Smart Chair

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***Abstract*** – **The project is a smart chair that encourages healthy habits in an office job. One of the many issues facing office workers is back pain caused by long periods of time sitting coupled with poor posture. The product includes an array of sensor that are located on the seat of the office chair and gather data on the user’s sitting trends. The smart chair monitors how long the user sits and reminds them to get up at a regular interval. The device also monitors the user’s posture and provide feedback. The smart chair pairs with an application on the user’s phone to provide feedback and reminders.**

***Index Terms -* Diseases, Internet of Things, Mobile Applications, Pressure Sensors, Web Services**

### I. Introduction

The National Institute of Neurological Disorders and Stroke claims that back pain is the most common job-related disability. Around 80% of adults will experience back pain during their lifetime and 25% of adults have experienced back pain recently.

According to Spine-health’s website, sitting in office chairs involves a ‘static posture’ that can cause or worsen back pain. The increase in back pain is caused by over-stretching the spinal ligaments due to posture used when sitting in an office chair (slouching). A prolonged slouch posture can cause damage to the spine. It is advisable to maintain proper posture when sitting in an office chair to reduce the cause of this pain. Ergonomic chairs can assist in improving back support, but will not stop back pain unless the proper posture is used [1].

According to Spine-health, proper posture includes making sure your office chair is adjusted appropriately as well as your sitting posture.

Regular standing breaks can aid in reducing back pain induced by office chairs. Spine-health recommends getting up from an office chair at least once every half hour for at least one to two minutes.

While the market does offer products to aid in improving posture, those options are very limited and difficult to employ. The design team’s goal was to develop a product that allowed the user to improve their posture without requiring an apparatus to be attached to their body. Our product offers a more-discrete and more comfortable option for users who want to improve their posture.

### I. Overview

The main goal of the project was to use pressure sensors to gather data on weight distribution and to analyze that data to help the user track trends and present the data to the user in a graphical format. In order to meet this objective, the design team elected to use pressure sensors and a modified center-of-gravity equation (with distance averaging) to determine if and in what direction the user was leaning. Once that value is calculated, the data is transmitted to storage in Firebase in the form of a Cartesian coordinate. The user can view this data in the form of a scatter plot whose quadrants correspond to quadrants of the chair (front-left, front-right, rear-left, rear-right). In order to provide more immediate feedback for the user, a vibration feature was added to cause the chair to buzz if the user holds poor posture for a significant period of time.

The posture data is generated by an array of pressure sensors placed on the seat of the chair beneath the foam padding. The placement of these sensors was decided by determining the center of the chair and then identifying where the user’s legs would rest relative to the center.

Storing the user’s posture data is performed by visualizing the chair as a Cartesian grid and determining a variation on center of gravity from the center of the grid. If the user is leaning forward and left, the coordinate will have a negative horizontal (left-to-right) value and a positive vertical (front-to-back) value. Since it is very rare for an individual to sit perfectly dead-center on the chair, a tolerance threshold was introduced to increase the usability of the data.

The vibration feature reminds the user to correct posture by vibrating if the user has held poor posture for a set amount of time. If the user meets this condition, the vibrate modules will vibrate. As some users may find this feature undesirable, the developers added a toggle control to the mobile application to permit the user to turn off the feature.

Storage of the user’s data was performed by way of Google’s Firebase Realtime Database. The embedded software on the WiFi module uploads the Cartesian coordinates to the Firebase database. This data can be accessed via the mobile application.

The mobile application pulls the user’s sensor data from Firebase and displays the coordinate points on a scatter plot. This allows the user to see their sitting trends referenced against the quadrants of the chair.