A Piezoelectric Approach to the Mobile Monitoring of Neonatal Breathing

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Background:

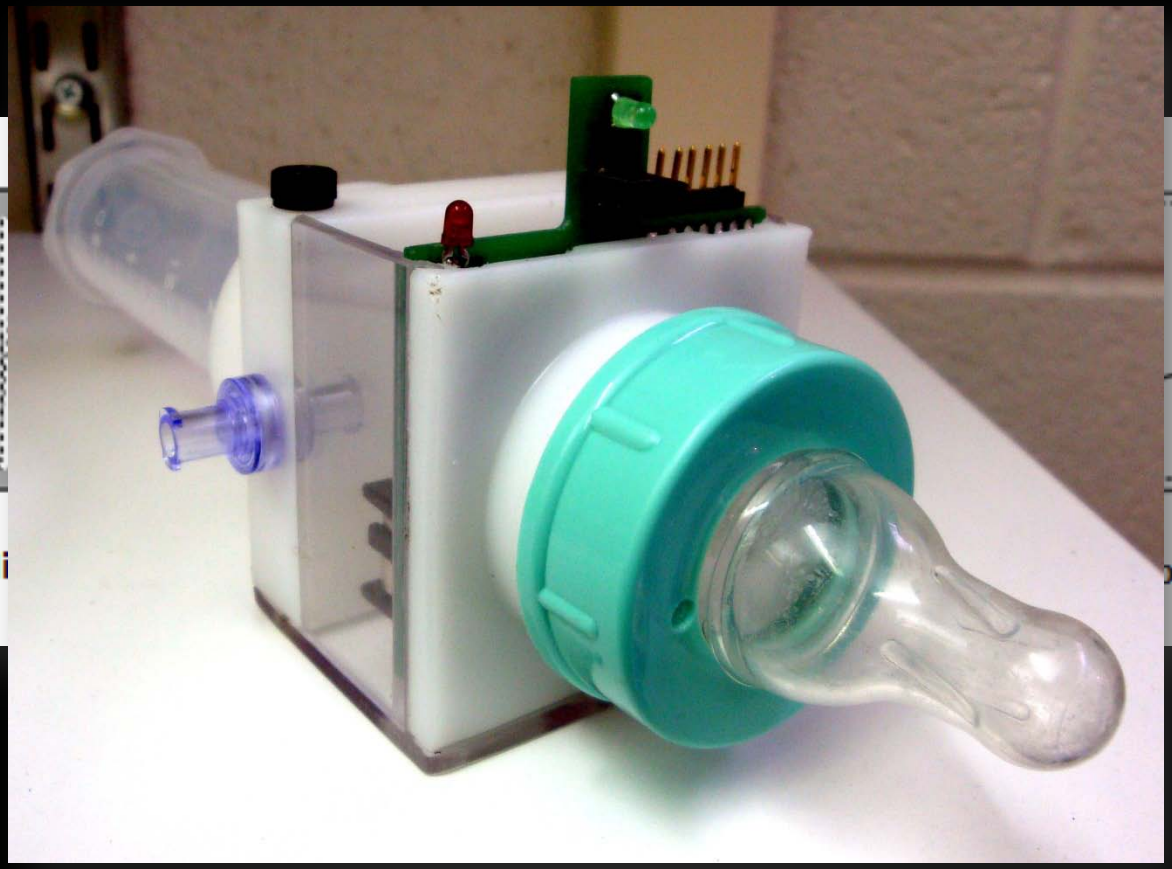
- Complexity of Neonatal Feeding
- "Indicator of Neurological Behavior"
- The Breathing and Sucking Relationship

The Problem:

Overall Goal:

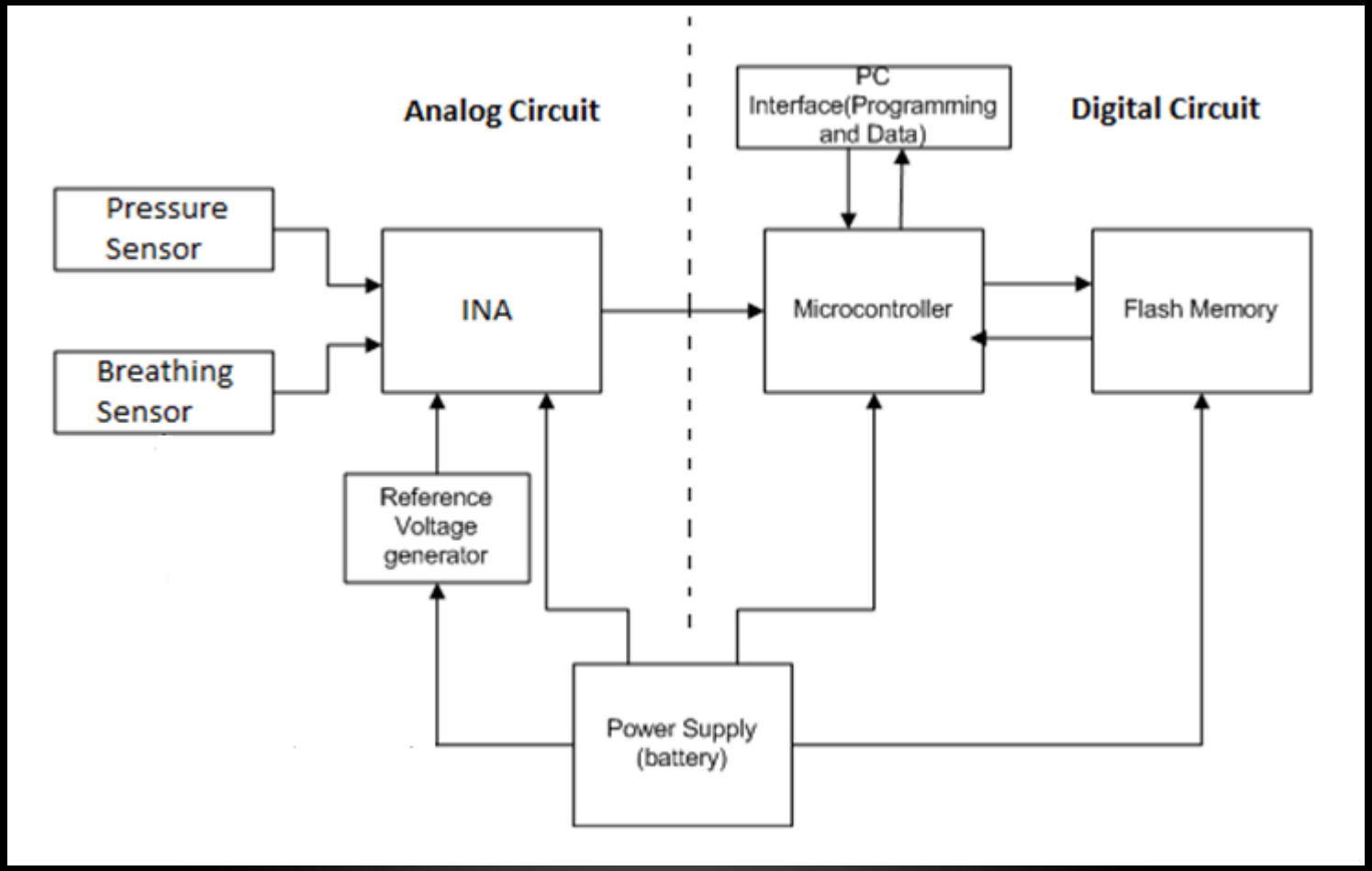
Design a mobile device to capture neonatal feeding behavior

