Sensor for Breast Imaging Device

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Client- Professor Hagness

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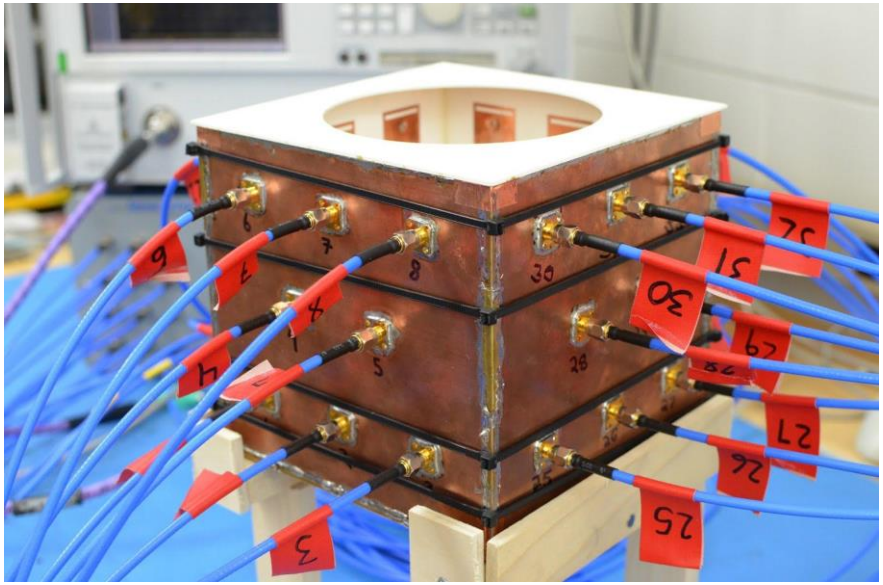

Figure 1: Picture of 3D imaging device courtesy of Owen Mays.

Outline

- Background
- Motivation
- Problem Statement
- Client Requirements
- Design 1
- Design 2
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Background

- 1 in 8 women develop breast cancer
- 30% of cancer in women
- Initial screening
  - Mammogram
  - X-ray

Figure 2: Example of x-ray device used in a mammography [4].

References: [1] [5]

Background

- Mammography gold standard
- Underserved population
  - Higher risk
  - High breast density
  - Harder to screen
- MRI has 50% false-positive

References: [6]

Background

- 3D microwave imaging device
  - Fraction of cost of MRI
  - Ease of use
  - Accessibility
  - Low health risk

- Conductivity and permittivity of tissue
  - Contrast
  - Biocompatible contrast agents

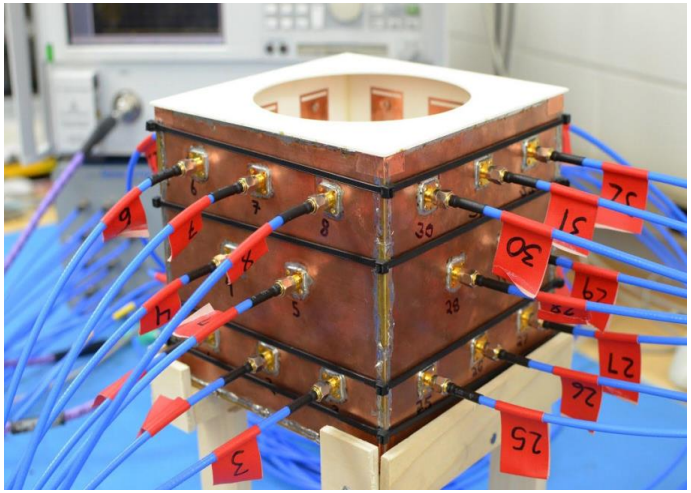

Figure 1: Picture of 3D imaging device courtesy of Owen Mays.

References: [6]

Motivation

- Filling/draining currently performed by human
  - Requires significant effort
  - Can't tell how much liquid needed
  - Large margin of error, frequent spills
- Client needs pump with sensor
  - Monitors liquid level, stops at top
  - Adjusts volume filled with breast size

Problem Statement

- Sensor / Pump system
- Automated
- Fill / Drain
- Portable
- Fill time < 5 Min

Client Requirements

- No metal inside box
- Two holes maximum
  - 1cm or smaller
- Not reliant on manual operator
- No size constraint
  - Wheeled into room
  - Fit under MR bed
- $600 budget

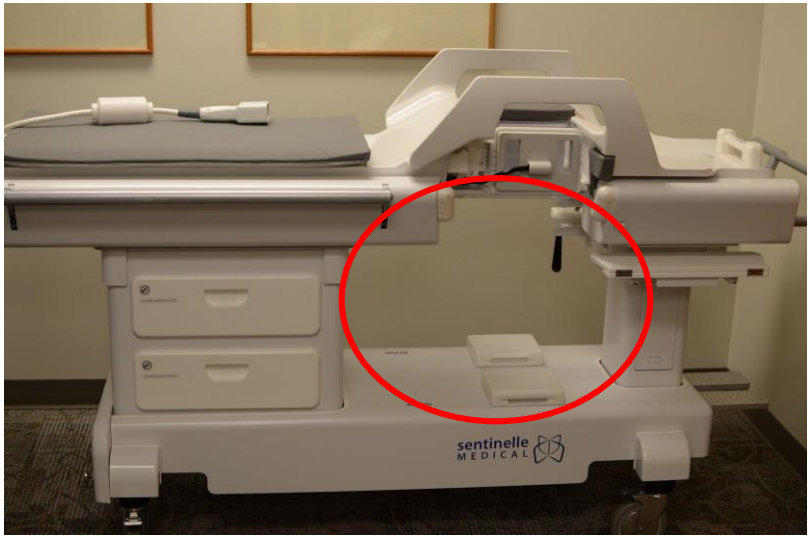

Figure 3: Picture of cart that patient is placed on for the breast imaging procedure. Red circle denotes the prospective location of the device. Picture courtesy of Owen Mays.

