

# Impedance Cardiography

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# Overview

- Problem Statement
- Impedance Cardiography Background
- Client Specifications
- Design Proposals & Matrix
- Social Considerations
- Future Work

# Problem Statement

- This semester our goal is to begin experimental impedance testing on human subjects using an electrode array we will construct in conjunction with a custom circuit.

# Cardiac Output

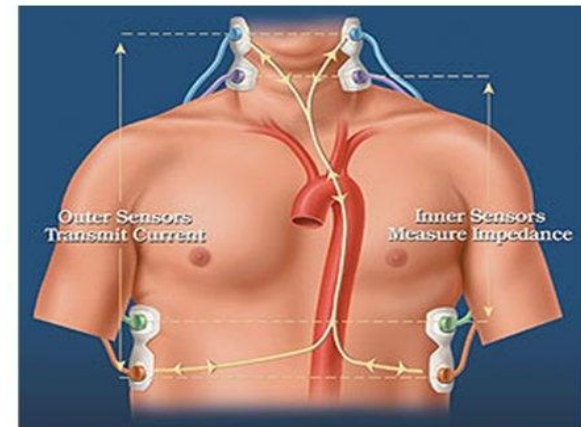
- Cardiac Output
  - $Q = SV * HR$ 
    - SV = Stroke Volume, which is end diastolic minus end systolic
    - HR = Heart rate
- Cardiac Output important in diagnosis
  - Sepsis
  - Cardiomyopathy
  - Heart Failure

# Measuring Cardiac Output

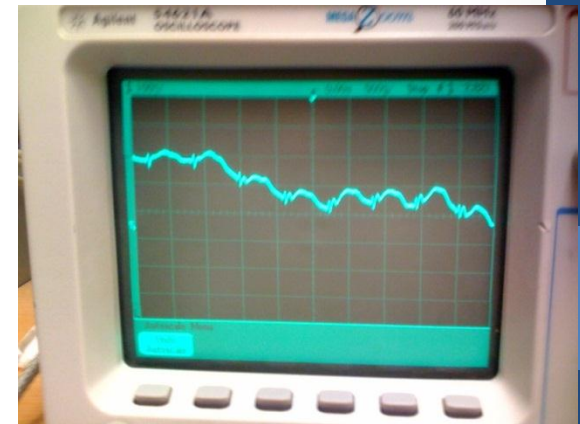
- Current methods for measuring cardiac output invasive
  - Thermodilution Catheter
  - MRI
- Impedance Cardiography is the non-invasive possible solution
- Impedance Cardiography does not directly measure cardiac output
  - This technique actually measures the change in resistance of blood flow through the aorta
  - With the use of an equation we can ascertain cardiac output from this data

# Impedance Cardiography

- ▶ High frequency (150 kHz) wave passed over aorta to measure impedance and track volumetric changes occurring in the cardiac cycle
- ▶ Pressure wave of the heart
- ▶ Non-invasive, painless, simple technique



