APRIL 16, 2015

OUR TEAM

- Nick Pizzacalla
  Chief Executive Officer
- Bonnie Ha
  Chief Operating Officer
- Scott Beaupre
  Chief Science Officer
- Alexandra Hauser
  Chief Technology Officer

OUTLINE

1. Introduction:
   - Problem, Solution, C.A.R.E., Market and Motivation, Cost-Benefit Analysis
2. Technical Design:
   - Background, System Diagram, Results, Reliability
3. Project Specifics:
   - Schedule, Roles, Materials, Finances
4. Conclusion:
   - Summary, Future Work, Lessons Learned, Acknowledgements

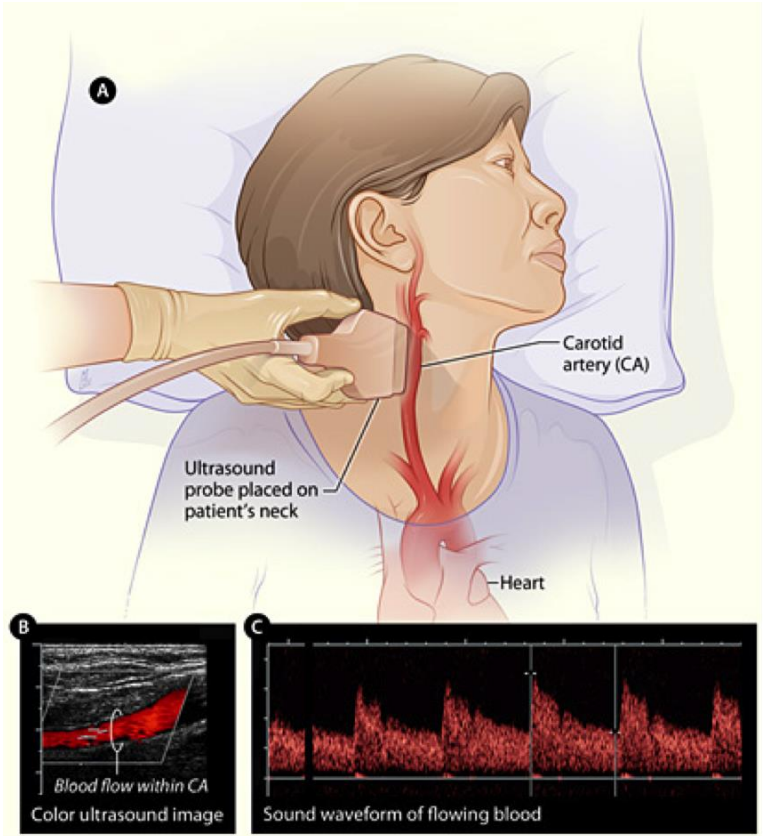
INTRODUCTION

PROBLEM, SOLUTION, C.A.R.E., MARKET AND MOTIVATION, COST-BENEFIT ANALYSIS

THE PROBLEM

- A stroke occurs every 10 minutes
- 3rd cause of death in Canada
- 80% caused by blood clots from plaque in carotid artery
- Lack of accessibility to early detection

http://upload.wikimedia.org/wikipedia/commons/4/48/Carotid_Plaque.jpg



http://www.daviddarling.info/images/carotid_ultrasound.jpg

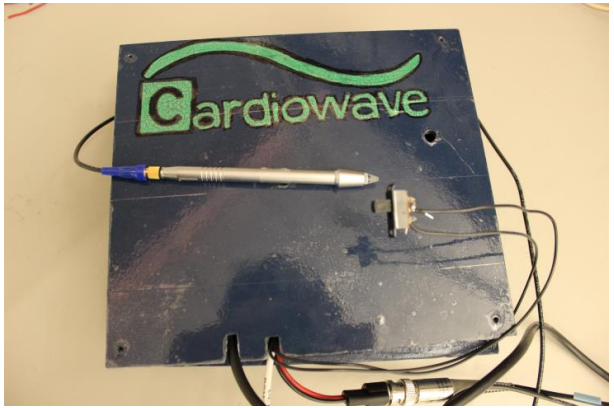
SOLUTION?

- Already exists!
- So what are we doing?
- We want it to be convenient, affordable, reliable, and portable

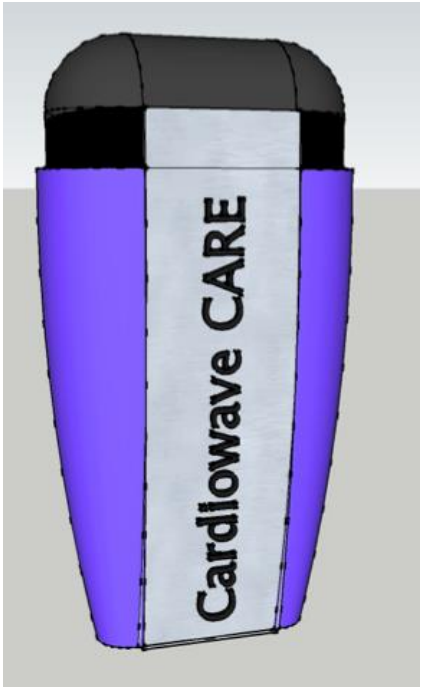
http://www.providianmedical.com/wp-content/gallery/ultrasonix-sonixsp/sonixsp-ultrasound.jpg?2ad35f

INTRODUCING C.A.R.E.

