



Doppler Dot

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Overview

- Problem Statement
- Background
- Current Devices
- Product Design Specifications
- Preliminary Designs
- Design Matrix
- Future Work
- References



Problem Statement

- Reconstructive surgery requires the monitoring of blood flow
- Hourly readings disturb patient
 - Difficult to locate artery
 - Ultrasound gel creates mess
- Design device to:
 - Attach → Mark location → Transmit sound waves
 - Improve patient's overall comfort



Background

What is a Doppler Pen?

- Uses ultrasound technology to measure blood flow
 - Detects triphasic signal in a given artery
 - Detects venous and arterial blood flow

What is the clinical impact?

- Used to determine the success of the surgery
 - Can detect sufficient blood flow
 - Tissue can be saved with corrective surgery



Figure 1: Doppler device currently used in the hospital



Background

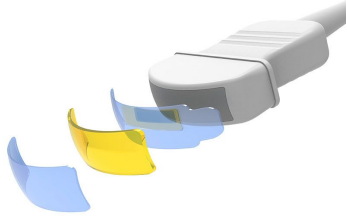


Figure 2: SonoFast
Hydrogel Pad

Image: <http://www.sonofast.com/>

What is wrong with the current design?

- Creates mess
- Disturbs the patient
- Difficulty finding artery location

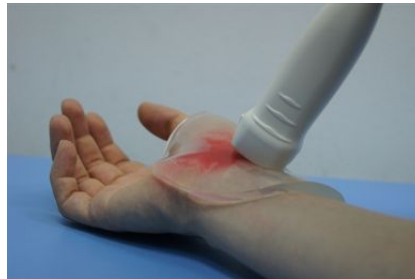


Figure 3: HydroAid[®] Ultrasound
Hydrogel Pad

Image: <http://www.civco.com>



Figure 4: Current Ultrasound Gel

Image: <http://www.parkerlabs.com>



Product Design Specifications (PDS)

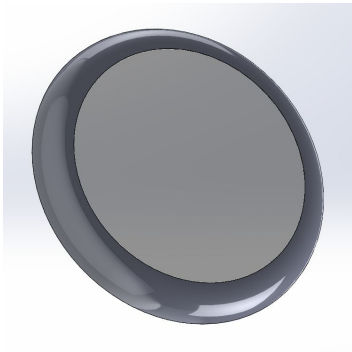
- Performance requirements
 - Attach to the skin
 - Mark location (2 cm radius)
 - Transmit sound waves (8.1-9.5 MHz)
- Accuracy and reliability
- 5 day service life



Preliminary Designs - Sample Holder

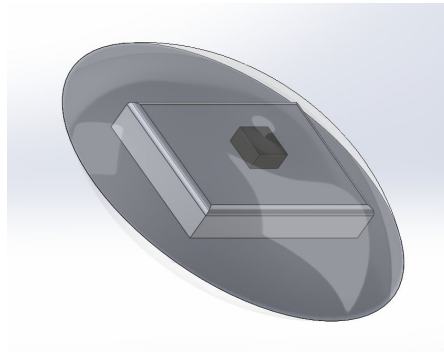
Design 1:

Disposable Hydrogel
Adhesive Patch



Design 2:

Reusable Doppler with
Disposable Hydrogel

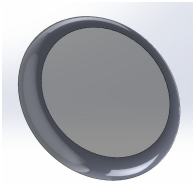
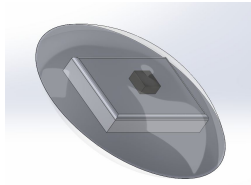



Design 3:

Disposable Hydrogel
Adhesive Container



Design Matrix

	Design 1: Disposable Hydrogel Adhesive Patch		Design 2: Reusable Doppler with Disposable Hydrogel Patch		Design 3: Disposable Hydrogel Adhesive Container	
						
Effectiveness (30)	4/5	24	4/5	24	5/5	30
Patient Comfort (25)	4/5	20	4/5	20	3/5	15
Ease of Use for Nurses (15)	4/5	12	2/5	6	4/5	12
Service Life (10)	2/5	4	3/5	6	5/5	10
Cost (10)	5/5	10	3/5	6	4/5	8
Safety (10)	5/5	10	4/5	8	5/5	10
Total (100)	80		70		85	



Final Design

- Constructed from a flexible resin
 - Easy to produce via 3D printing
 - Improves comfort and fit
- Removable cap
 - Reduces mess
 - Easy access for nurses to take readings
- Adhesive bottom to ensure tack
 - Hypoallergenic and atraumatic when removed
 - Indicates location of the artery



Figure 5: Final Design



Future Work

Design:

- Refine design
 - Dimensions, materials, precise cost evaluation
- Testing
 - Conductivity and tack of materials
 - Feedback from nurses

Potential Roadblocks:

- Competing products
 - Novelty
- Budget
- Fulfilling all of client's requests during course of semester



Acknowledgements

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References

Buntic, R. MD. (2017). *Flap and Replant Perfusion Monitoring*. [online] Microsurgeon.org. Available at: <https://www.microsurgeon.org/monitoring> [Accessed 21 Sep. 2017].

D. A. Montecalvo, "Solid multipurpose ultrasonic biomedical couplant gel in sheet form and method," U.S. Patent 5 522 878, June 4, 1996.

R. E. Tuchler, "Diverging signal tandem doppler probe," U.S. Patent 5 119 821, June 9, 1992.

"Functional Prototyping Materials for Engineers | Formlabs", *Formlabs.com*, 2017. [Online]. Available: <https://formlabs.com/materials/engineering/>. [Accessed: 22 Sep. 2017].



Questions?