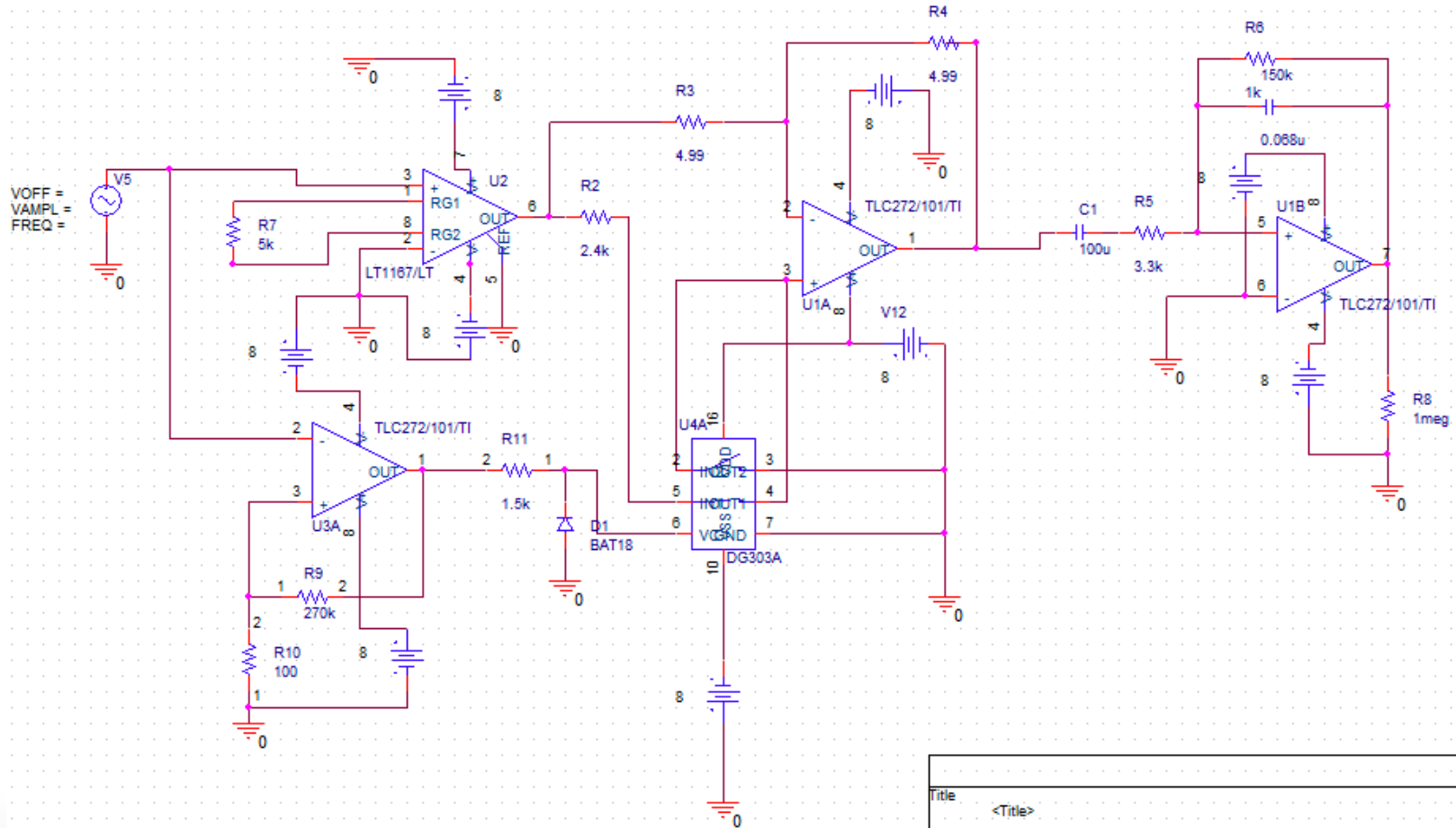
[Impedancecardiography.com](http://Impedancecardiography.com)



# Client Specifications

- ▶ Electrode Array
  - ▶ Spatially adjustable on body
  - ▶ Reusable, non-adhesive
  - ▶ Ability to record position for tests
  - ▶ Usable on male & female subjects
- ▶ Circuit
  - ▶ Eliminate EKG interference