- Carotid Artery Real-Time Echo by Cardiowave
- Portable Ultrasound Device
- Detects Plaque in Carotid Artery
- Integrates with existing IT infrastructure
- Video demonstration



CURRENT VERSION



PROTOTYPE VERSION

DESIRED GOALS FOR PRODUCT

- Convenient
- Affordable/Cost-Effective
- Reliable
- Portable

MARKET AND MOTIVATION

- Market is underutilized on the low-cost end
  - Mobisante: $10,000
- Reduces accessibility
- Prices for end-user/patient are high

http://www.mobisante.com/products/product-overview/

COST-BENEFIT ANALYSIS

	C.A.R.E.	Competitors
Price Point	$1,500	$10,00-$25,000
Use	Quick clinic visit	Long waiting times
Appointments	Affordable	+$500

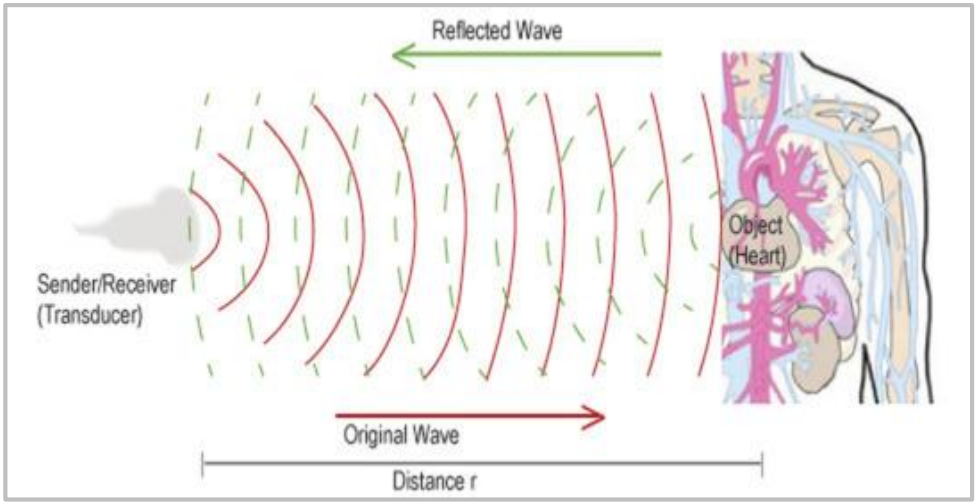
- Benefit: Early detection of plaque to save countless lives and prevent family tragedies.
- Can you really put a number value to that?

TECHNICAL DESIGN

BACKGROUND, SYSTEM DIAGRAM, RESULTS, RELIABILITY

BACKGROUND: ULTRASOUND

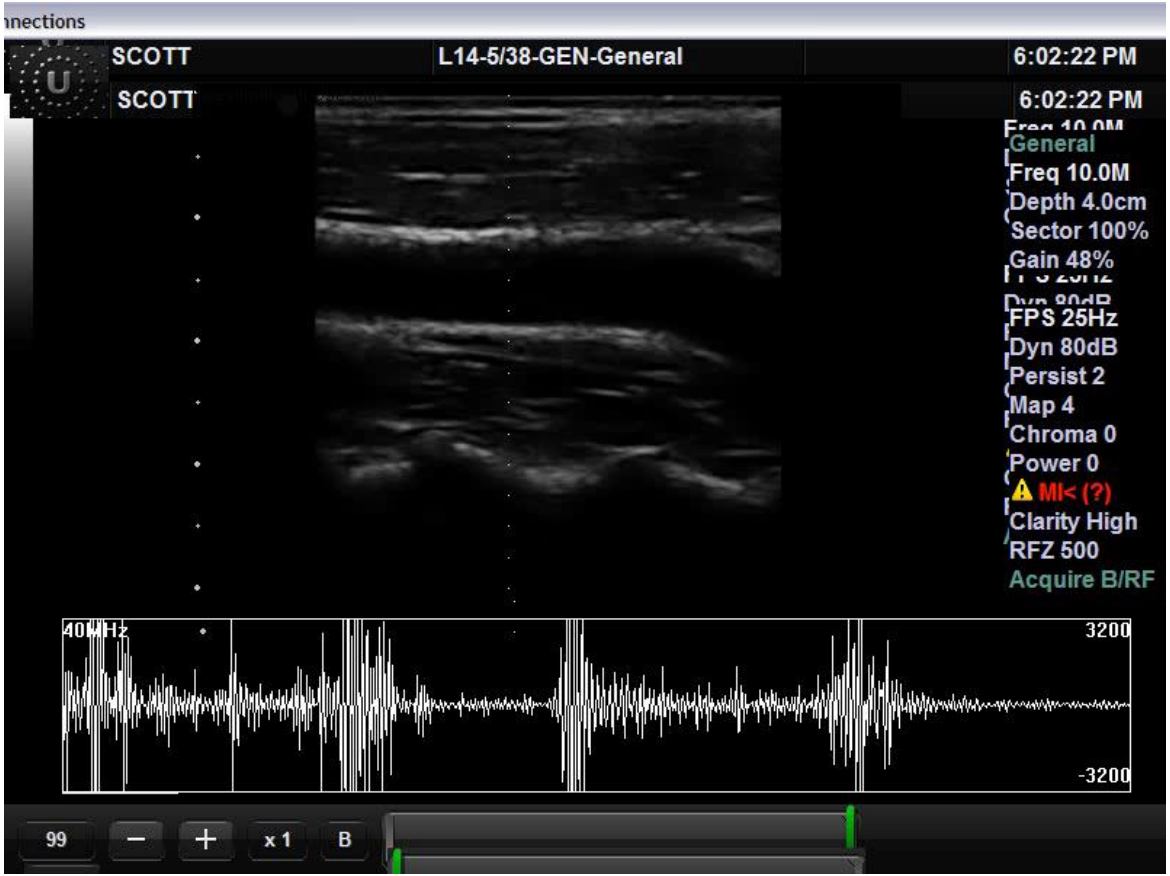
- A non-invasive imaging modality
- Utilizes high frequency sound waves to produce an image in real time
- Captures reflections of internal structures in the body



