홈 혜스케어를 위한
휴대형 유방암 진단 시스템

- A Portable Breast Cancer Detection System
for Home Health Care

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Contents

- Introduction
  - Breast Cancer
  - Challenges of Present Scanning Methods

- Materials and methods
  - Hardware
  - Experimental Procedure
  - Sample Phantom Model Preparation

- Results and discussion
  - Sensor Calibration
  - Breast Cancer Dummy Scanning
  - Phantom Model Scanning

- Conclusion
Introduction

Breast Cancer Statistics

Incidence

Source: National Cancer Registry, Institute of Health Information and Statistics of the Czech Republic
Introduction

Breast Cancer Detection

- **Tumor Size Detection**

  - by a woman who rarely examines her own breasts: 49mm
  - by a woman who occasionally examines her own breasts: 31mm
  - by a woman who examines her own breasts every month: 19mm
  - by a doctor or nurse giving a clinical breast exam: 13mm
  - on a woman’s first mammogram: 8mm
  - by getting mammograms every 1-2 years: 5mm

- **Tumor Shape**

  - Irregular shape
  - feel bumpy
  - **very hard**
    - like a bit of raw carrot

http://www.publichealthgrandrounds.unc.edu/brcancer/necklace.htm
Introduction

Breast Cancer Diagnosis Modalities

- Breast Self Exam (BSE)
- Ultrasound (US)
- Mammography
- Pressure Imaging (PI)

Invasive

Biopsy

Accurate

Inaccurate

Non Invasive
Introduction

Breast Self Exam

Pros.
- Possible regular check up
- Comfortable

Cons.
- Lack of confidence
  - Don’t know what to feel for
- Limited tactile sensitivity
  - With a bare hand

Breast self-exam: Manual examination (standing)
Introduction

– Ultrasound

Pros.
• Sensitive
• Harmless

Cons.
• Not for routine examination
• Uncomfortable
• Bulky
Introduction – Mammography

Pros.
- Sensitive

Cons.
- May cause defects (X-Ray)
- Longer examination time
- Bulky

(a) genglob.com
(b) http://blog.daum.net/e-vven/17202447
(c) www.christchurchradiology.co.nz/...ography/
**Introduction – Pressure Imaging**

**Pros.**
- Harmless

**Cons.**
- Clinical use only
- Expensive

(a) www.healthmanagementmedia.co.za/
(b) (c) http://www.pressureprofile.com/case-study-mti.php/
Common Screening Methods

- Bulky & Heavy
- Clinical use only
- Expensive
- Uncomfortable
- Inconvenient

Breast Self Examination

- Indefinite decision
- Limited tactile sensitivity

Proposed System

- Home health care use
- Cheap
- Comfortable
- Definite decision
- Magnified tactile
- Real Time
Material and Methods

- Hardware

**Hardware Block Diagram**

- **Hardware Specification**
  - Flexiforce Force Sensing Resistor (FSR) 1 lb (450g) Multi-Array
  - Micro-controller
  - 6Hz Low pass filter
  - 12 Bit ADC
  - 50 Hz Data Sampling
  - Wireless (Bluetooth)
 Material and Methods

– Experimental Procedure

- Breast Scanning to detect Pressure Change vs. Time

- Fact
  Breast : <100kPa
  Tumor : >100kPa

- Device Pressure
  20g = user maximum force with the device
  (Pressure value from the device < 100)
Material and Methods

Sensor Calibration

- Multi-Sensor Array
- Calibration Experimental Set-up

[Image of a multi-sensor array]

[Diagram showing a sensor calibration experimental set-up with a manipulator, distance meter, and scale]
Results and Discussion
– Sensor Calibration

- Calibration

- Resting Position

- Breast (without Tumor)
### Material and Methods

#### Phantom Model

**Tumor**

<table>
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<tr>
<th>Phantom Number</th>
<th>Size (mm)</th>
<th>Depth (mm)</th>
<th>Hardness (silicone: curing reagent)</th>
<th>Young’s Modulus (kPa)</th>
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<td>17</td>
<td>10</td>
<td>1:15</td>
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</table>

**Breast**: Silicon Rubber, 31 kPa
Results and Discussion

Breast Cancer Dummy

- Dummy Specification
  Tumor Size: 20mm
  Location: 2mm down

- Result
  Detected pressure > 200
Results and Discussion

- Size

(a) 5mm     (c) 15mm
(b) 10mm    (d) 20mm

Phantom Model Specification

- Tumor Size: 
  a) 5 mm  
  b) 10 mm  
  c) 15 mm  
  d) 20 mm

- Depth: 10mm down
- Hardness: 300kPa

- Graphs for each size showing data analysis.
Results and Discussion

- Depth

**Phantom Model Specification**

- Tumor Depth:
  - a) 10 mm
  - b) 15 mm
  - c) 20 mm
  - d) 25 mm

- Size: 15mm
- Hardness: 300kPa

(a) 10mm

(b) 15mm

(c) 20mm

(d) 25mm
Results and Discussion

- Hardness

(a) 300kPa
(b) 297kPa
(c) 288kPa
(d) 142kPa

Phantom Model Specification

Tumor Hardness:
- a) 300 kPa
- b) 297 kPa
- c) 288 kPa
- d) 142 kPa

Depth: 10mm down
Size: 15mm
Conclusion

Advantages

- Wireless (Light)
- Standalone
- Real time monitoring
- Home health care purpose
- Magnified tactile feedback
- Definite detection
- Cheap
Further Research

Practical Consideration

- Upgrade Pressure Monitoring System

- Clinical trials
Thank You

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