Design 1: Piezo-Resonant Sensor

- Non-intrusive
- Acoustic impedance mismatch
- Plastics compatible
- USB interface

Figure 4: Image of Piezo-resonant sensor. [7]

Design 2: FSR Sensor

- Microcontroller
- Minimally intrusive
- Circuits
- Placement of sensor

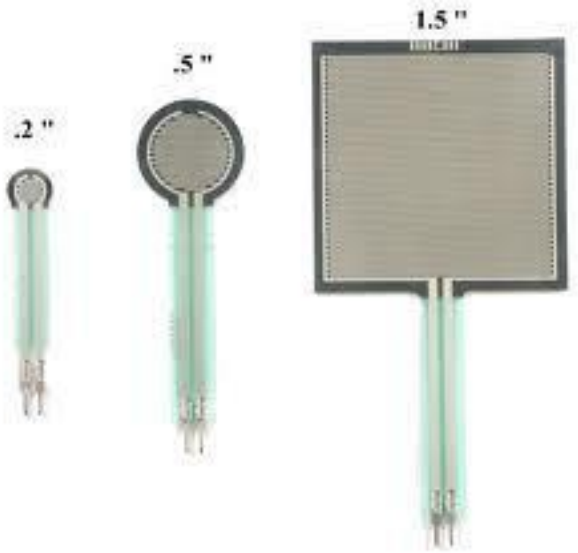

Figure 5: Various sizes of FSR Sensors. [5]

Design 3: Kill-Switch

- No microcontroller
- Invasive
- Automatic shutoff
- Buoyant ball

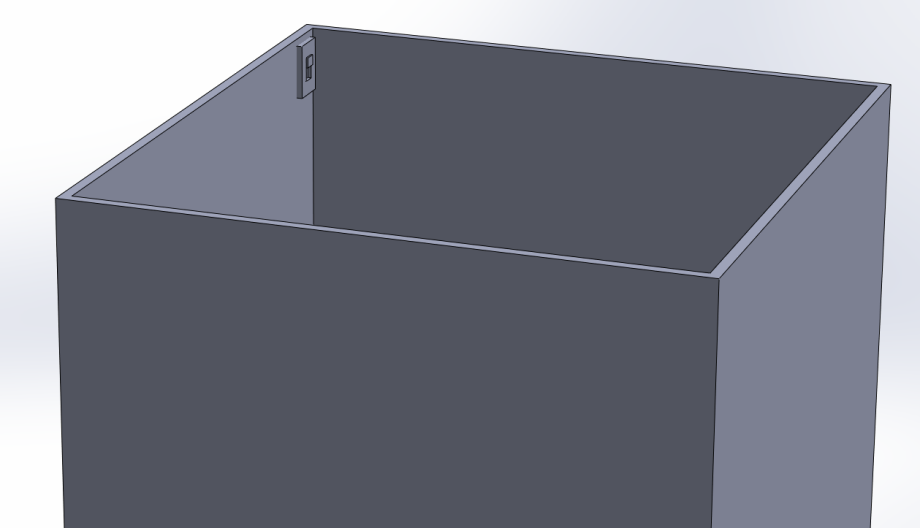

Figure 6: Proposed implementation of kill-switch design.

Design Evaluation Matrix

Criteria	Weight	Piezo-Resonant	FSR	Kill-Switch
Invasiveness	30	30	10	10
Reliability	30	25	20	15
Feasibility	20	15	10	17
Compatibility	15	10	5	15
Removability	5	5	0	0
Total	**100**	**85**	**45**	**57**

Future Work

- Construct model box
- Research new non-invasive sensor
- Order sensor
- Perform sensor testing
- Incorporate pump in prototype, retest

References

[1] "Benefits and Limitations of Mammography," ed.

[2] "Saving Women's Lives: Strategies for Improving Breast Cancer Detection and Diagnosis," ed. Washington (DC): National Academies Press, 2005.

[3] (2011, 10/11/12). *New method for breast cancer imaging*.

[4] "What Is Mammography?" *RadiologyInfo*. N.p., n.d. Web. <http://www.radiologyinfo.org/en/info.cfm?pg=mammo>.

[5] (9/17/12, 10/11/12). *U.S. Breast Cancer Statistics*. Available: http://www.breastcancer.org/symptoms/understand_bc/statistics

[6] "Inside the Box." *Perspective*. Perspective, 21 June 2011. Web. <http://perspective.engr.wisc.edu/2011/06/inside-the-box/>.

[7] "ExOsense Piezo-Resonant Sensor." *GemSensors*. N.p., n.d. Web. 26 Sept. 2012. <http://www.gemssensors.com/en/Products/Level/Single-Point-Level-Switches/Piezo-Resonant-ExOsense>.

Acknowledgements

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Questions?