http://ultrasoundsolutions.net

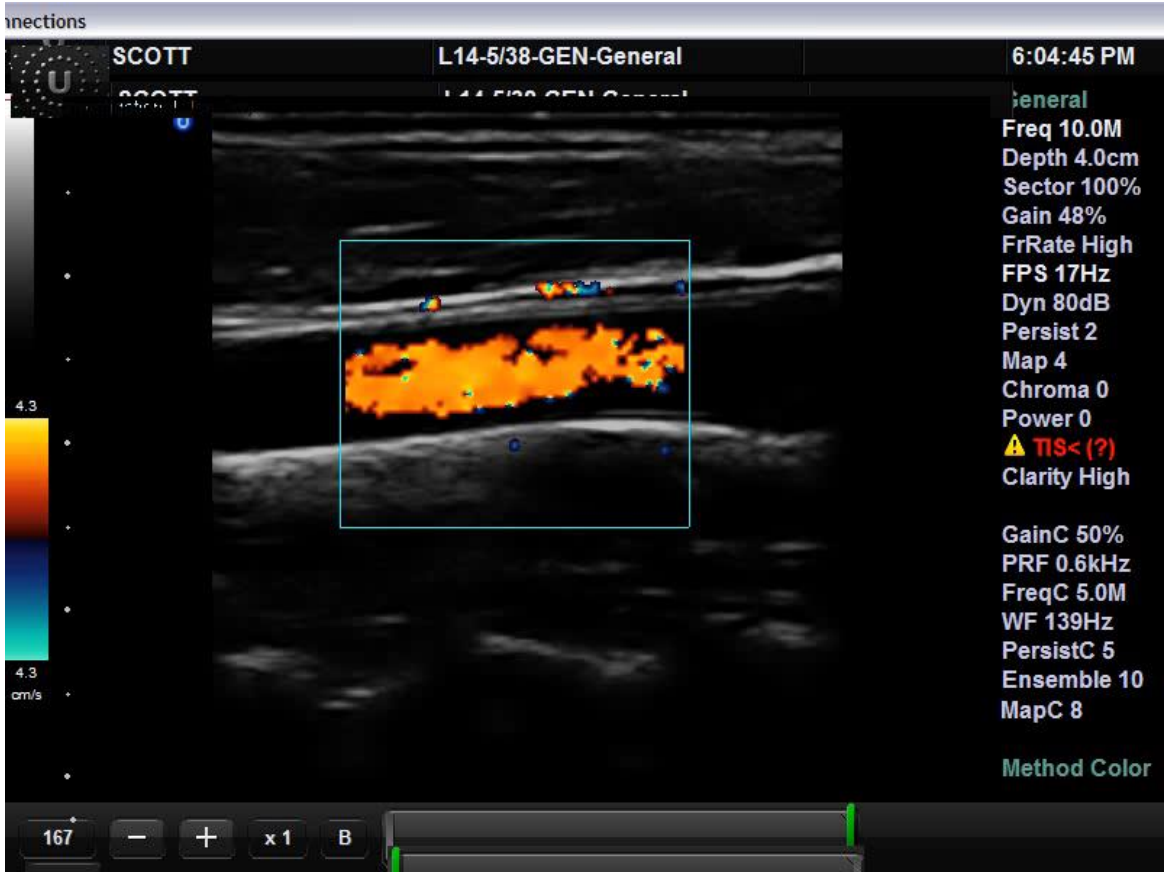
BACKGROUND

- A-mode
- B-mode



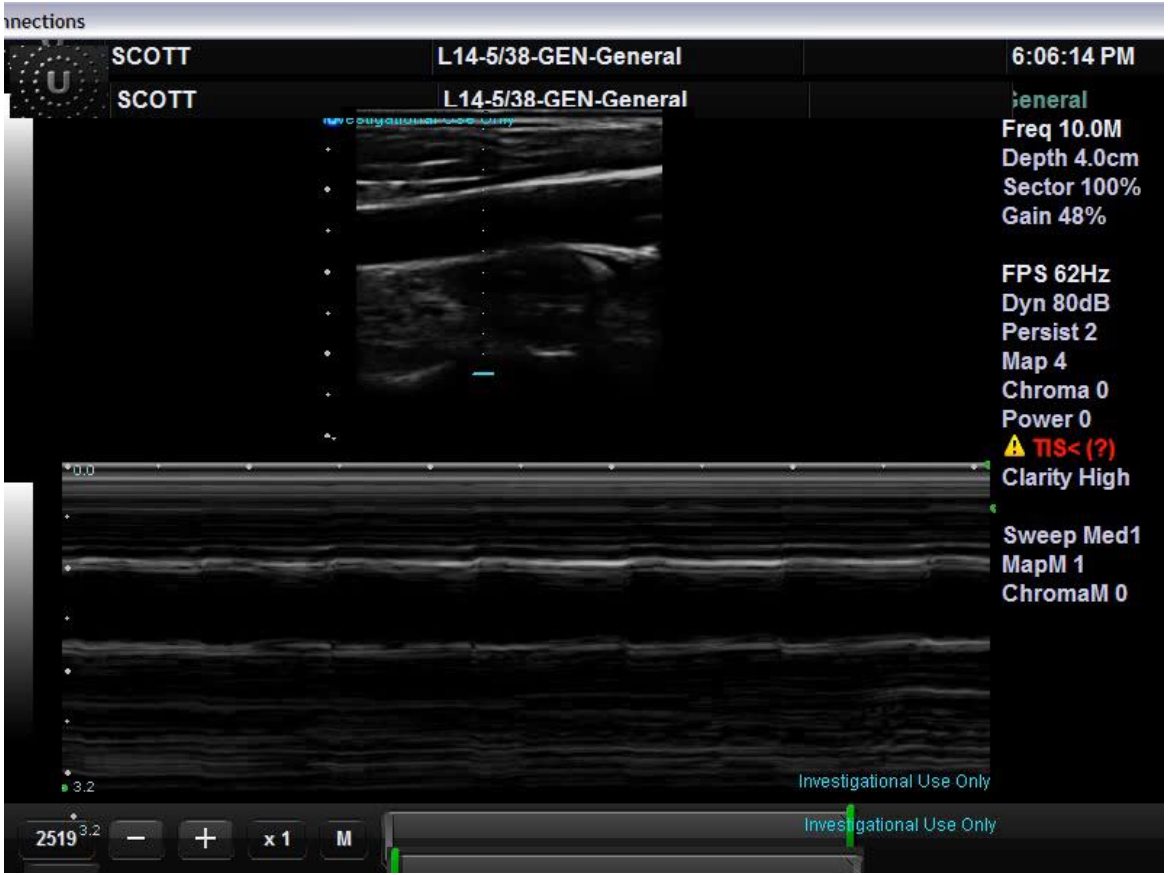
BACKGROUND

