RaDistance Safety Meter

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Overview

- Problem Statement
- Background
- Product Design Specifications
- Design Alternatives and Matrices
- Prototype Design
- Future Work
- References/Acknowledgements

Problem Statement

- Detect human proximity to thyroid patients
  - Wearable device to detect proximity (1 meter)
  - Distinguish between nonhuman and human
  - Should not detect the wearer's body
- Warn patients about proximity
  - Alert by audio, visual, vibratory feedback, etc.
- $100 budget

Background

- Patients with Thyroid Cancer ingest radioactive Iodine-131
- Six weeks until it is out of their system
- Others must avoid prolonged exposure
- Device needed to warn user of other people

Image from www.cbsnews.com

Product Design Specifications

Client Requirements

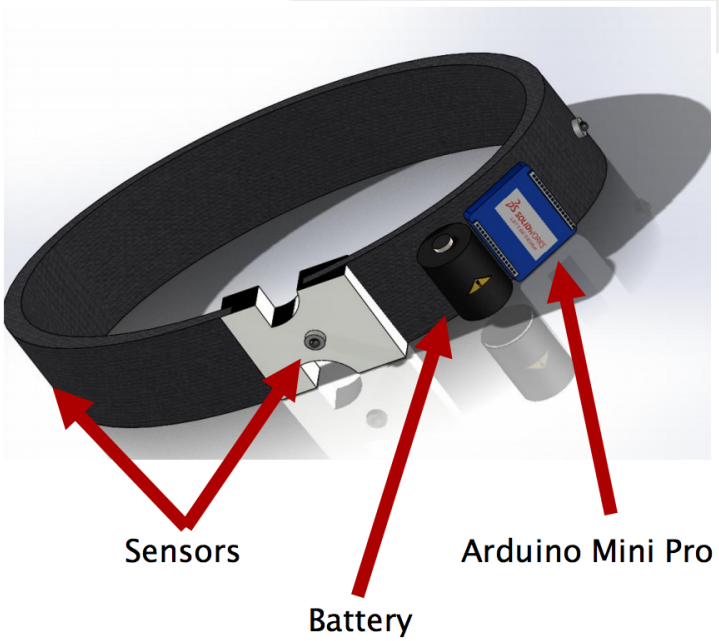
- Device must see 360° around user
- Detect only humans within 1 meter
- Provide some notification to user
- Must be sturdy enough to last six weeks
- Must have battery life of one day
- Comfortable to wear

