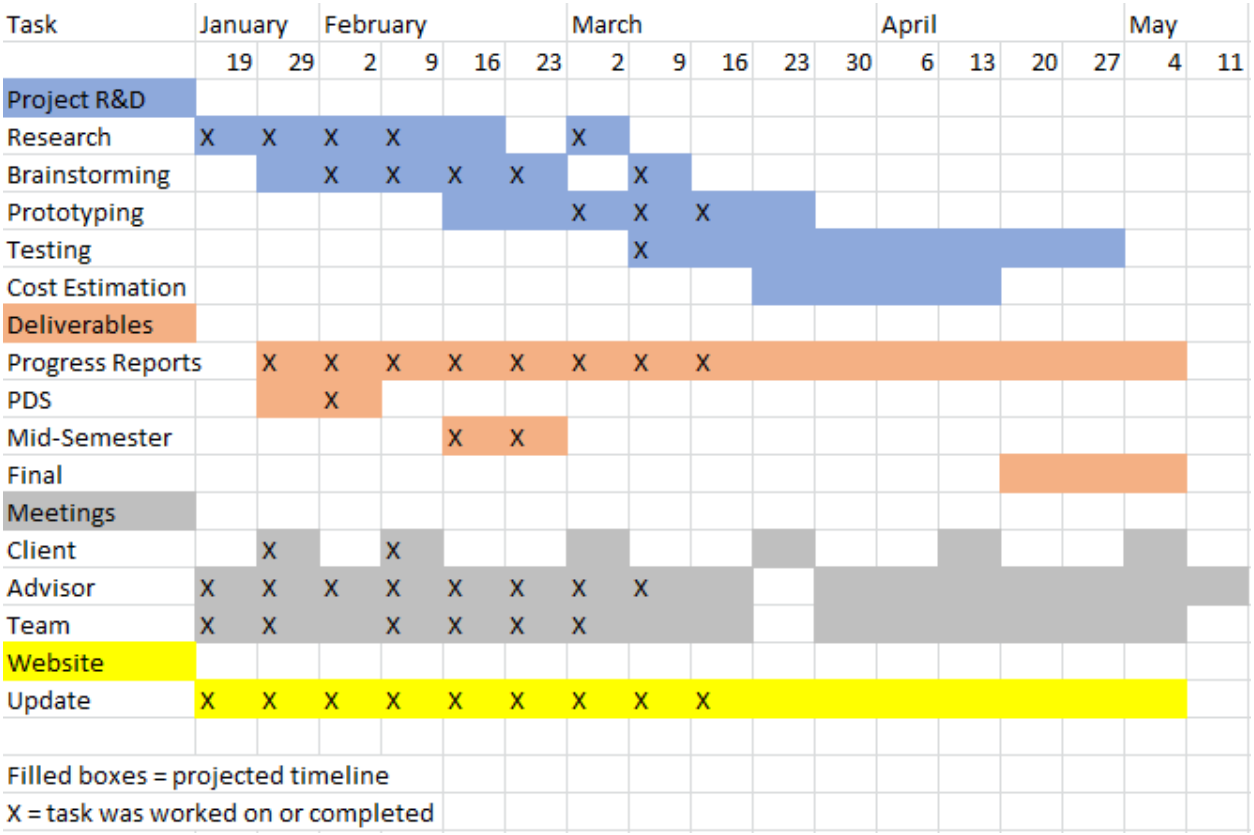
Our current proposed circuit makes use of transistors to control the activation of powered components. Transistors are only sold in bulk which makes purchasing a large package with a need for only two not cost effective. Asking for a donation of two transistors from the BME

department might be the best option. Pre-Spring Break exams have also set the team back in completing certain project goals this week.

Activities

Date	Person(s)	Task	Time (hrs)	Semester Total
3/13/2017	Calvin	Purchased prototype parts and brainstormed fabrication	1.0	8.5
3/14/2017	Taylor	Researched comfort tests of alternate designs	1.0	2.5
	Jen			2.0
3/13/2017	Ben	Purchased prototype parts and brainstormed fabrication	1.0	6.0
	Team			11.5

Project Schedule



Expenses

Part	Cost	Supplier
Body – Tupperware water bottle	17.51	Tupperware
5V Stepper Motor and Driver	13.04	Amazon.com
1” PVC and 2 x 1” PVC Adaptor	2.91	Home Depot
Total	33.46	