- Colour Doppler



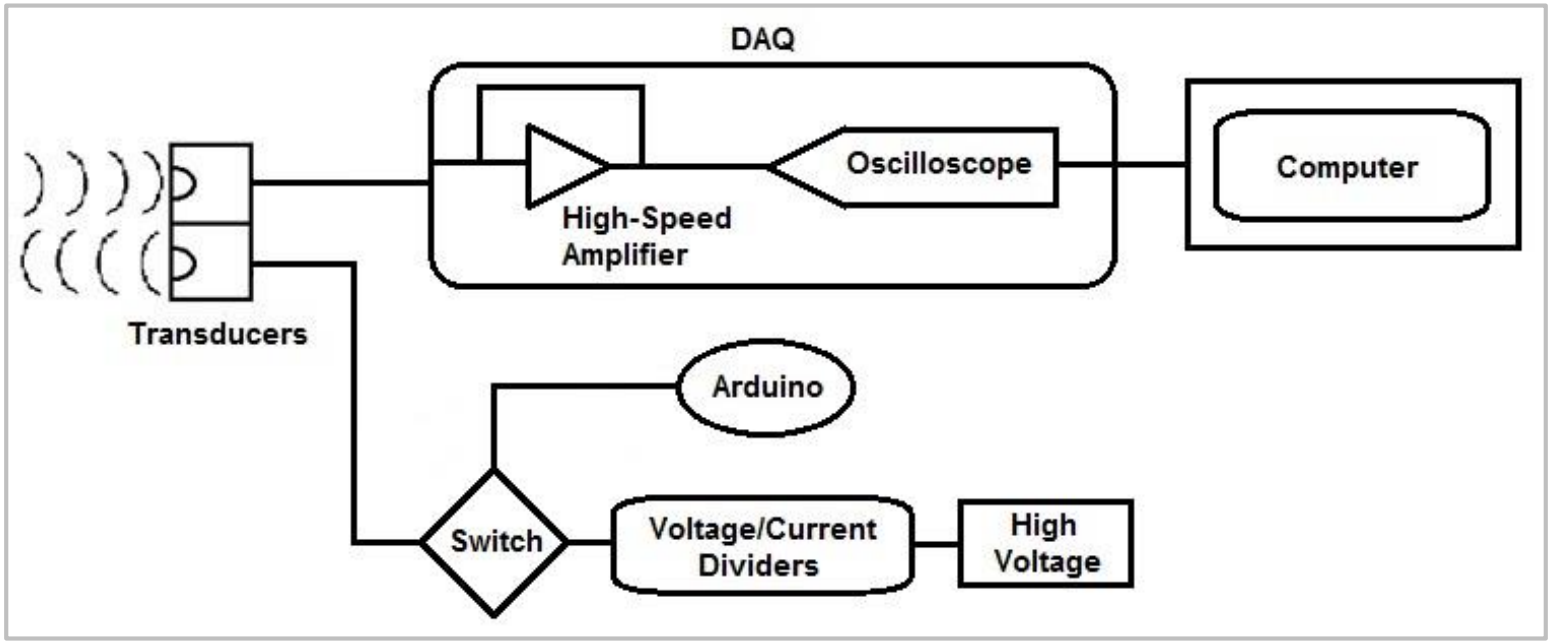
BACKGROUND

- M-mode



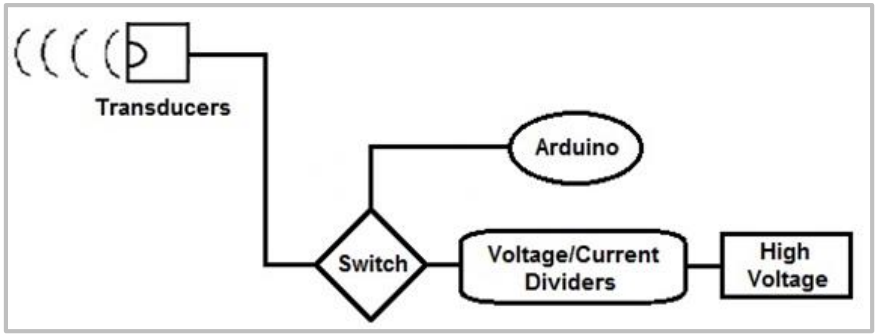
SYSTEM DIAGRAM

- Current state of our product:

