



BCI gaming for Attention Deficit Hyperactivity Disorder

Giuseppe Marchioro¹ - Andrea Remondini - Umberto Castellani¹

¹Università degli Studi di Verona



Motivation

- Develop a videogame using Unity 3d engine, that interfaces itself with MindWave (a low cost BCI device) and Pure Data (an open source software).
- Users can play the game and regulate the music with their emotional states of mind.
- Can be used as a neurofeedback treatment for children affected by ADHD (Attention Deficit Hyperactivity Disorder).

What is a BCI?

- A communication system in which messages or commands that an individual sends to the external world do not pass through the brain's normal output pathways of peripheral nerves and muscles.
- The goal of BCI is not determine a person's intent by eavesdropping on brain activity, but rather to provide a new channel of output for the brain that requires voluntary adaptive control by the user.

What is MindWave?

- Low cost device, price under 100 euro.
- Single dry sensor on FP1 (international 10-20 system), no use of gel.
- It detects EEG raw signal, eight brain waves, eye-blinking, attention and meditation values.
- Communication with PC is done via USB wireless plug-in.
- Research grade EEG.

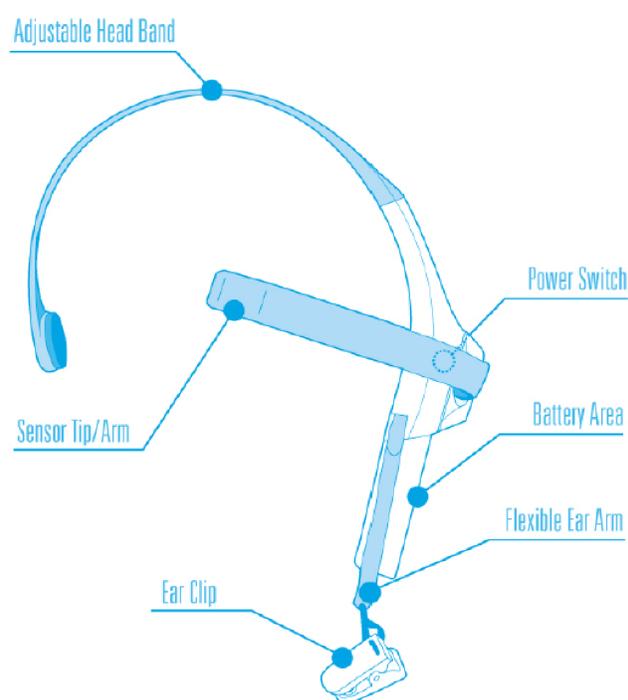


Figure 1: MindWave Headset

How it works?

When you run the software this creates a no-gui *Pure Data* process and two TCP connection with two *netreceive* objects present in the *Pure Data* patch, finally it sets up a connection with the *MindWave* headset.

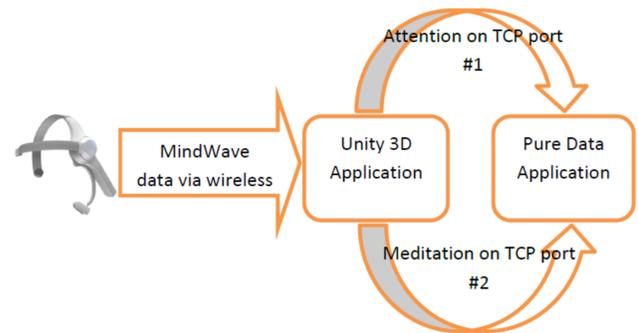


Figure 2: Application diagram.

The game

- The aim is to throw a ball as far as possible.
- Initial height of the ball is given by the meditation level of the subject.
- Initial speed of the ball is given by the attention level of the subject.
- Music is regulated by the mental states of the subject.
- Ball is thrown when the subject blinks his eyes.
- Score is given by the levels of meditation and attention of the subject at the moment of the eyes's blink.

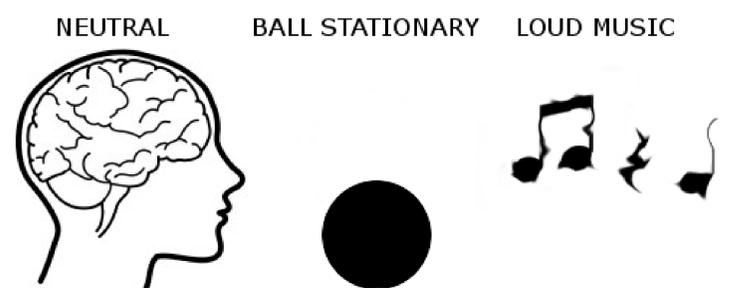


Figure 3: Player isn't focusing or relaxing: ball is stationary and music is loud.

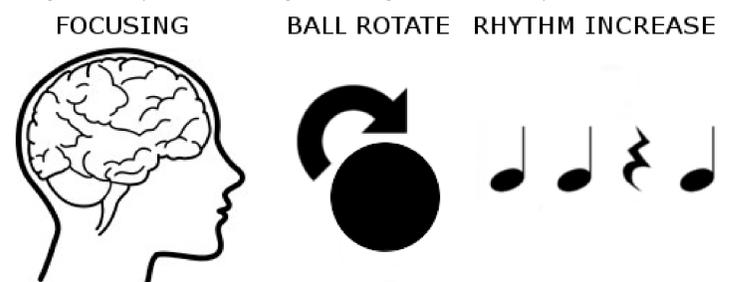


Figure 4: Player is relaxing: ball rotates (increasing his velocity) and music is more rhythmic.

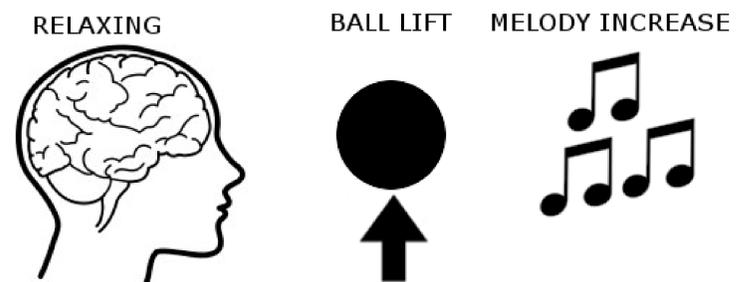


Figure 5: Player is focusing: ball rises and music is more melodic.



(a) When player is relaxing and focusing.



(b) Game ended, player blinked his eyes.

Figure 6: Snapshots of the videogame.