# Our Circuit

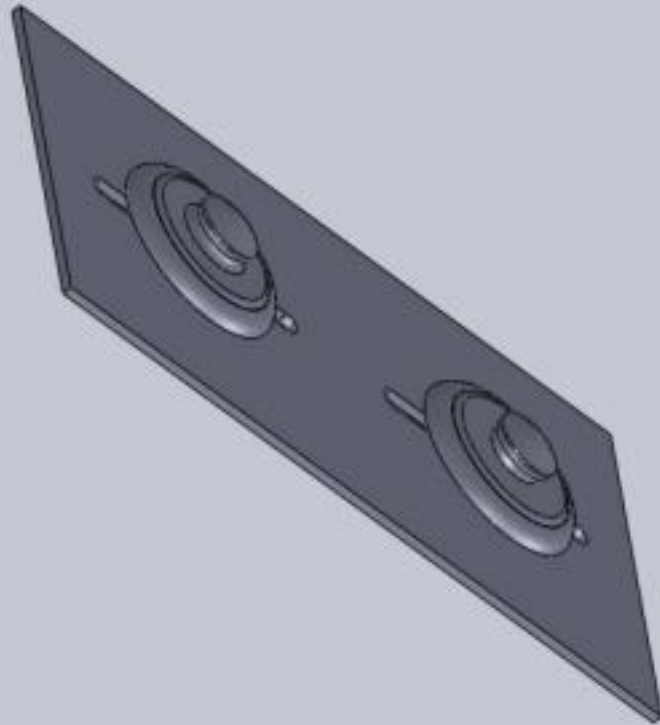


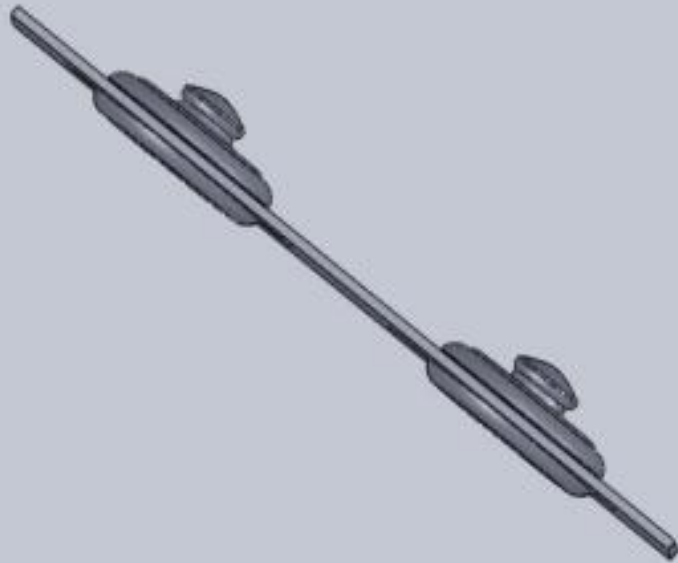
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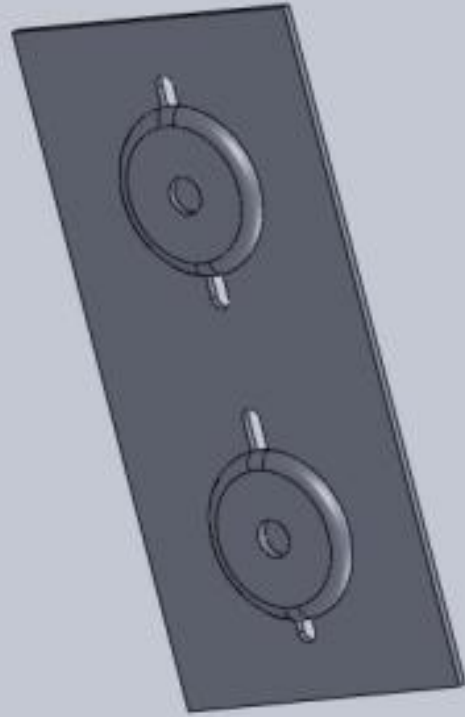


# Electrode Array

- Electrode array meets demands for testing
  - Reproducibility
  - Ease of use for Male and Female subjects
  - Freely moving electrodes
- Upgrade over last semesters prototype







# Matrix

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<b>Design</b>	<b>Spatial Adjustability (25)</b>	<b>Reusable/ non-adhesive (25)</b>	<b>Record position (25)</b>	<b>Usable on males/ females (25)</b>
Dual 2 Part track	20	25	25	25
Matrix sheet	0	25	15	0