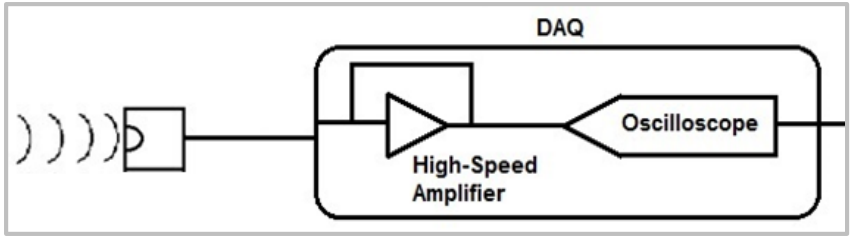


HARDWARE: TRANSMITTER

Issues	Resolution
Transducer did not excite with high frequency oscillator	Applied short, high voltage pulses
Voltage booster did not boost voltage enough	High voltage DC-to-DC used with Arduino-controlled BJT switch



HARDWARE: RECEIVER

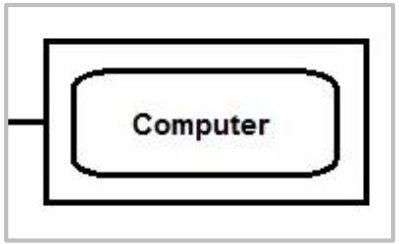


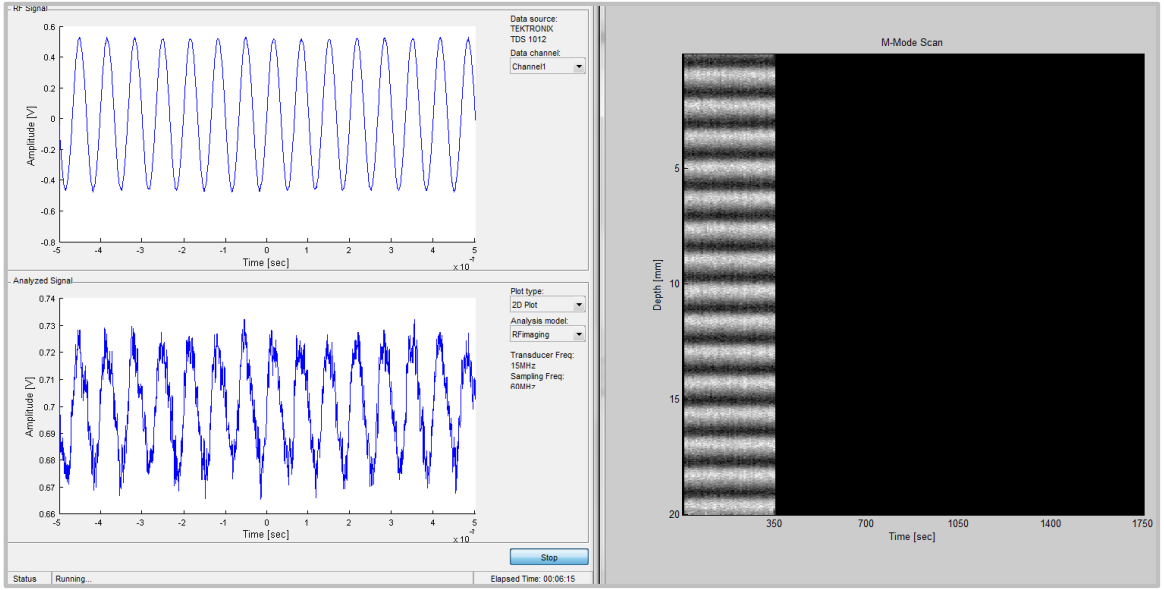
Issues	Resolution
Breadboard added too much capacitance to amplifier circuit (high frequency noise)	Utilize prototype board
Operational amplifier suited for high frequency	Purchased a 200MHz high speed opamp
DC offset	Applied a Vreg = Vcc (9 V) with a variable resistor
ADC shipping issue	Used oscilloscope as ADC + DSP

SOFTWARE: GUI

- Reads data from the oscilloscope and displays using MATLAB
- Processes data and produces M-Mode Scan

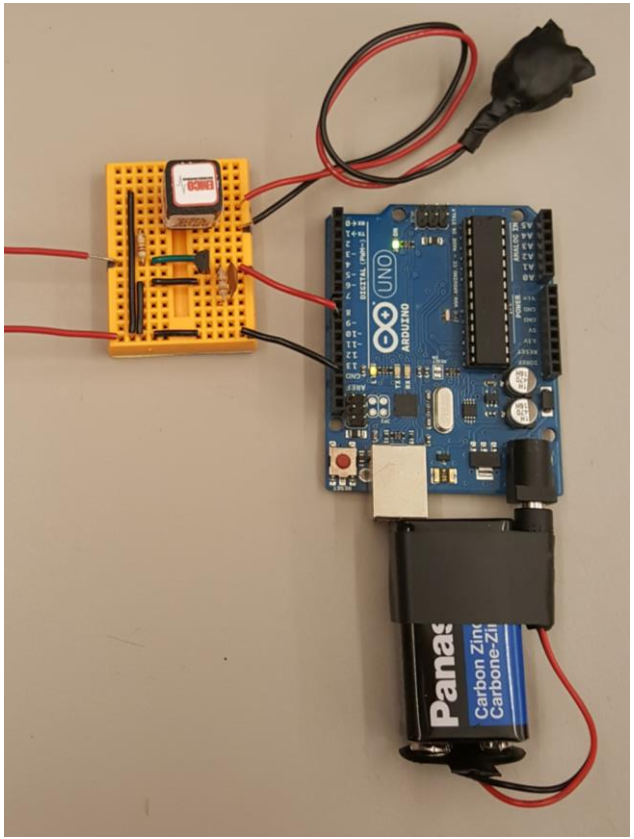
Issues
Updates every 7 seconds
Crashes randomly due to too much processing