Past Work:

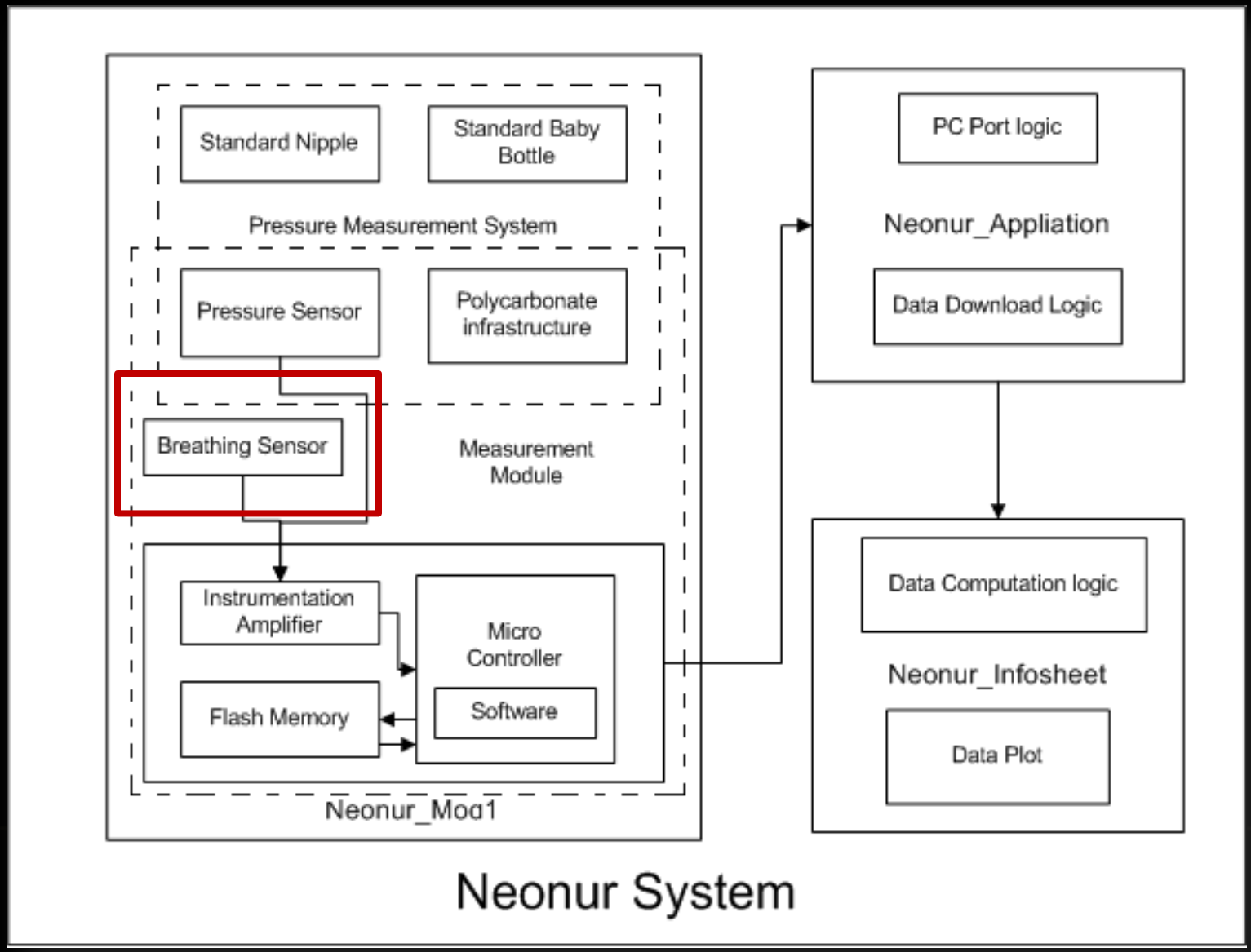


NeoNur

Past Work:


Analog Circuit
PC Interface(Programming and Data)
Digital Circuit
Pressure Sensor
Breathing Sensor
INA
Microcontroller
Flash Memory
Reference Voltage generator
Power Supply (battery)

Past Work:

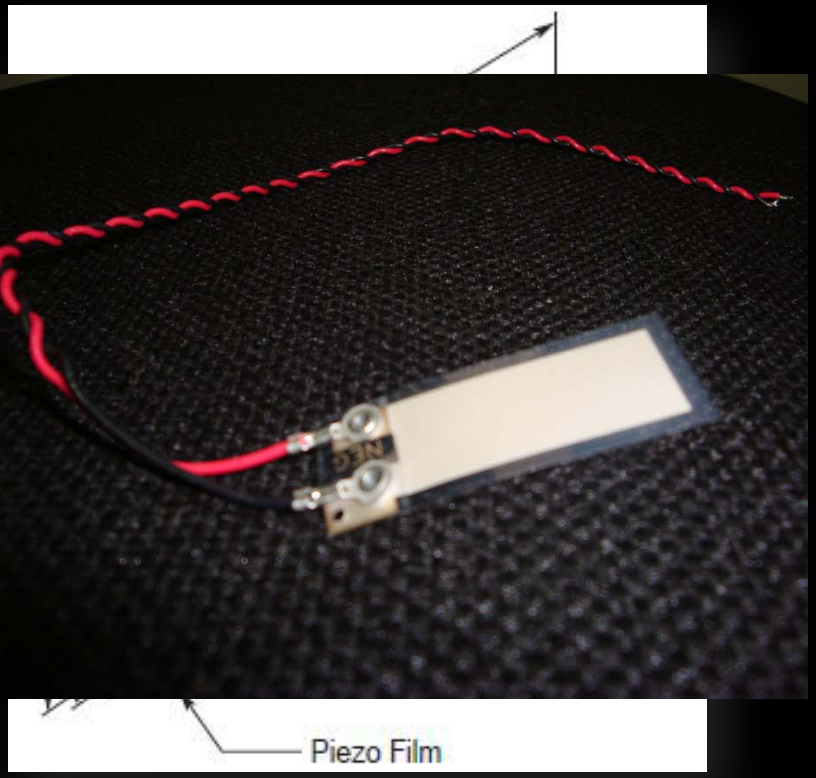

Standard Nipple
Standard Baby Bottle
Pressure Measurement System
Pressure Sensor
Polycarbonate infrastructure
Breathing Sensor
Measurement Module
Instrumentation Amplifier
Micro Controller
Flash Memory
Software
Neonur_Mod1
PC Port logic
Neonur_Appliation
Data Download Logic
Data Computation logic
Neonur_Infosheet
Data Plot
Neonur System

My Goal:

Implement a breathing sensor compatible with the existing NeoNur apparatus

Sensor Overview:

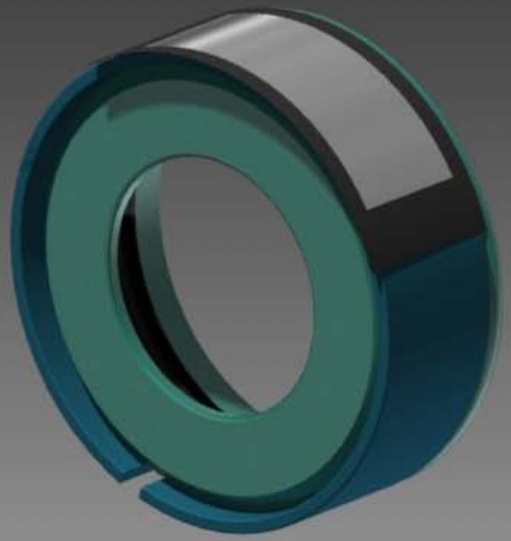
- Sensor Options
- Piezoelectricity
- Current-Generating



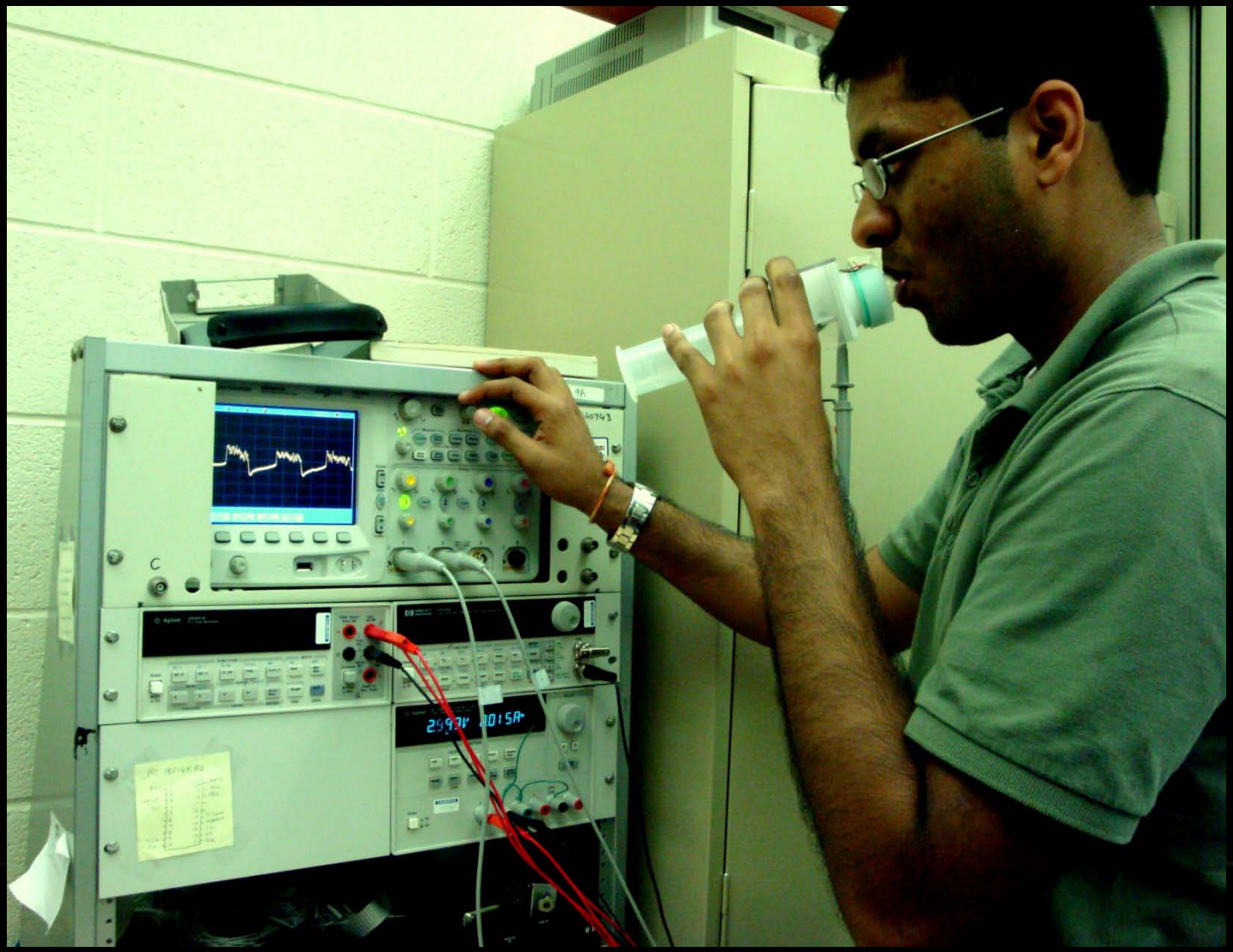
Design Constraints:

- Safety
- Measurement Reliability
- Ease of Use
- Versatility
- Additional constraints

