

Sleep Apnea Therapy Device – Progress Report #11

Client: Dr. John Webster

Advisor: Dr. Megan McClean

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

Date: April 7th – April 13th, 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 complete device circuit
- Finish fabrication of prototype
- Begin empirical testing of prototype

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) – n/a

Summary of Design Accomplishments

The final circuit is all but completed, only lacking transistor control of power to the flow sensor. The flow sensor wires must first be extended by either soldering it to a longer wire or using alligator clips. All other elements of the apnea therapy device circuit are functional and implemented. Further testing revealed that the K3767 MOSFET is not compatible with the final circuit as the cut-off gate voltage was not working correctly with the Arduino Uno's I/O pins. Despite the slightly higher power consumption it has been decided that the circuit will now use the TIP41C bipolar junction transistors. Additionally, the power saving sleep mode of the Arduino will no longer be a part of the apnea detection code as it will be difficult to implement into the code without running the risk of interrupting crucial functional lines in the algorithm. Instead, delays between data collection and strict power control on the flow sensor and motor will be used to save power.

Fabrication is nearly complete with all parts being machined except for putting holes in the internal tubing. All that remains is the final assembly of the parts, including the attachment of the motor in the tubing, the attachment of the tubing to the face mask and the fixing of the rotating cover slip to the motor. Once the full prototype is assembled the circuit can be connected and testing can begin.

This week a paper was started for our final report. Additionally, our draft for our executive summary was created.

This Week's Goals

- Assemble Prototype
- Begin Testing
- Work on Final Report

Difficulties with Project

The MOSFET's that we had to use did not work properly in restricting power to our motor so the BJT set was used instead. Power saving modes for the Arduino have proved to be difficult to add to our existing code and may run the risk of interrupting crucial steps in the apnea algorithm.

Activities

Date	Person(s)	Task	Time (hrs)	Semester Total
	Calvin			10.0
	Taylor			3.5
4/13/2017	Jen	Researched dead-space and circuit housing	2.0	4.0
4/12/2017 4/13/2017	Ben	Fabrication of Prototype	5.0	13.5
4/13/2017	Team	Tested device circuit and completed executive summary draft	2.5	15

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				
Testing								X			X	X	X				
Cost Estimation											X	X					
Deliverables																	
Progress Reports		X	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	X	X				
Team	X	X		X	X	X	X				X		X				
Website																	
Update	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	