Belt

Woven nylon belt

Advantages
- Easy to wear
- 360° view

Disadvantages
- Interference from limbs
- Bulky around the waist

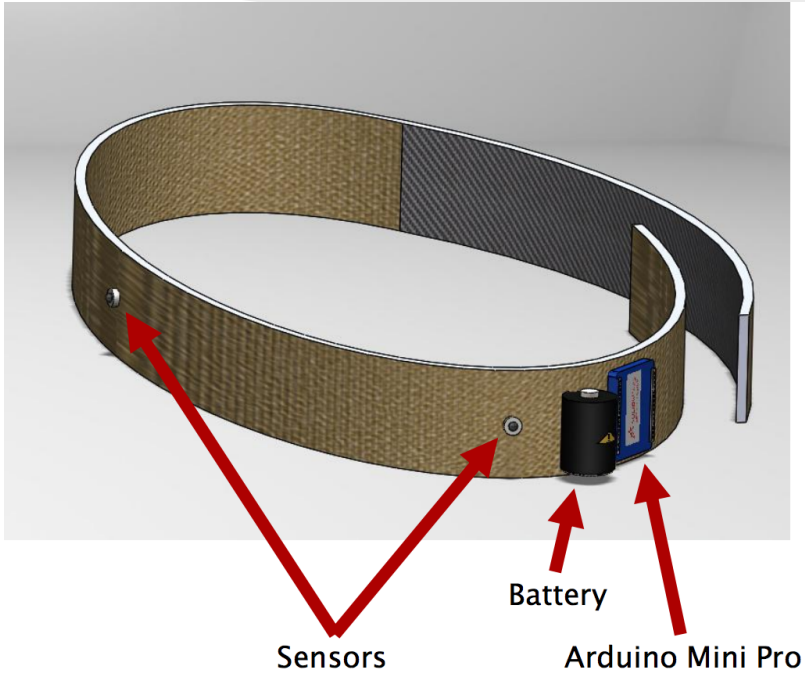


Headband/Hat

Flexible headband worn around hat - battery pack on waistband

Advantages
- Unobstructed view
- Durability

Disadvantages
- Uncomfortable
- Variation in heights

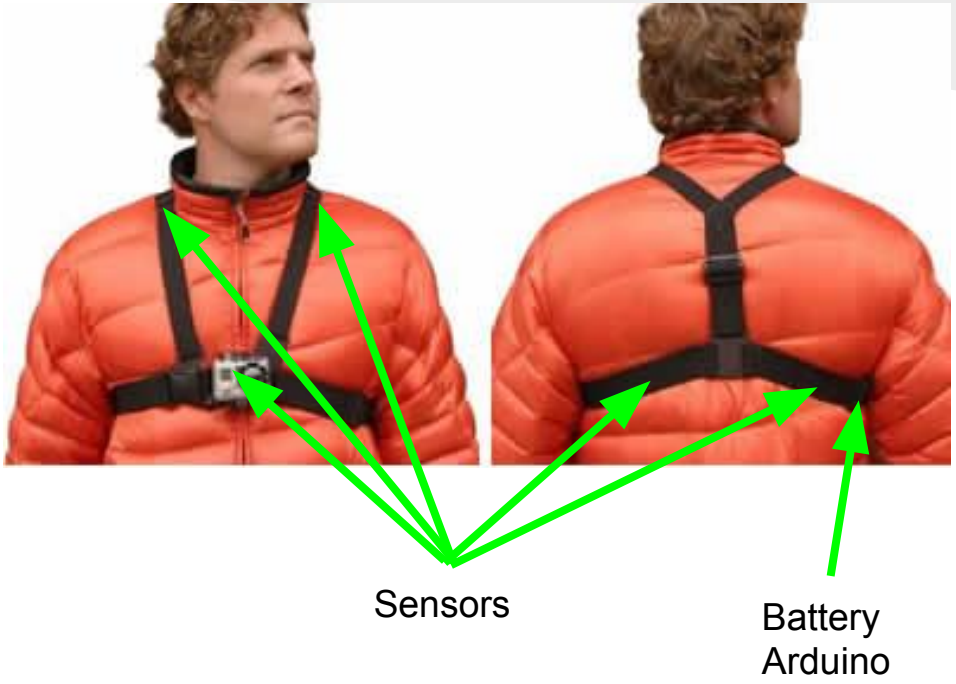


Chest Harness

GoPro Chest Mount made of elastic

Advantages
- Field of view
- Comfort

Disadvantages
- Hard to fabricate
- Aesthetics



Design Matrix - Device Configurations

Device / *Criteria (weight)*	*Weight*	Belt		Fitted Headband for Hat		GoPro-style Chest Mount	
Accuracy	30	*2*	*12*	*4.2*	*25.2*	*4*	*24*
Field of View	20	*4*	*16*	*3*	*12*	*5*	*20*
Wearability	20	*3*	*12*	*4.5*	*18*	*4*	*16*
Durability	10	*4*	*8*	*4*	*8*	*4*	*8*
Cost	5	*4*	*4*	*4*	*4*	*4*	*4*
Safety	5	*4*	*4*	*3*	*3*	*4*	*4*
Aesthetics	5	*3*	*3*	*3*	*3*	*2*	*2*
Ease of fabrication	5	*4*	*4*	*3*	*3*	*3*	*3*
Total	*100*	*63*		*76.2*		*81*	

Passive IR/Ultrasonic Distance Sensors

- Measures infrared light from objects to detect movement
- Horizontal field of view of 120°
- Reliably differentiates humans from other objects
- Passive sensors don't emit their own energy
- Able to buy many sensors with budget
- Paired with ultrasonic distance sensors which sense distance using soundwaves

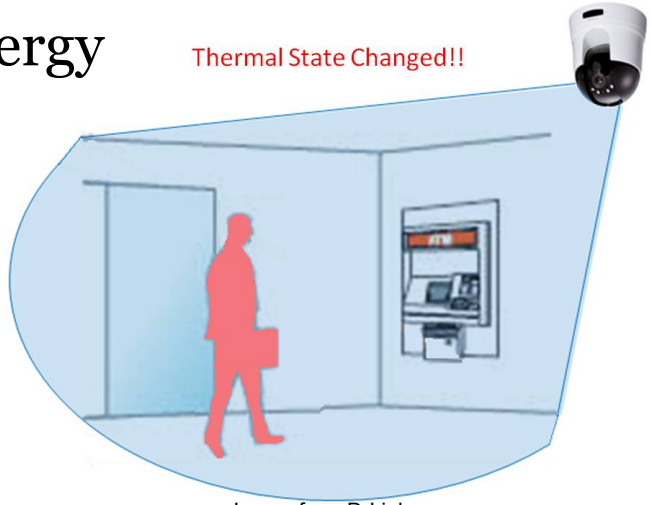


Image from D-Link

3D Depth Sensor

- Maps area with IR laser projector
- Motion analysis tracks joints to form a skeleton
- Relatively expensive and complex
- Unable to buy multiple sensors with budget

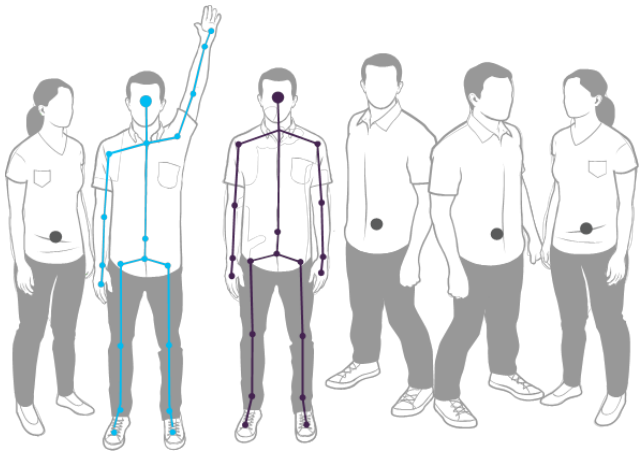


Image from Microsoft

MicroElectroMechanical Systems

- Smaller, more reliable
- 4 components
  - Microsensors
  - Microactuators
  - Microstructures
  - Microelectronics
- Used in high precision, low volume equipment
- Not readily available to consumers

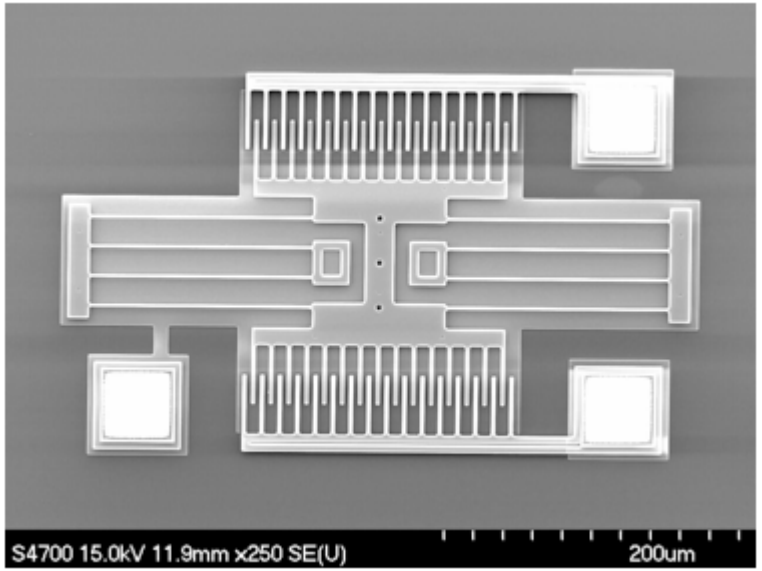


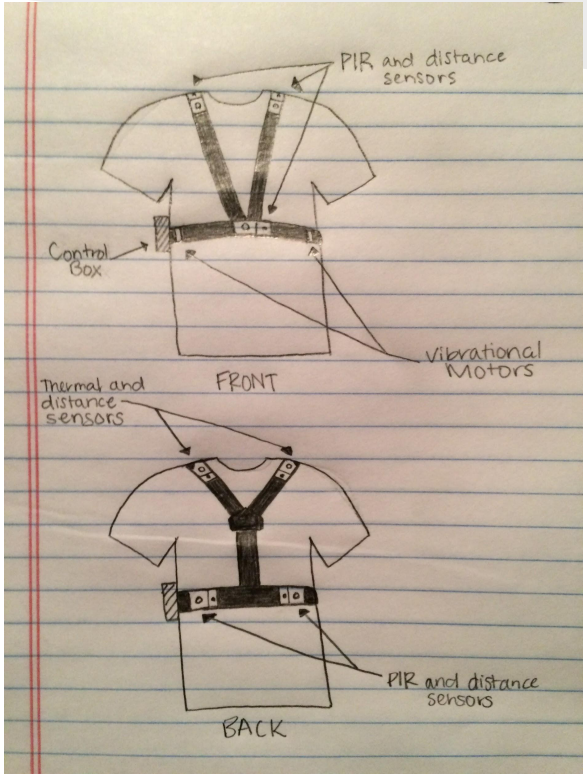
Image from MEMS & Nanotechnology Exchange

Design Matrix - Sensors

Sensor / *Criteria (weight)*	*Weight*	 PIR with Distance		 3D Depth Sensor		 MEMS	
Accuracy	30	*3*	*18*	*4*	*24*	*3.5*	*21*
Field of View	30	*5*	*30*	*2*	*12*	*3*	*18*
Cost	25	*4*	*20*	*2*	*10*	*1*	*5*
Size	10	*3*	*6*	*4*	*8*	*5*	*10*
Safety/Aesthetics	5	*3*	*3*	*2*	*2*	*5*	*5*
Total	***100***	***77***		***56***		***59***	

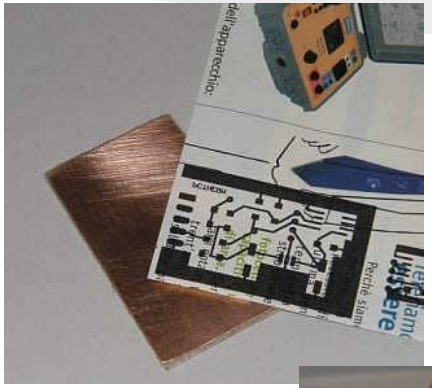
Prototype Design

- GoPro chest mount
- PIR sensors
- Omron thermal sensors
- Directional vibrations
- Control box



Future Work

- Purchase materials
- Restore materials
- Create circuit board
- Wire and program
- Test prototype



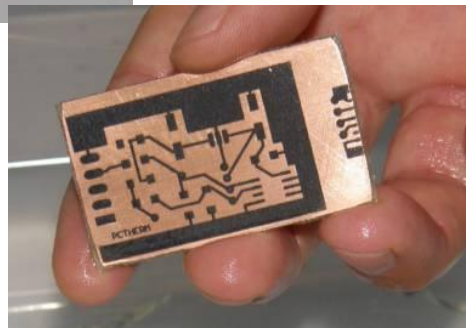


Image from http://www.riccibitti.com/pcb/pcb.htm

Acknowledgements

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