NeuroPad: Use Cases For A Mobile Physiological Interface
Denys J.C. Matthies1, Jan-Niklas Antons2, Frank Heidmann1, Reto Wettach1, Robert Schleicher2

1 Department of Design, Fachhochschule-Potsdam
2 Telekom Innovation Laboratories, Technische Universität Berlin

Motivation
Being engaged with real-world tasks - when hands are busy - also means not being able to use mobile devices. Trying to overcome this problem we present NeuroPad, an iPad-application that connects a commercially available low-cost headset for recording physiological signals with an iPad. The read biosignals are used for controlling different functionalities in a touchless manner.

Technical Details

Eye Wink Detection
To ensure a reliable control, the artifacts created by moving facial muscles are used to classify an eye wink. The identification is based on peak detection in the signal, that is a mixture of electroencephalogram (EEG), electromyogram (EMG) and electrooculogram (EOG).

Head Movement Detection
The head movement (nod and shaking) detection was accomplished by a simple threshold analysis. A head shake or nod can start with the left or right, and ends with a weaker follow-up movement in the opposite direction.

Eye Wink Calibration Interface
To avoid a lengthy calibration procedure, we focused on a distinct event - voluntary eye winks - which can be detected quite reliably in the raw signal. The user interface offers a simple way to adjust an individual sensitivity threshold with a slider and gives instant feedback: A successful event detection makes the depicted eye blink as well.

Use Cases

Music Player
Is a touchless control of the iOS iPod through head gestures and facial muscle activity. Eye winks play or pause songs, shaking head skips the current song and a nod repeats it.

Browser Boss Button
When browsing the internet in public areas like at work or in the subway, people nearby can invade one’s privacy by watching the screen. The app enables a quick switch to a neutral start page by eye winks instead of a frantic gesture.

Virtual Scapegoat
„Furry“ is a furry plush ball with eyes and mouth - the minimal components that create a face for us humans. Furry offers the possibility to reduce frustration by teasing it with excessive strong eye winks.

Conclusion
The technical challenge was to combine two different technologies: a mobile physiology recording system (Emotiv EPOC) and a mobile device (Apple iPad). After identifying capabilities and limitations of the system under custom test conditions, we developed interaction concepts suitable for mobile contexts. We think that this approach shows appropriate deployment of such low-cost devices and will extend it to other scenarios.