Sleep Apnea Therapy Device – Progress Report #10

Client: Dr. John Webster
Advisor: Dr. Megan McClean
Team Members: Calvin Hedberg, Taylor Karns, Jen Rich, Ben Mihelich
Date: March 31st – April 6th, 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

- Research and select transistors
- Test device circuit with transistors
- Fabricate prototype
- Design additional tests

Summary of Team Role Accomplishments

- Calvin (Leader) - filled out the week's progress report
- Taylor (Communicator & BPAG) – n/a
- Jen (BWIG) – updated the team website
- Ben (BSAC) – attended BSAC meeting Friday March 31st

Summary of Design Accomplishments

The three sets of transistors that were obtained from the BME department were analyzed and tested to determine which should be used in the circuit. The first set is the TIP41C which is an NPN bipolar junction transistor that is rated for maximums of 100V and 6A. It has a total power dissipation of 67W. This set was functional and would serve its purpose in the circuit with minimal power drain on the system. The second set was the K3767 which is a MOSFET that is maximally rated for 600V and 2A. These transistors have a total power dissipation of 25W making them even more power efficient. These were tested to be functional and would operate effectively in our circuit. The final set was the 2N3906 which is a PNP type transistor. This was not tested as the maximum ratings fall short at only -200mA where our driver requires a current draw of 600mA. This makes the K3767 the best choice for the circuit but the TIP41C is also viable. The next step is to set up the complete circuit and then find housing to contain it.

Fabrication has yet to be started but approximately 2.5 hours has been reserved at the shop tonight (4/6/2017) to begin the process. Any additional time needed to complete fabrication will be scheduled for this weekend.

In continuing the search for a power source to battery power the device it has been determined that the proposed prototype could run off of two 3.7V Li-Ion batteries in series. This would satisfy the requirement for the Arduino to be fed at least 7V while having a power source that can last longer than a 24 hour period (i.e. 9V batteries). For testing sake an external power source will be used but the final prototype is still planned to be battery powered.

This Week's Goals

- Test complete device circuit
- Finish fabrication of prototype
- Begin empirical testing of prototype

Difficulties with Project

None to report at this time.

Activities

Date	Person(s)	Task	Time (hrs)	Semester Total
4/6/2017	Calvin	Researched and tested transistors	1.0	10.0
	Taylor			3.5
	Jen			2.0
4/6/2017	Ben	Fabrication of Prototype	2.5	8.5
	Team			12.5

Project Schedule

Task	January		February				March					April				May	
	19	29	2	9	16	23	2	9	16	23	30	6	13	20	27	4	11
Project R&D																	
Research	X	X	X	X			X										
Brainstorming			X	X	X	X		X									
Prototyping						X	X	X				X					
Testing							X			X	X						
Cost Estimation										X	X						
Deliverables																	
Progress Reports	X	X	X	X	X	X	X	X		X	X						
PDS		X															
Mid-Semester				X	X												
Final																	
Meetings																	
Client	X		X														
Advisor	X	X	X	X	X	X	X	X		X	X						
Team	X	X		X	X	X	X			X							
Website																	
Update	X	X	X	X	X	X	X	X		X	X						

Filled boxes = projected timeline
X = task was worked on or completed

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	