

Sleep Apnea Therapy Device – Progress Report #9

Client: Dr. John Webster

Advisor: Dr. Megan McClean

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

Date: March 24th – Mar 30th, 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

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

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) – prepared for BSAC meeting Friday March 31st

Summary of Design Accomplishments

Testing for the revised sleep apnea algorithm was completed Tuesday (3/28/17) at our team meeting. The stepper motor was connected to the Arduino along with the flow sensor and an indicator LED light. The results are included in detail under the experimentation folder of the team's design notebook but will be summarized here. Repeated cycles of 20 seconds of breathing and no breathing were conducted on the flow sensor to simulate regular breathing and apnea respectively. While breathing was occurring no response was given by the circuit. When breathing stopped the system updated and both activated the indicator LED and motor. These were the desired results making this a successful test of the algorithm. With this confirmation all that is left is to re-conduct this test with transistors controlling the power to the components involved.

After consulting Dr. Nimunkar and Samuel Lines from the BME 310 course, our team has been given three sets of transistors to use in our circuit. One set are bipolar junction transistors (BJT) and the other two are MOSFETs giving us options on which to use. The datasheets for each of these transistors will be researched and the set that can perform the desired switch function while consuming the least amount of power will be chosen for the project.

The comfort test protocol has been drafted including situations for short term use and overnight use of the device. The test will be refined as we continue to construct our prototype. Additionally the subject selection protocol is currently omitted due to lack of confirmation on who would be relevant to conduct these tests on. This subject must be further discussed in future meetings.

This Week's Goals

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

Difficulties with Project

Our group only has one member that has paid the student shop fees and has relevant experience with fine part machining which is going to be a minor bottleneck on progress. Luckily not much machining has to be done and the other group members can stay busy with test and circuit design.

Activities

Date	Person(s)	Task	Time (hrs)	Semester Total
3/30/2017	Calvin	Meeting with Sam Lines for transistors	0.5	9.0
3/27/2017	Taylor	Drafted comfort test	1.0	3.5
	Jen			2.0
	Ben			6.0
3/28/2017	Team	Tested algorithm with stepper motor	1.0	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								
Testing								X			X						
Cost Estimation											X						
Deliverables																	
Progress Reports		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	