Design of Tactile Method for Breast Lump Detection

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Introduction

- According to the American Cancer Society, 1.6 million women will be diagnosed with breast cancer in 2018. The causes for lumps in breast are:
  - fibrocystic changes 33%
  - no major pathology (i.e. normal) 24%
  - benign diseases 13%
  - cancer 23%
  - fibroadenoma 7%
- The breast is made of non-homogeneous tissues and glands.
- Cancerous lumps are approximately 16 times stiffer than normal tissue while benign lumps are about 7 times stiffer.

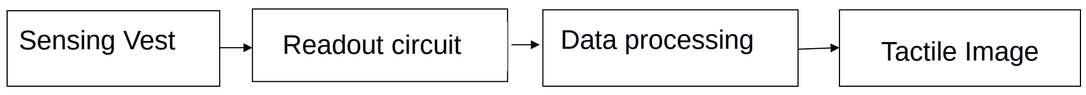
Motivation

- The available screening methods X-ray mammogram uses low dose radiotin which increases the risk of cancer.
- MRI, Ultrasound and Molecular based detection are expensive and time consuming.
- Clinical examination methods are uncomfortable and painful for some women.
- Third world countries lack the expertise and the technology for diagnostics.

Project Aim

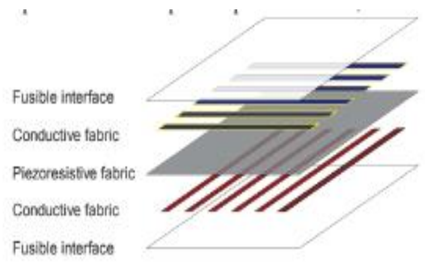
- Develop a simple, low-risk method for the detection of breast lumps.
- Develop a tactile imaging method for the detection of the location and the type of lumps

Tactile Imaging Method



Sensor Design:

- Textile bi-directional force sensitive resistor (FSR) was used
- Contains piezo resistive fabric sandwiched between conductive fabric
- Output Voltage at each intersection decreases with increasing pressure.



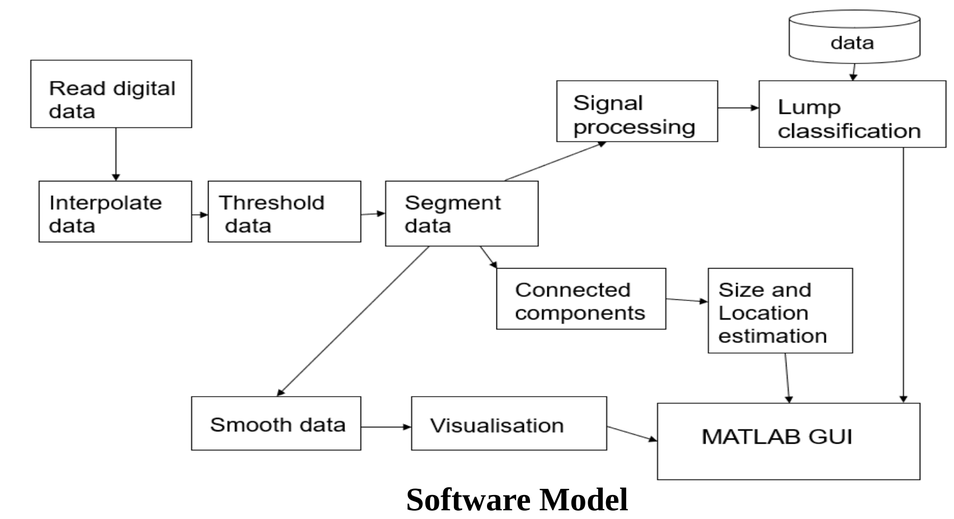
Resolution: 0.06N
Sensitivity: 0.1N
Operating Range: 0-30N
Maximum output Voltage: 5 V
Spatial Resolution: 05mm

Tactile Sensor Design

Readout Circuit:

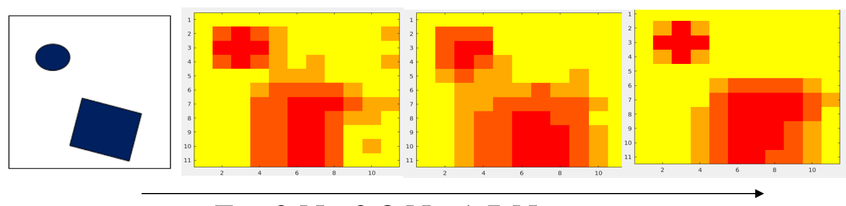
- Resistance at intersection is measured by measuring the potential difference.
- Standard multiplex followed by AD conversion circuit.

Data Processing Model:



Software Model

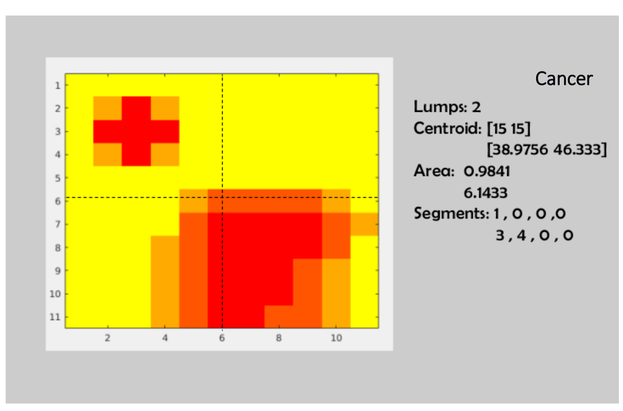
Results



Depth : 3mm
6mm
Size : d = 10mm
20x20mm

F = 0 N , 0.8 N , 1.5 N

Image plot at applied Forces



MATLAB Visual

Material	Stiffness	Ratio
Plain phantom	0.0123	
Plastic	0.1677	13.64
Circle	0.1983	16.12

Stiffness Table

Sensitivity: depth d = 0 - 6mm: 78 %

6-10mm: 37%

Future Work

- Develop the imaging system (garment) and explore possibilities for a imaging glove and probe.
- Collect data for the prediction model and tune the algorithm parameters to make the model robust.
- Test the developed method on different tissue samples and lump models.

Reference

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[2] L. Osborn, R. Kaliki, and N. V. Thakor,” Utilizing tactile feedback for biomimetic grasping control in upper limb prostheses,” in Proc. IEEE Int. Conf. Sensors, 2013, pp. 1266-1269.

[3] Wellman, P. S., Dalton, E. P. and al, e., “Tactile Imaging of Masses: First Clinical Report”, Archives of Surgery 136(2): 204-8, 2001.

[4]Weber, G., Using Tactile Images to Differentiate Breast Cancer Types. Division of Engineering and Applied Sciences. Cambridge, Harvard University, 2000.

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