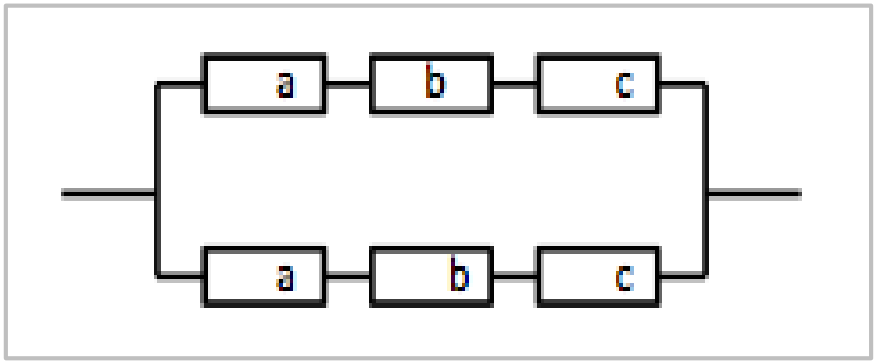
RESULTS

- Major challenge:
  - One of the transducers broke!
- Due to all the challenges, we did not progress through the proof of concept stage
- Currently:
  - Transmitter circuit outputs high voltage and excites the transducer
  - Receiving circuit amplifies reflected signal
  - Software displays A-mode and M-mode scan



RELIABILITY

- Reliability R_n – probability that the system will still be operational after n demands.
- **$R_n = e^{-np}$** where p is the probability of of failure in single demand.
- **Redundancy:** High level redundancy



$$R_{HL} = 2\,R_a R_b R_c - (R_a R_b R_c)^2$$

Figure and Equation taken from ENSC 481 class notes

RELIABILITY TESTING

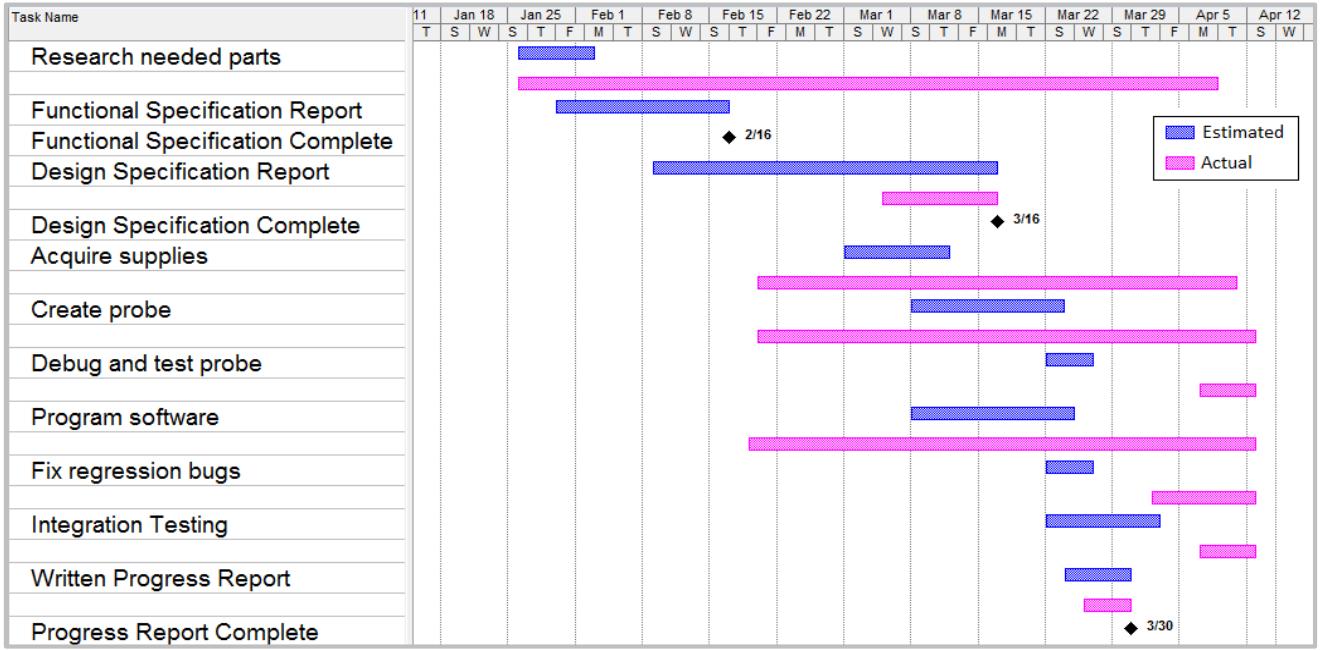
- Sampling and destructive testing: Electronic components such as BJTs, resistors, capacitors
- Advance Stress-Testing: Also done on electronic components using more power than is anticipated
- Transducer Testing: Had to rely on historical data