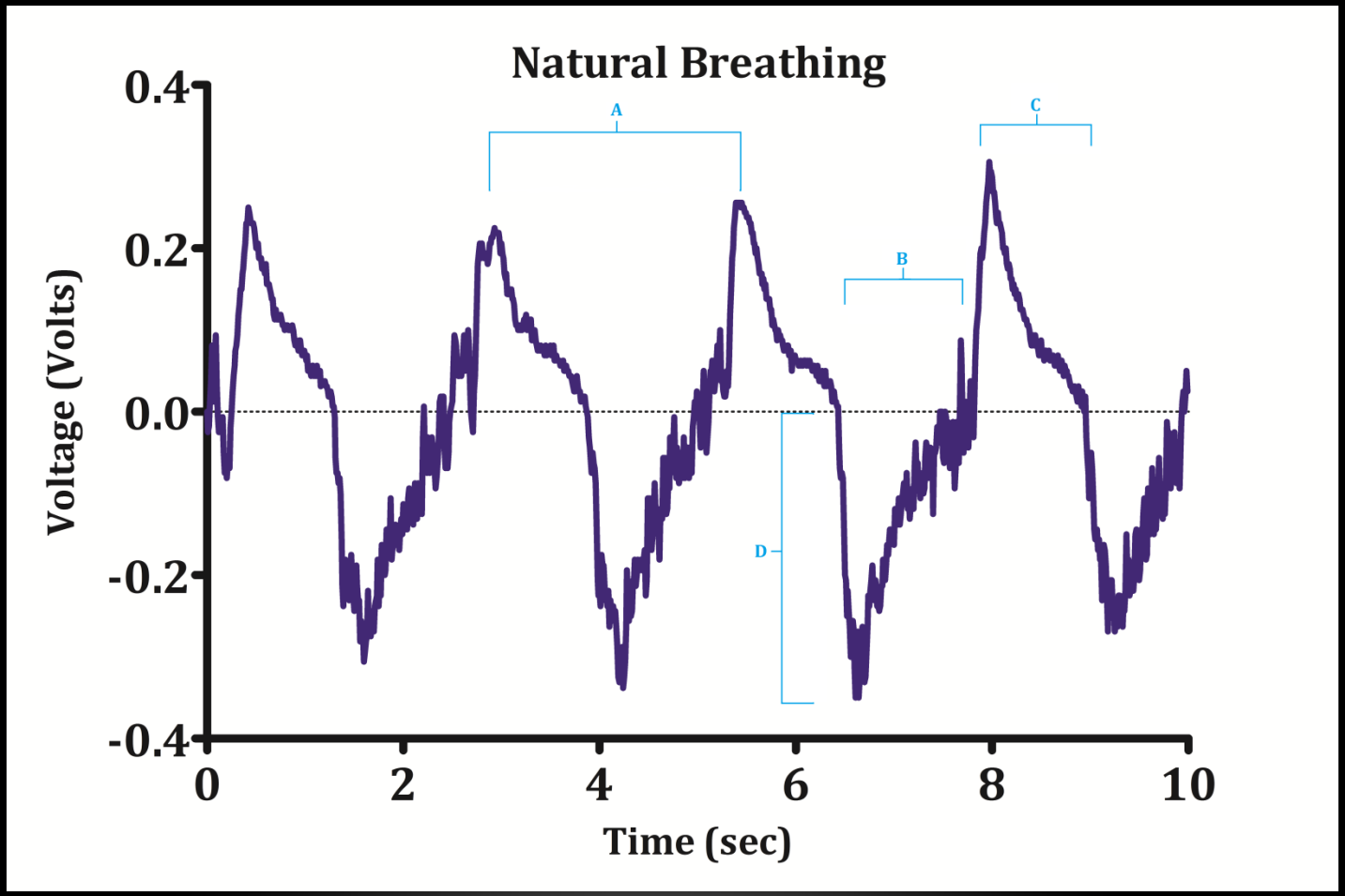
Sensor Assembly



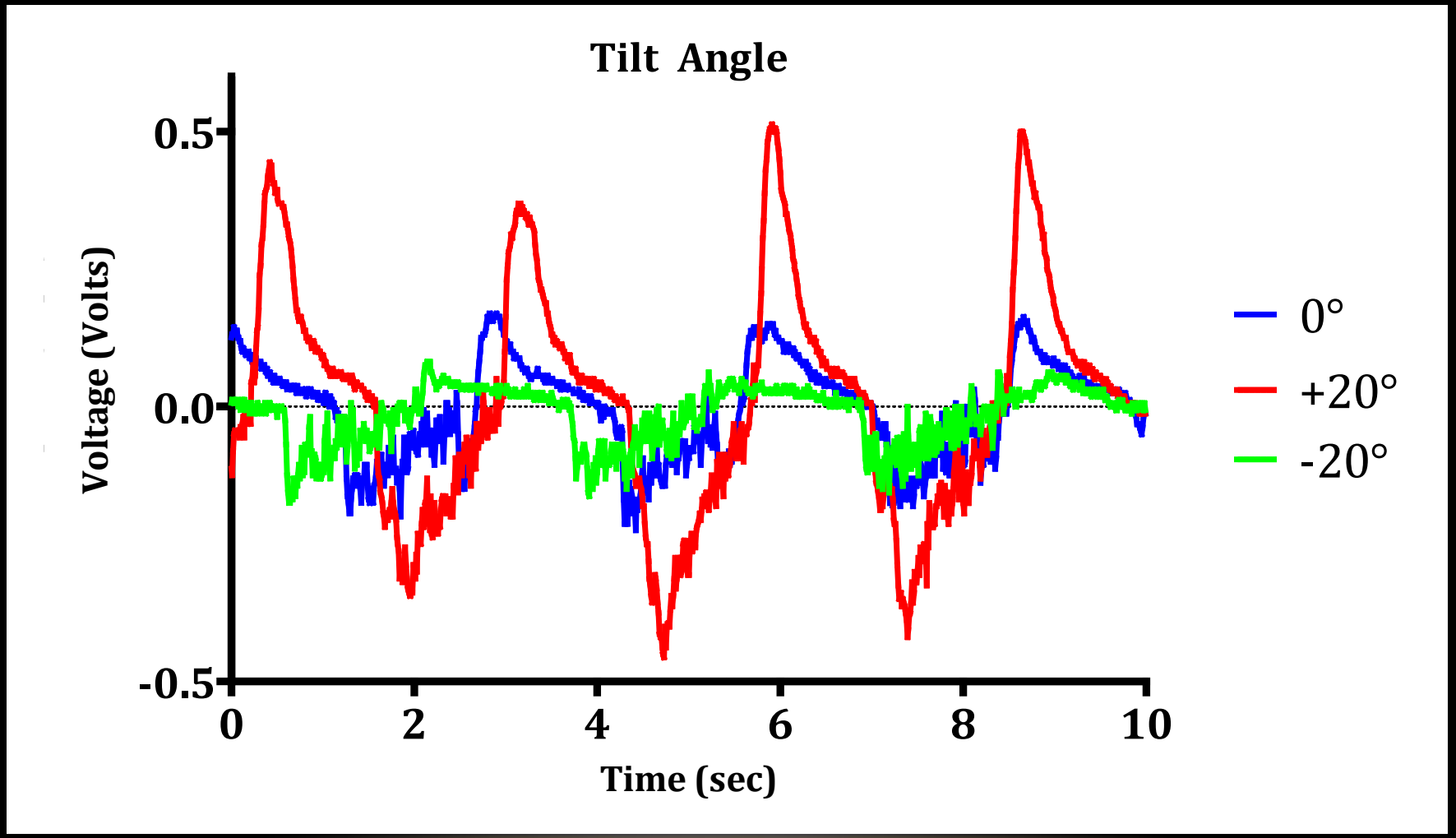
Methods:



