

Sleep Apnea Therapy Device – Progress Report #13

Client: Dr. John Webster

Advisor: Dr. Megan McClean

Team Members: Calvin Hedberg, Taylor Karns, Jen Rich, Ben Mihelich

Date: April 21st – April 27th, 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

- Active and Passive Device testing
- Additional testing
- Work on poster and final report

Summary of Team Role Accomplishments

- Calvin (Leader) - filled out the week's progress report
- Taylor (Communicator & BPAG) – compiled expenses
- Jen (BWIG) – updated the team website
- Ben (BSAC) – attended BSAC meeting April 21st

Summary of Design Accomplishments

The sleep apnea therapy device is now fully fabricated and functional; able to run while plugged in to an external power source. The sleep apnea detection algorithm was updated to include specific increments for the cover slide to completely open and close. Approximately 600 motor steps will completely open the slits in the inner tubing to access the extra dead space volume. This is done in increments of 100 steps per instance of apnea for a total of six possible variations of dead space using the device. Coding was entered in to ensure that the slide won't move beyond this 600 step limit in either direction. Additionally, the breathing threshold code was updated to more accurately and consistently test for voltage waveforms obtained from air flow inside the device; logic error had been noticed that was giving poor results. Also added is the ability to write data to excel files giving the potential to have sleep records be monitored and recorded while the device is in use. Testing to ensure the algorithm's functionality was performed and the data was collected in a Microsoft Excel file for creating graphical displays. Future work could include using LabVIEW as another potential data monitoring program.

Comfort testing will be concluding this afternoon. Data will be compiled and statistical testing will be performed to showcase subjective/qualitative features of the device. Qualitative measurements will also be taken to ensure that design specifications have been met. Battery power was not fully realized for this prototype but could be implemented at a later time. At this time the main focus is continued testing of the current device.

This Week's Goals

- Continue any additional tests
- Check prototype to design specifications
- Give poster presentation and complete final report

Difficulties with Project

Difficulties were met in trying to mate the cover slide to the interior of the inner tube without causing the slide to be immobile. The mating surface is not perfect but it is sufficient to block significant airflow. Issues with the algorithm were discovered but were an easy logic correction.

Activities

Date	Person(s)	Task	Time (hrs)	Semester Total
4/25/2017	Calvin	Algorithm coding	1.0	12.0
4/26/2017		Created circuit schematic	1.0	
4/25/2017	Taylor	Worked on poster	1.5	6.5
4/26/2017		Worked on final report	1.5	
4/25/2017	Jen	Worked on poster	1.0	9.0
4/26/2017		Reformatted poster and comfort testing	2.0	
4/26/2017	Ben	Comfort testing	1.0	16.5
4/24/2017	Team	Fabrication of prototype and circuit testing	4.0	30
4/25/2017		Device testing and poster design	4.5	
4/26/2017		Device testing, poster and final report	4.5	

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	X	X			
Testing								X				X	X	X	X	X	
Cost Estimation												X	X				
Deliverables																	
Progress Reports		X	X	X	X	X	X	X	X			X	X	X	X	X	
PDS			X														
Mid-Semester						X	X										
Final														X	X		
Meetings																	
Client		X		X													
Advisor	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Team	X	X		X	X	X	X					X		X	X	X	
Website																	
Update	X	X	X	X	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	