PROJECT SPECIFICS

TIMELINE, ROLES, MATERIALS, FINANCES

SCHEDULE

- Estimated and actual timeline



ROLES

- Technical:
  - Nick implemented the transmitting circuit
  - Bonnie and Scott developed the receiving circuit
  - Alex programmed the software GUI
- Managerial:
  - Nick managed finances and administrative tasks
  - Bonnie was responsible for meeting minutes and documentation
  - Scott and Alex researched technical components

MATERIALS

- Parts used in our final design

Transmitter Circuit	Receiver Circuit	Accessories
Transducer	Transducer	Ultrasound Gel
BNC to Microdot	BNC to Microdot	Proto-board
Breakout to BNC	200MHz Op-Amp	Battery Holder
Arduino	BNC Connector to PCB Mount	
DC-to-DC Converter	Coaxial BNC-BNC	
BJT		
Transistor - 2N5550G		

FINANCES: REVENUE

Estimated Revenue	
Item	**Total**
ESSEF Funding	$ 500.00
Wighton Fund	$ 500.00
Personal Funding	$ 352.70
Total:	**$ 1,352.70**

Actual Revenue	
Item	**Total**
ESSEF Funding	$ 700.00
Nick Pizzacalla	$ 200.00
Bonnie Ha	$ 200.00
Scott Beaupre	$ 200.00
Alex Hauser	$ 200.00
Total:	**$1,500.00**

FINANCES: EXPENSES

- Over budget by **$706.48**

Estimated Expenses	
Item	**Total**
Transducer	$ 800.00
Transceiver	$ 120.00
Digital to Analog Converter	$ 30.00
Ultrasound Gel	$ 27.25
Wires & Electronic Components	$ 100.00
Administrative Expenses	$ 50.00
Contingency (20%)	$ 225.45
Total:	**$ 1,352.70**

Actual Expenses	
Item	**Total**
Locker Lock	$ 8.91
Olympus Transducers	$ 1,369.76
BNC to Microdot Cable	$ 111.37
Ultrasound Gel	$ 9.24
ADC & Breakout to BNC	$ 60.74
200 MHz Op-Amp	$ 25.92
Printed Circuit Board	$ 6.05
DC-to-DC	$ 312.02
Transistor 2N5550G	$ 2.24
Coaxial BNC-BNC	$ 6.70
BNC Connector to PCB Mount	$ 8.74
Battery Holder 9V	$ 3.36
Unused Parts in Final Design	$ 145.91
Total	**$2,059.18**

FINANCES: ACTUAL

- Current standings: **$(559.18)**

Actual Revenue	
Item	**Total**
ESSEF Funding	$ 700.00
Nick Pizzacalla	$ 200.00
Bonnie Ha	$ 200.00
Scott Beaupre	$ 200.00
Alex Hauser	$ 200.00
Total:	**$1,500.00**

Actual Expenses	
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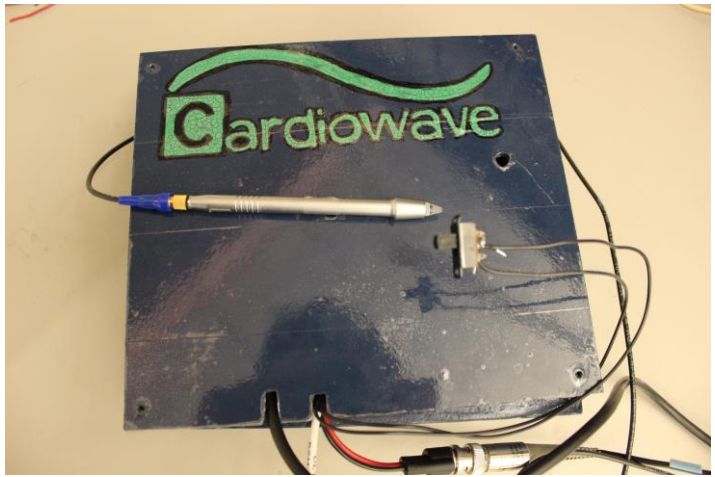
Unused Parts in Final Design	$ 145.91
Total	**$2,059.18**

CONCLUSION

SUMMARY, FUTURE WORK, LESSONS LEARNED

SUMMARY

- CARE is cost-effective, reliable, and portable
- Early detection is increasingly necessary with an ever-aging population
- Clinics and elderly homes are main customer focus