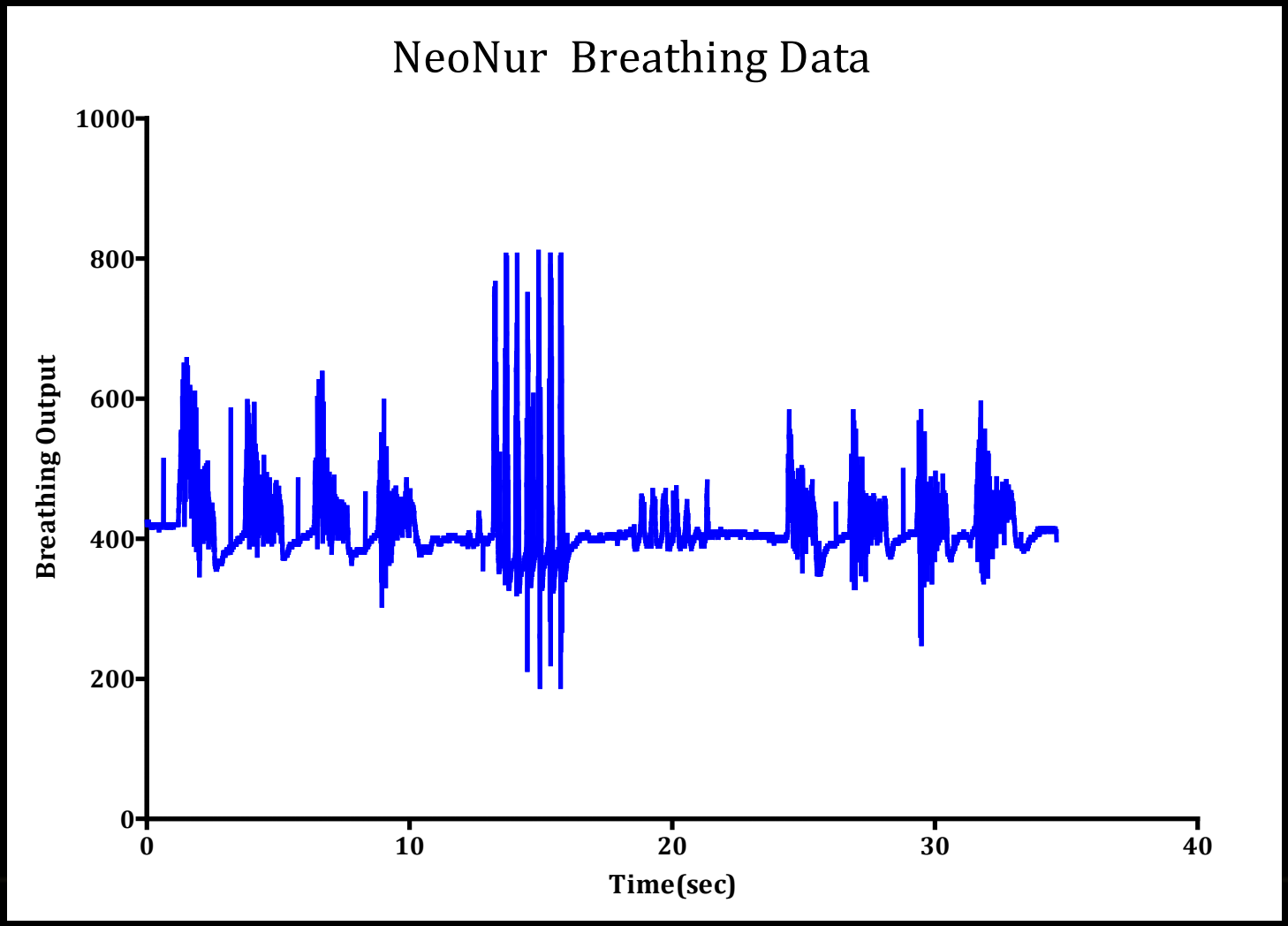
Results:


Natural Breathing
A
B
C
D
0.4
0.2
0.0
-0.2
-0.4
Voltage (Volts)
0
2
4
6
8
10
Time (sec)

Results:



Results:


NeoNur Breathing Data
Breathing Output
1000
800
600
400
200
0
0
10
20
30
40
Time(sec)

Conclusions:

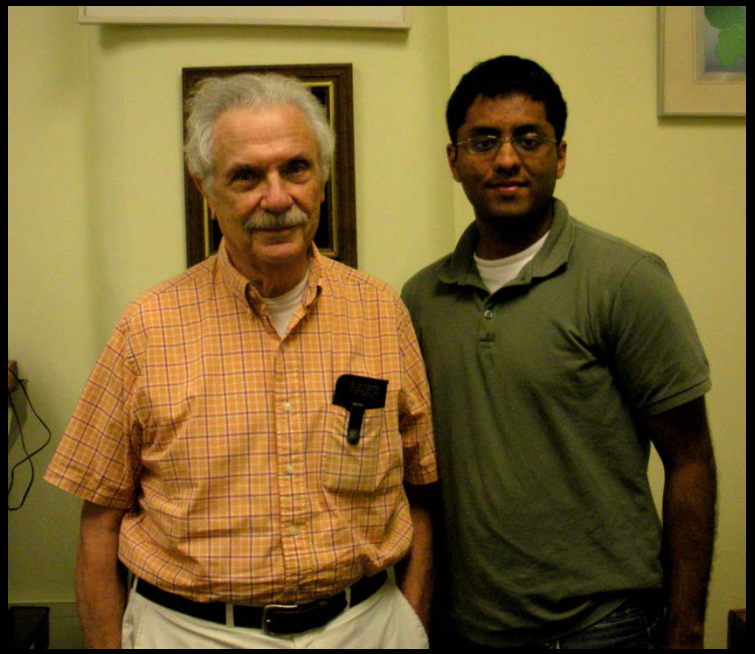
- Produced working physical prototype of a breathing sensor
- Satisfied all intended design constraints of breathing sensor
- Produced accurate breathing data with existing NeoNur hardware and software

Future Work:

- Simultaneous breathing and sucking data
- More practical electrode design

Acknowledgements:

- Dr. Zemel
- Dr. Van der Spiegel
- Dr. Medoff-Cooper
- National Science Foundation
- Mr. Szczeniak
- My colleagues



Questions?