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# Future Work

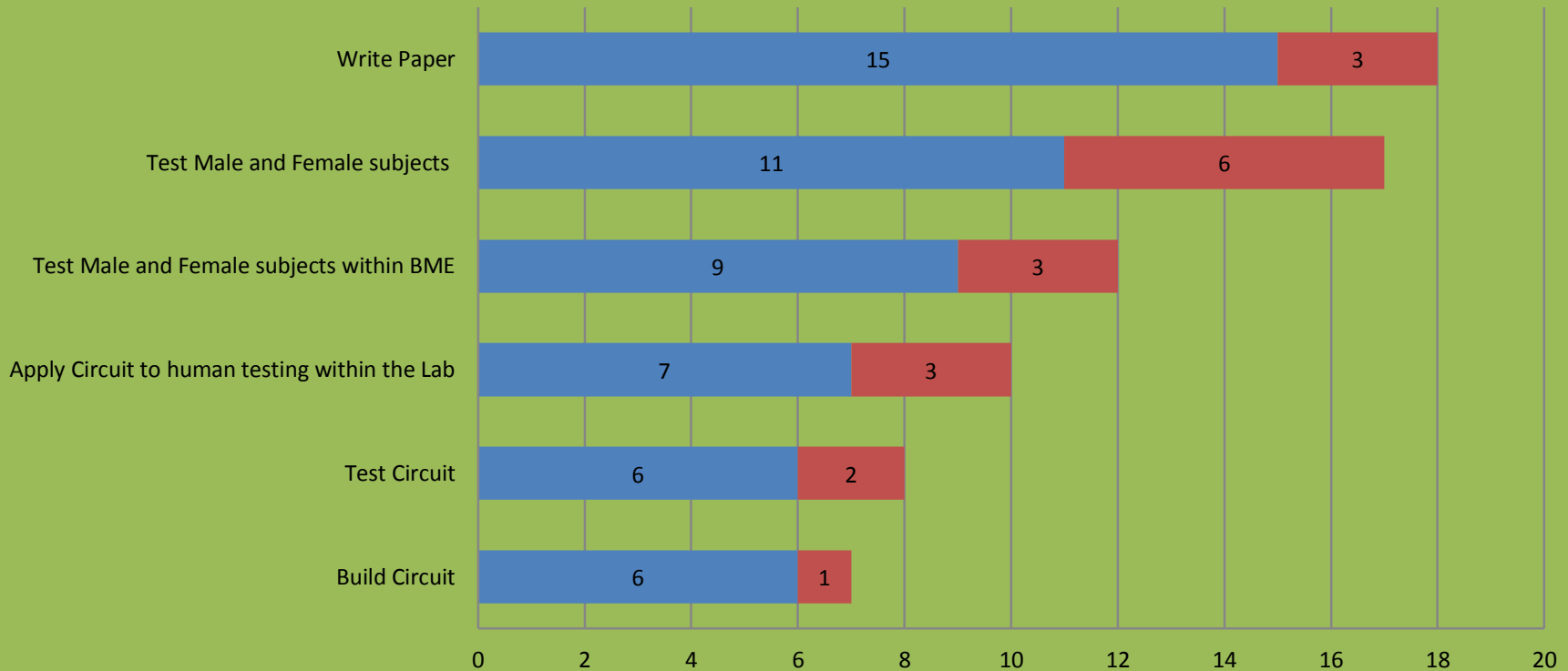
- ▶ Finalize the Circuit
- ▶ Obtain clean impedance signal
- ▶ Preliminary tests
- ▶ Testing on Male and Female subjects  
through pending approval

# Testing on Human Subjects

- Applied for IRB approval
- Test on males and females
- Obtain data on three different locations
  - Front and back
  - On chest
  - Neck and abdomen
- Obtain data for different orientations on the chest

# Gantt Chart

## Gantt Chart Impedance Cardiography



	Build Circuit	Test Circuit	Apply Circuit to human testing within the Lab	Test Male and Female subjects within BME	Test Male and Female subjects	Write Paper
Start Week in the Semester	6	6	7	9	11	15
Prospective Weeks Spent	1	2	3	3	6	3



# Perspectives and Ethics

- Requires personal interactions
  - Operator-patient relationship
- Safety considerations
  - Electrical components
  - Electrode components

# References

- Mitchell, G. F. (2009). Clinical achievements of impedance analysis. *Medical & Biological Engineering & Computing*, 47(2), 153-163.
- O'Rourke, M. F. (1982). Vascular impedance in studies of arterial and cardiac function. *Physiological Reviews*, 62(2), 570-623.
- <http://chestjournal.chestpubs.org/content/123/6/2028.full>

# Acknowledgments

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# Questions?