

Introduction

Wheelchair racing has a strong presence in the Paralympic Games. In order to achieve optimum performance, the athletes have to assume a posture that maximises power output while minimizing air resistance.

Our device

BOSS was created to give athletes constant feedback while training. A simple app that can be installed on any Android mobile device, receives input from any posture element, including the upper and lower back, or sternum using an adjustable Velcro strap. A soft patch is attached to the Velcro strap for comfort. The device gives real time output of the back's inclination relative to the racing line.



Figure 2: Components

Case for the BOSS sensor and logo

The design specifications allow the product to be waterproof, provide a secure cover for the delicate circuits, look attractive and prevent heat build up. Solidworks was used to design the case. The base has openings for access to the USB port and a fitted opening for the switch. We wanted to embed the name of our project, BOSS. The logo is minimalistic and effective, the letters at 0.3 mm wide and etched to a depth of 0.5 mm.

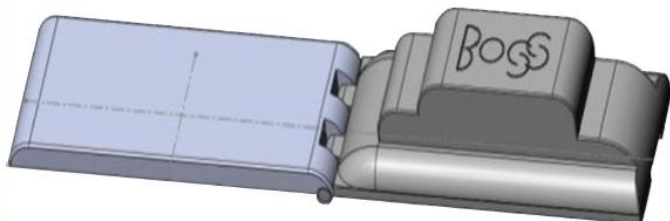


Figure 3: BOSS Case



Figure 3: Final prototype

App

The display was created using JAVA.

The aesthetics and ergonomics of the app were designed to display relevant data to the athlete in a simple, legible and discreet manner. To make the design more personalised and effective, the parameters can be varied by the user for their preferred angle.

- Step 1 Figure 4-6
 Establish Bluetooth connection
- Step 2 Figure 7-9
 Set parameters to preferred limits
- Step 3 Figure 10-12
 Display data to athlete



Figure 4: Establishing Bluetooth connection between sensor and android app
Figure 5: Connecting sensor
Figure 6: Sensor successfully connected
Figure 7: Setting optimum posture pitch limits
Figure 8: Setting the upper limit (maximum upward motion)
Figure 9: Setting the lower limit (maximum downward motion)
Figure 10: Displaying data for the athlete (exceeding upper limit)
Figure 11: Displaying data for the athlete (exceeding lower limit)
Figure 12: Displaying data for the athlete (extreme range of display - upper limit)

BOSS angle test

Our aim is to verify that the sensor system is measuring the correct angles, the code is functioning properly and the android app is displaying the correct values. We set up characteristic angles between 0 -90° which were drawn on a white board. The BOSS system was set up on the test subject, and the angle displayed on the phone was compared to that on the board.

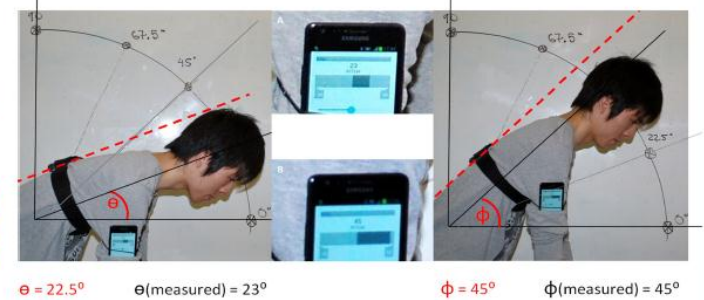


Figure 33: Testing sensor and app - A corresponds with 22.5° and B corresponds with 45.0°

Design of the output device attachment

The phone is contained in a case attached to an aluminium sheet platform. This platform is screwed on a clamp which is attached to the wheelchair.

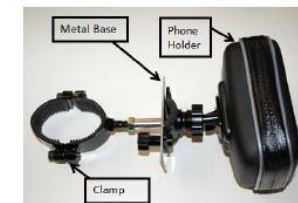


Figure 34: Phone case connected to wheelchair using clamp

Further development

We met our brief and completed our aim of having a system that allows real time posture monitoring to a precision of 1°, and accuracy of 0.5°. To further develop our design, we can provide further feedback data to the athlete, potentially with graphs monitoring their posture over time. Secondly, we could offer a data back up option to analyse the data after training. We could also add strain gauges to measure the power exerted from the athlete on each wheel of the racing wheelchair.