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An apparatus for the monitoring of weight distribution for balance rehabilitation of post stroke patients

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Due to a stroke a number of years ago, a hemiplegic individual cannot feel the left side of her body. She is ambulatory but, due to lack of left-side sensory feedback, she cannot sense if she is standing straight or leaning to one side or the other. She wants a way to practice distributing her weight equally on both feet. She is unable to look down at her feet without losing her balance. We are working on a device that will monitor her stance and provide feedback to guide it. This will allow her to practice standing straight. Our device will be compact and portable enough to travel with her if she travels.

Client requirements

- Portable device that can be easily transported and stored via folding or rolling up. Low weight and thinness will also contribute to to these characteristics.
- The device will operate using either battery power (preferably AA) or an AC adapter
- The user will be provided with quick visual feedback at eye level that is easy to interpret with a simple user interface
- Device is sized to accommodate a shoulder width stance.
- The client can pick up the device and carry it with one hand.
- No-slip surfaces and beveled edges will be incorporated into the final device.
- The device is durable enough to withstand frequent use.

Design requirements

1. Physical and operational characteristics

a) *Performance Requirements:* Our balance will be used briefly throughout the day. Often times while our client does other activities such as washing dishes or watching television. Therefore the physical operation requirements are that it must operate reliably in ordinary scenarios. It will be stood upon briefly multiple times throughout the day.

b. *Safety:* Our device will be used in a household environment. This presents several challenges in terms of safety. Our device will encounter many things like slippery floors and water. The balance cannot afford

to slide on slippery surfaces, which would put the user in danger. Also, our design uses sensitive FSRs, the housing must be waterproof so that the FSRs or other electronics will not be exposed to water and damaged.

c. *Life in Service:* Our client intends to use our device daily for the foreseeable future. Our balance should operate reliably and accurately throughout that time.

d. *Shelf life:* The device should maintain functionality for as long as possible so our client can use it to improve her balance over time. Shelf life can be enhanced by either battery or AC adapter use.

e. *Operating Environment:* The device will be being used in a wide variety of operating environments. Our balance will travel with our client in a purse or handbag. She could potentially use it anywhere. Usually, it will be in a home environment, but it could be outdoors, in wet scenarios. Our design should be able to cope with all of these environments.

f. *Ergonomics:* The device should be simple to use, and easy to understand. Our client wants to use this device while multitasking, which means she could be distracted. Our device must be effective even under these circumstances.

g. *Size:* The device will be around the size of a notebook and under 1 in. high unfolded. The dimensions will be as compact as possible to take up minimal space and to increase the possibility of portability. The device will include methods for battery access for maintenance.

h. *Weight:* The device should not exceed three lbs. as portability is one of our primary goals in this project. Our client will only be able to manipulate the balance with her right hand, so keeping it lightweight is essential.

i. *Appearance:* While our client has not expressed any aesthetic preferences, we would like to keep the design as small and nondescript as possible. We do not want our device to be unfashionable.

2. Production Characteristics

a. *Budget:* Ideally only one prototype will be necessary as the portability of the product will exceed the need for an additional unit. Our team was not given a specific budget by our client, but we expect to minimize cost as much as possible. We intend to spend less than $50 on FSRs, roughly $50 on microprocessor for feedback, and around another $50 on all the remaining elements of the design (circuitry, power sources, and housing material).

3. Miscellaneous

a. *Competition:* Many similar physical therapy methods, Wii Balance Board, and other consumer like product derivatives exist, but all of these fail to meet our client's specialized needs.