

Authors:
Jack Livingston
Mike Revoir

An application for people with Parkinson's Disease

Authors:
Leighanne Davis
Kevin Caves

Background

- Postural instability and resulting falls are major factors in determining quality of life, morbidity, and mortality for individuals with Parkinson's Disease (PD).
- People with PD often/can have a forward flexed posture while sitting and standing. They often perceive this posture as straight, but with cueing they can work to fix their posture.
- The effects of bradykinesia, rigidity, impaired proprioception, freezing of gait and attention on postural stability in patients with idiopathic PD have been well characterized in laboratory studies [1].
- According to a retrospective fall study of 489 patients admitted to a Department of Neurology, approximately 60% of PD patients had a history of at least one fall over the previous twelve months [2].
- The purpose of *One-Thing-Straight* is to help people with Parkinson's Disease correct poor posture while using the app, as well as to collect posture data over time for clinical analysis.

References:

1. Park, Jeong-Ho, Yeo-Jeong Kang, and Fay Bahling Horak. "What Is Wrong with Balance in Parkinson's Disease?" *Journal of Movement Disorders* 8.3 (2015): 109-114. PMC. Web. 28 Dec. 2017.
2. Stolze H, Klebe S, Zechlin C, Baecker C, Friege L, Deuschl G. Falls in frequent neurological diseases--prevalence, risk factors and aetiology. *J Neurol.* 2004;251:79-84.

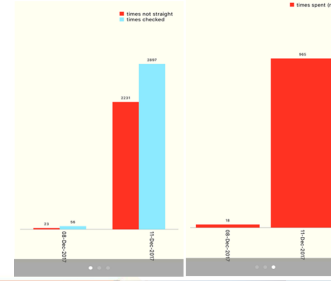
Solution

- The app uses a Bean by PunchThrough via Bluetooth to monitor the angle of a user's back using an on-board accelerometer.
- The app monitors posture and provides discrete notifications to the user.
- The app will help physical therapists and users to detect and monitor long-term trends in posture.
- By providing this constant feedback and data analysis, *One-Thing-Straight* works to counter incorrect posture resulting from Parkinson's Disease.

Data Insights

The app polls data from the Bean to record:

- time spent
- incidents of bad posture
- incidents per hour of bad posture
- angle of the back
- timestamps
- actions such as calibration
- The data is stored on the device.
- The data can be emailed from the app in CSV format for further clinical analysis.



Operations and Features

- The user sets the Bean **Orientation** and calibrates their back angle by standing with correct posture, perhaps against a wall.
- The user indicates if they are **Seated**, **Standing**, or in **Standby Mode**.
- Data will begin polling every 20, 40, or 60 seconds as determined by the user **Frequency**.

- If posture is outside of **Tolerance**, an alert of **Sound**, **Vibration** or **Text** notifies the user.
- An icon indicates if the user's posture is correct.
- The app alerts the user when two consecutive data polls indicate poor posture. This reduces the risk for false positives from reaching or movement.

Function using the force of gravity on the Bean to find the angle:

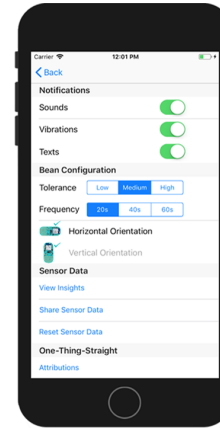
$$\text{Angle} = \text{atan2}\left(\frac{A_y}{\sqrt{A_x^2 + A_z^2}}\right) * 180/\pi$$

In Code:

```
Angle = abs(Double(atan2(Float(acceleration.y), Float(((acceleration.x*acceleration.x) + (acceleration.z*acceleration.z)).squareRoot())) * 180 / Double(pi))
```

- Data can be exported with an email button in the app via CSV for analysis.

*Ask the presenter for a live demonstration of *One-Thing-Straight* on an iPhone.




Results

- The app has performed well in test trials and has been shown to have great sensitivity and specificity.
- We plan to perform a wider scale clinical trial with physical therapists & their patients.
- In one day using the app with random sounds enabled, a test subject had fewer than half as many warnings for poor posture than without.
- While the app was developed for people with PD, the results from testing indicate that the app can be used in many other situations including:
 - Supranuclear palsy (PSP) patients have gait instability and tend to lean backwards when they walk.
 - Vestibular disorders.
 - Stroke survivors.
 - Children with congenital heart disease.
 - Geriatric age.



Next Steps

- Fabricate a smaller device.
- Currently, a 3D printed case and magnets are used to attach the Bean to the user's collar. A method of attaching the case inconspicuously is necessary if the user is not wearing a collared shirt.
- **One-Thing-Straight was designed to help Parkinson's patients. However, many other illnesses or disabilities also create the tendency for poor posture and increase the risk of dangerous falls. In the future, the app can be extended to apply to these related situations.**

Sponsor Statements

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