References:

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[2] C. Lau, E. O. Smith and R. J. Schanler, "Coordination of suck-swallow and swallow respiration in preterm infants," *Acta Paediatr.,* vol. 92, pp. 721-727, Jun, 2003.

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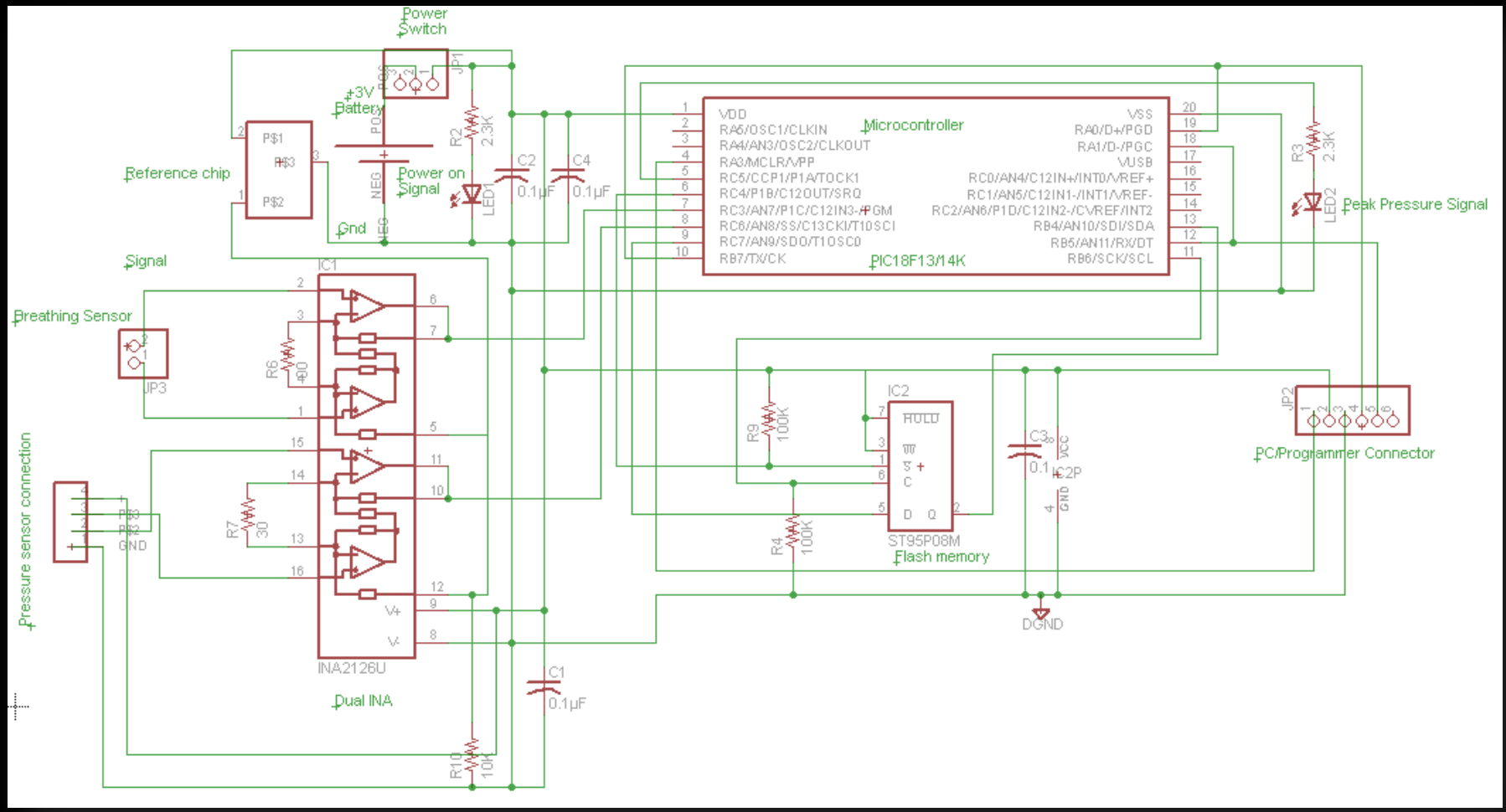
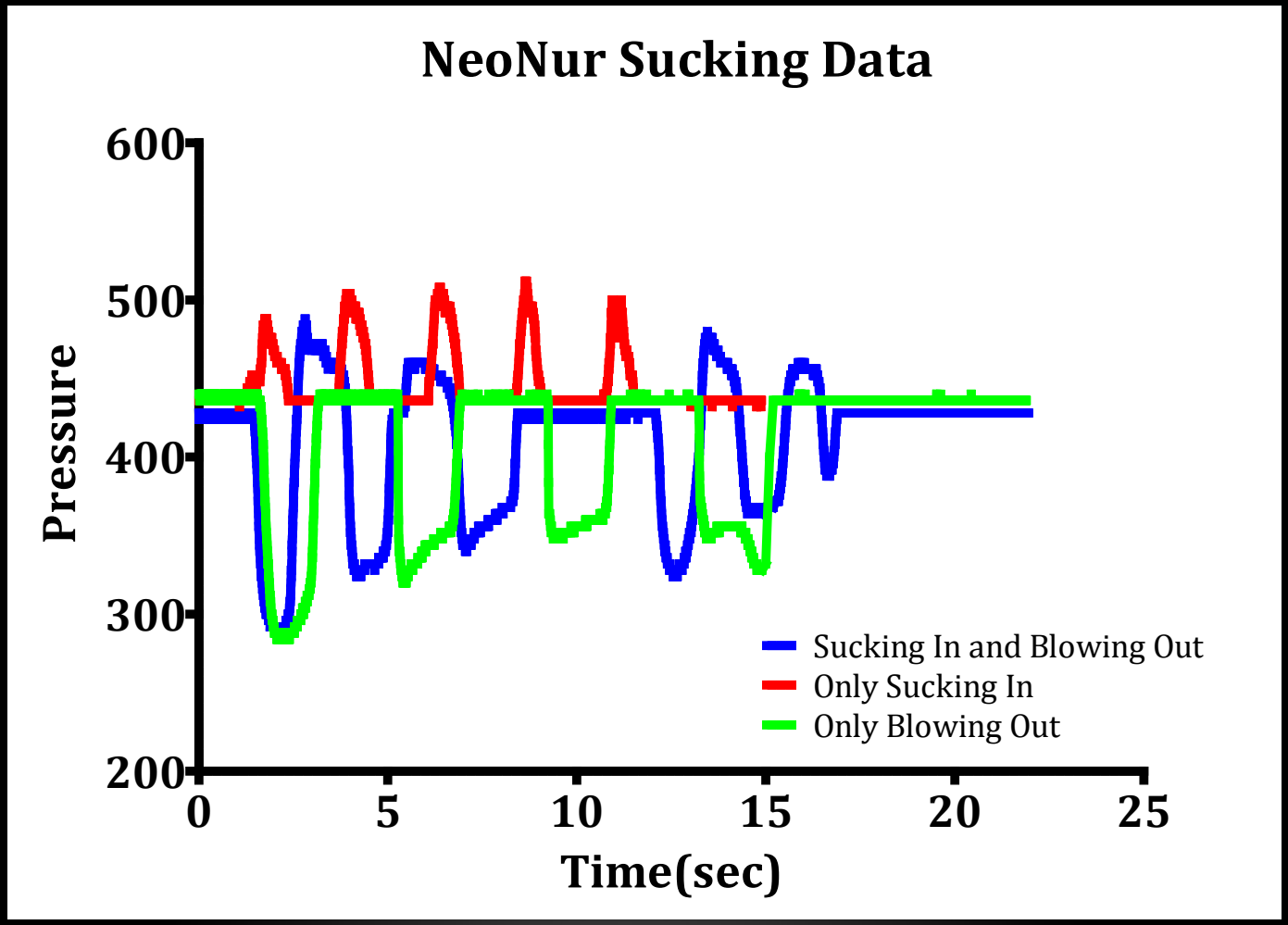
Thank You!