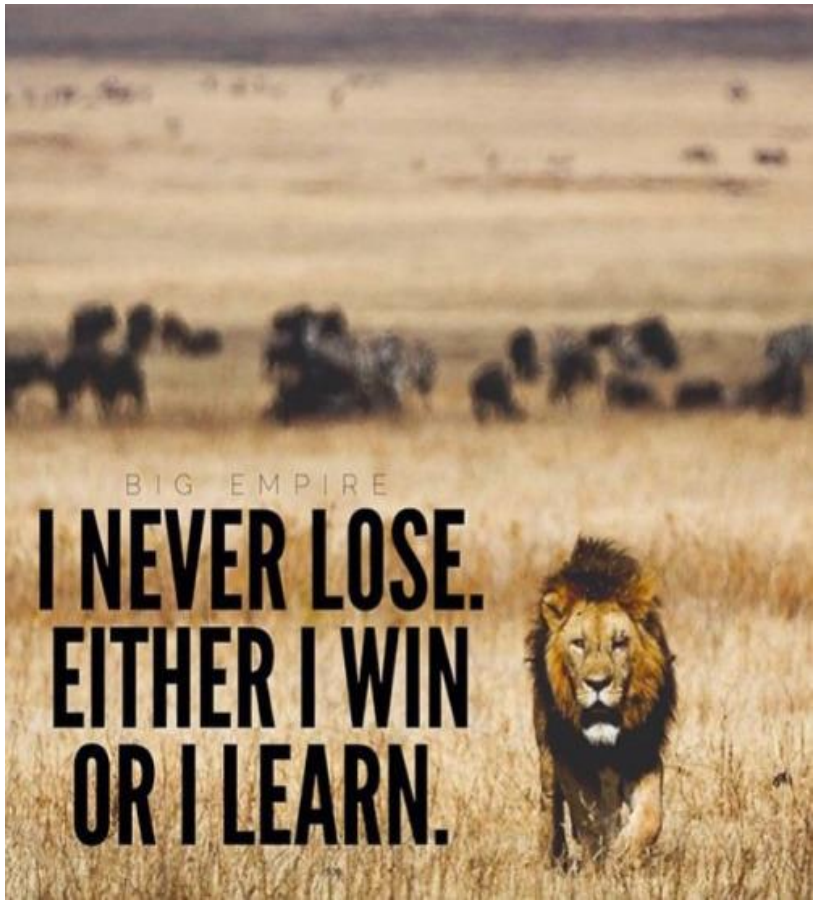


FUTURE WORK

- Implement a transducer array
- Convert proto-type board to PCB (Printed Circuit Board)
- Enable Bluetooth capabilities
- Smartphone/computer application
- Use of one power source
- We want to continue working on the project this summer

LESSONS LEARNED

- Challenging full-time project
- Read the datasheets correctly
- Share information with team
- Have a Plan-B
- Technically:
  - Ultrasound technology
  - High-frequency amplifiers
  - Circuit building and testing



http://40.media.tumblr.com/3c8fbe4f52a9bb6d939d0d03e86bace5/tumblr_niz6r97iey1qhjm6yo1_500.jpg

ACKNOWLEDGMENTS

- Thank you for all your knowledge, assistance, and support throughout this project!
  - Andrew Rawicz, SFU
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  - Ash Parameswaran, SFU
  - Arash Taheri, SFU
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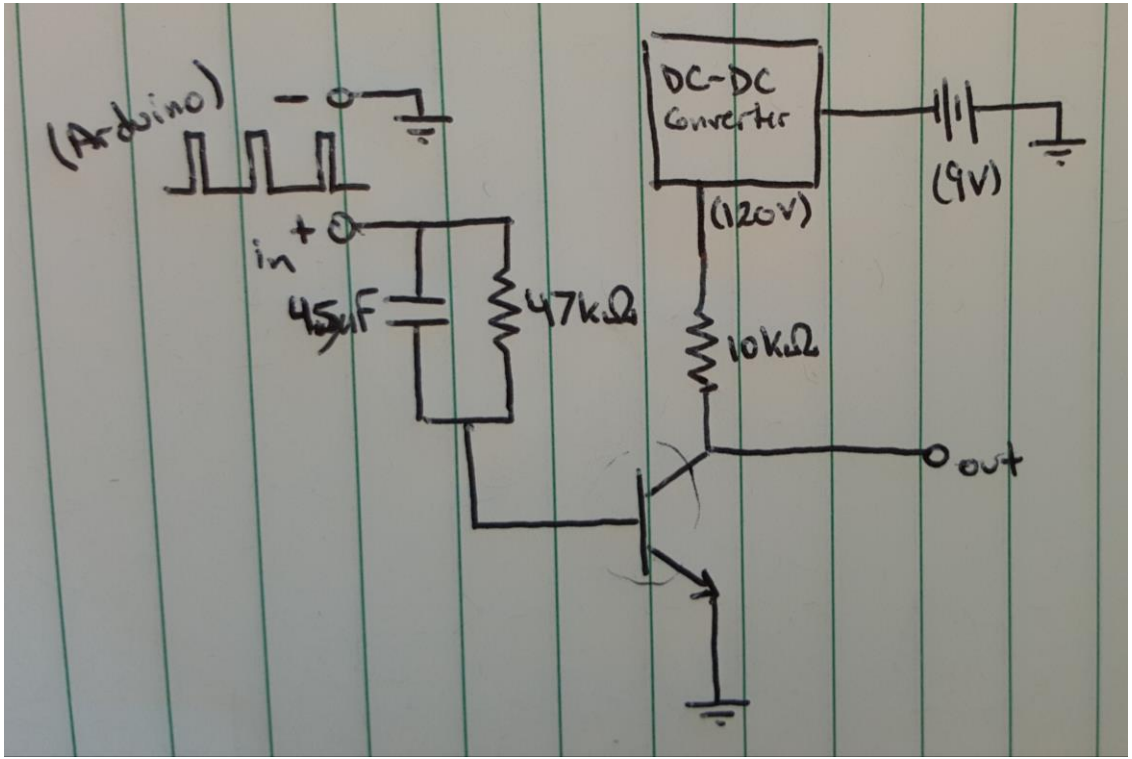
  - Graham Wiens, Olympus NDT
  - Ken Rutledge, CSA
  - Kelly, EMCO
  - On-Time Service
  - ESSS
  - Friends and Family

QUESTIONS?

THE FLOOR IS OPEN FOR QUESTIONS!

APPENDIX: TRANSMITTING CIRCUIT



APPENDIX: AMPLIFIER CIRCUIT DIAGRAM