WII® BALANCE BOARD CENTER OF PRESSURE INTERFACE

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1. Abstract

The quality of life is greatly affected by individuals suffering from balance disorders. Balance disorders can result from conditions such as neurodegeneration, Parkinson's disease, multiple Sclerosis and more[1]. However, rehabilitation measures can be taken to ease the difficulty of daily activities of suffering from a balance disorder.

Rehabilitation of balance disorders **utilize the center of pressure data** to determine if the individual is balanced. Current methods in measuring the center of pressure are extremely expensive and inconvenient. Examples include force plates and the BEEP board. However, the Wii Balance Board has the potential to become a cheap, easily accessible solution for rehabilitation. The **goal** of this design project is to construct an interface to a computer and the Wii Balance Board. The **final design** will include the Wii Balance Board connected to a computer via Matlab programming and Bluetooth technology. **Visual feedback** will inform the individual if he/she is off-balanced. This will allow rehabilitation in a cheap and easy manner for individuals suffering from balance disorders.

2. Problem Definition

Background

Balancing the human body, in both static and dynamic environments, is achieved through collaboration between the body's visual, vestibular, and proprioceptive systems[2]. Problems with balance can be caused by stroke, brain/spinal injuries, and degenerative diseases[1]. This can greatly affect daily life. Balance exercises, with daily repetitions of certain movements, have been proven beneficial.

Motivation

Current methods to measure the center of pressure (CoP) (see Fig. 1) are **expensive** and **not easily accessible**. For example, the clinical grade force plate costs between $4,000-$80,000 and are usually located at healthcare facilities.[3] Because there is no validated and commercially available means to measure the CoP, our clients request a cheap, easy manner for individuals using the Wii® Balance

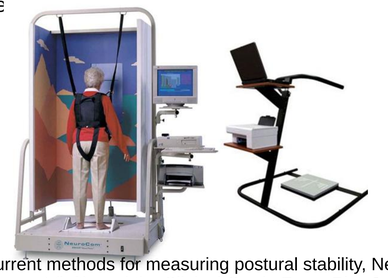


Figure 1: Current methods for measuring postural stability, NeuroCom® Balance Manager[4] (left), and the Clinical Grade Force Plate[5].

3. Design Criteria

A computer interface for the Wii Balance Board that must meet the following requirements:

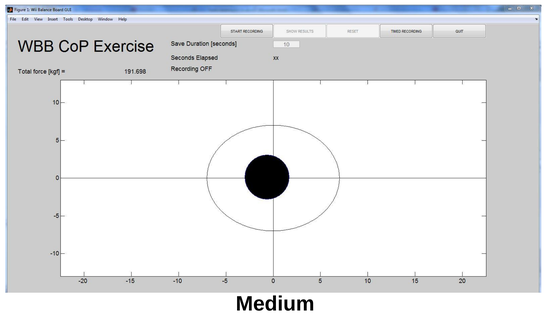
- Cost effective and easily accessible
- Accurately display the movement of CoP
- Provide instant audio and/or visual feedback
- Easy and enjoyable to operate for all ages
- Readily available for use in users' homes
- Withstand daily use for up to five years

4. Final Design

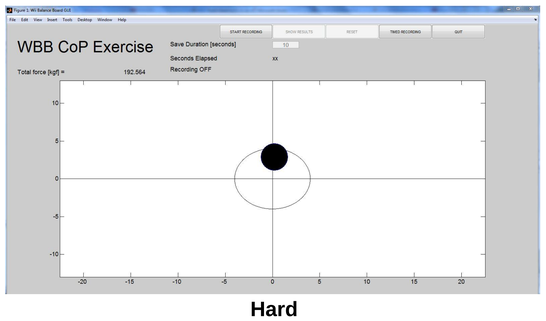
Figure 2: Final Design: Wii® Balance Board[6] connected to computer[7] via Bluetooth.

Final Design: A Windows computer interface for the Wii® Balance Board that visually displays the CoP (Fig. 2). Connection with the board and computer are made via Bluetooth and programs written in MatLab (r2010a, 32-bit). Levels of easy, medium, and hard available, which correspond to the difficulty of maintaining dot in the target (Fig. 3).

Easy



Medium



Hard

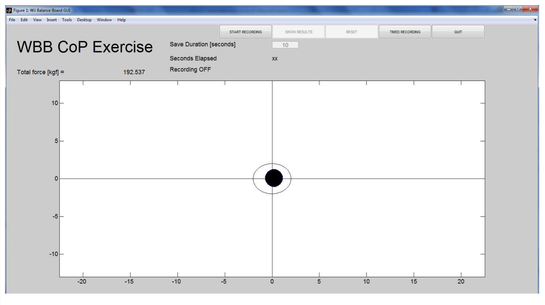


Figure 3: Screen shot of the visual display of CoP on computer.

Figure 4: Device in use.

5.Testing of Accuracy

Method

Tests were performed with the interface to verify the accuracy of the CoP read by the program and the Wii® Balance Board. A 4.54 kg weight was placed on 5 locations of the board (Fig.5). Physical measurements of the CoP was made with a ruler was compared to the readings of the CoP from the interface. Three readings were obtained. Mean and standard deviation was calculated from the data collected (Fig. 6). Standard deviation (X CoP, YCoP) for position 1: (0.316, 3.39E-08); 2: (0.0185, 0.005), 3: (0.0135, 0.0005, 4: (0.0097, 2.15E-07), 5: (0.0141, 1.60E-09).

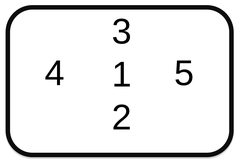


Figure 5: Aerial perspective of positions tested for accuracy. .

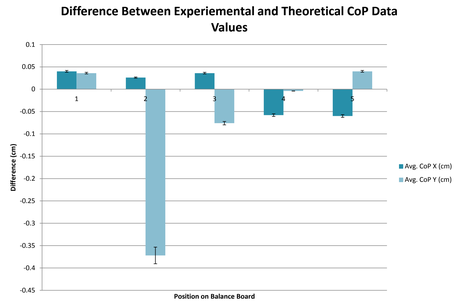


Figure 6: Testing Data

6. Future Work

- Provide audio feedback to allow for testing when eyes closed
- Test the user for 20 minutes and display how long the individual spent inside and outside the circle
- Potentially use physical feedback (ie foam)
- Create a driver that allows compatibility with a Macintosh computer

7. Acknowledgements

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- Thomas Yen (Advisor)
- Colorado University Neuromechanics Lab, Helen Huang, Ph.D.
- University of Notre Dame, Aaron Striegel, Ph.D.

8.References

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