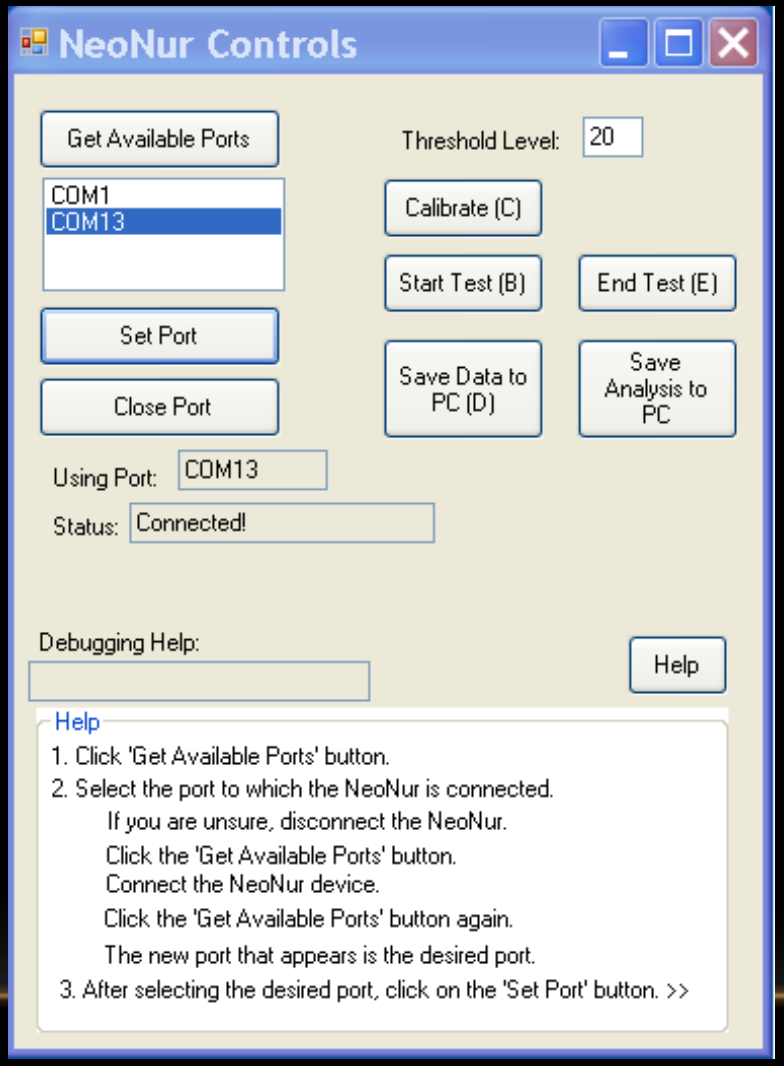
Appendix:


Power Switch
+3V Battery
Reference chip
Power on Signal
Gnd
Signal
Breathing Sensor
Pressure sensor connection
Microcontroller
PIC18F13/14K
Peak Pressure Signal
PC/Programmer Connector
ST95P08M
Flash memory
INA2126U
Dual INA
DGND

