



BME Design 301

Design of Weight Distribution Monitoring System

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Client: Dr. Willis Tompkins



Overview

- Introduction
 - Objective, Problem Statement, Client Information, PDS, Existing Devices, Previous Design
- Prototype Designs
 - Feedback Modalities, Design Matrix
- Discussion
 - Timeline, Future Work, Acknowledgements, References

Objective

- Design and fabricate a device that measures weight distribution to monitor balance and provide feedback for patients undergoing physical therapy.

Problem Statement

- Left/right balance board designed for hemiplegic individual last semester
- Balance issues present in variety of neurological disorders
- Kim Skinner from TCNL uses a combination of physical therapy and tongue stimulation for balance training
- Design generalized device to supplement physical therapy

Product Design Specifications

- Client Requirements
 - Four-directional measurement
 - Normal stance - no looking down
 - Carry with two hands
- Board Specifications
 - Measure up to 900 N (200 lb)
 - Less than 5 cm thick
 - Accuracy for 10% threshold
 - 20-minute usage intervals

Existing Devices

Wii Balance Board

- \$80 + external component



http://sickr.files.wordpress.com/2012/01/wii_fit_board.jpg

SMART Balance Master

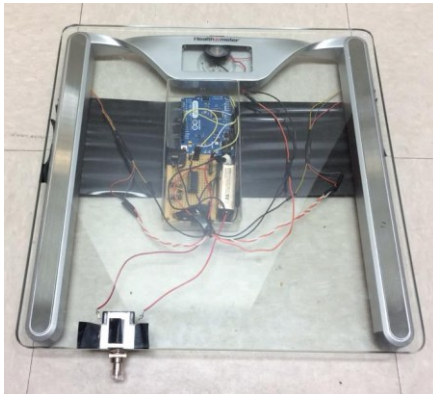
- ~\$100,000



http://www.neuro.fr/images/Image/SMEQTSOTclinician_1368881168.JPG

Previous Design

- Left/right biofeedback
 - Changing frequency of tone
 - Pulsing center tone
- Limitations
 - Left/right only
 - Limited battery life
 - Not loud enough



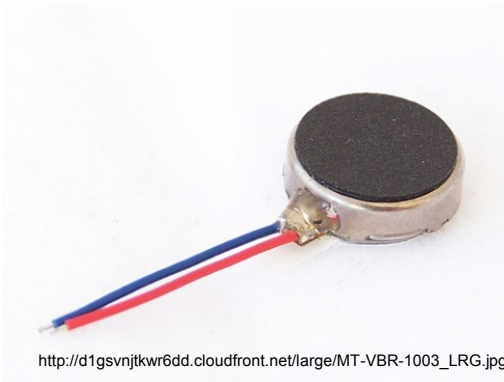
Design 1: Audio with Override

- Same left/right feedback
- Front/back feedback
 - Override existing tones
 - Broader center region



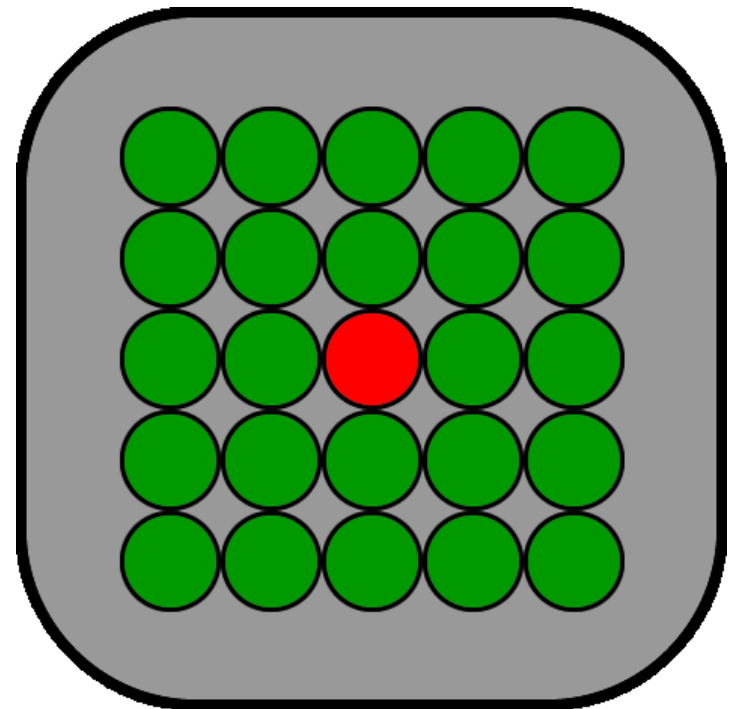
Design 2: Audio with Vibration

- Same left/right feedback
- Front/back vibration
 - L/R Tones still play
 - Localized vibration motors



Design 3: LED Matrix

- Visual feedback
- External device
- Sensitive to foot placement



Design 4: Touch Tone Audio

- Two simultaneous tones
- Touch tone phone
- Sensitive to foot placement
- Difficult to interpret



Design Matrix

Criteria	Weight	Design 1 Audio with Override		Design 2 Audio with Vibration		Design 3 LED Matrix		Design 4 Touch Tone Audio	
Ease of Use	35	5	35	4	28	5	35	2	14
Acceptable Feedback	20	3	12	2	8	5	20	2	8
Cost	20	5	20	4	16	2	8	4	16
Ease of Fabrication	15	5	15	3	9	2	6	4	12
Resolution	10	3	6	2	4	5	10	4	8
Total	100	88		65		79		58	

Future Work

- Purchasing materials
- Fabricating prototype
- Calibration of prototype

Timeline

Task	January		February				March				April			May		
	2 4	3 1	7	1 4	2 1	2 8	7	1 4	2 1	2 8	4	1 1	1 8	2 5	2	9
Project R&D																
Lit. Research	X	X	X	X												
Manufacturing					X											
Prototyping																
Testing																
Deliverables																
Progress Reports	X	X	X	X	X											
Preliminary					X											
Final Poster																
Meeting																
Client				X	X											
Team	X	X	X	X	X											

Acknowledgements

- Dr. Thomas Yen
- Dr. Willis Tompkins
- Ms. Kimberly Skinner
- The BME Department

References

- <http://www.stroke.org/site/PageServer?pagename=stroke>
- <http://www.strokecenter.org/patients/about-stroke/stroke-statistics>
- http://www.cdc.gov/stroke/facts_statistics.htm
- http://www.stroke.org/site/DocServer/STROKE_101_Fact_Sheet.pdf?docID=4541
- <http://link.springer.com/article/10.1007%2FBF02441555#page-1>
- <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3019192/>