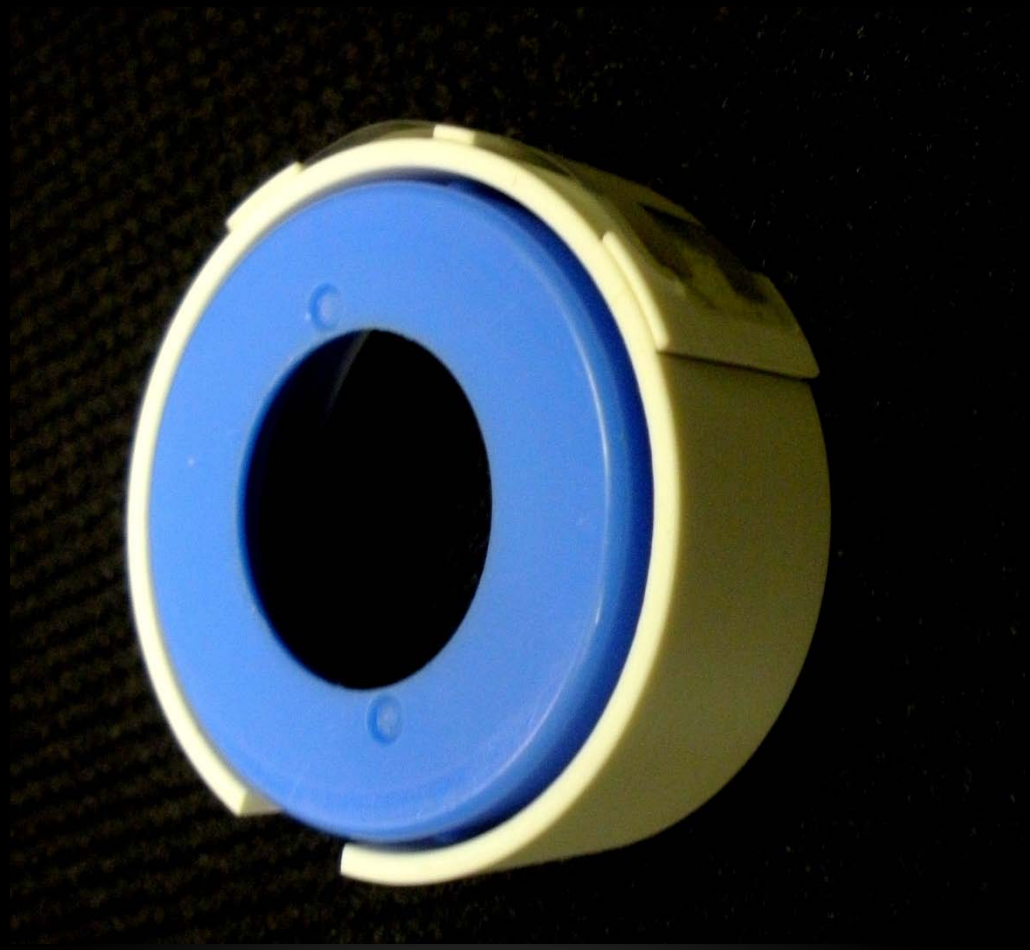
Appendix:


NeoNur Sucking Data
600
500
400
300
200
Pressure
0
5
10
15
20
25
Time(sec)
Sucking In and Blowing Out
Only Sucking In
Only Blowing Out

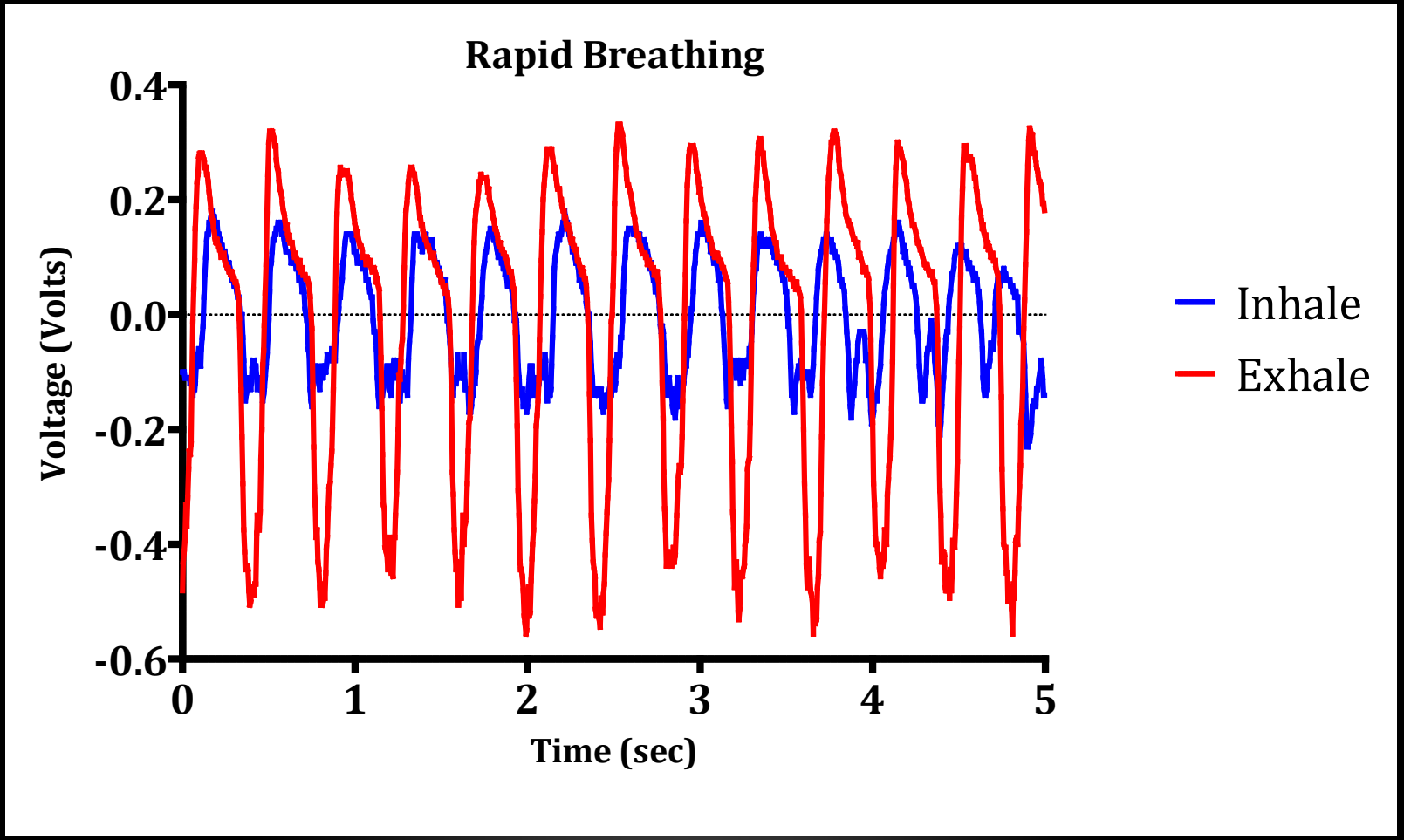
Appendix:


NeoNur Controls
Get Available Ports
Threshold Level:
20
COM1
COM13
Calibrate (C)
Start Test (B)
End Test (E)
Set Port
Close Port
Save Data to PC (D)
Save Analysis to PC
Using Port:
COM13
Status:
Connected!
Debugging Help:
Help
Help
1. Click 'Get Available Ports' button.
2. Select the port to which the NeoNur is connected.
If you are unsure, disconnect the NeoNur.
Click the 'Get Available Ports' button.
Connect the NeoNur device.
Click the 'Get Available Ports' button again.
The new port that appears is the desired port.
3. After selecting the desired port, click on the 'Set Port' button. >>

Appendix:



Appendix:


Rapid Breathing
Voltage (Volts)
0.4
0.2
0.0
-0.2
-0.4
-0.6
0
1
2
3
4
5
Time (sec)
Inhale
Exhale

Appendix: