Transparent: Brain Computer Interface and Social Architecture

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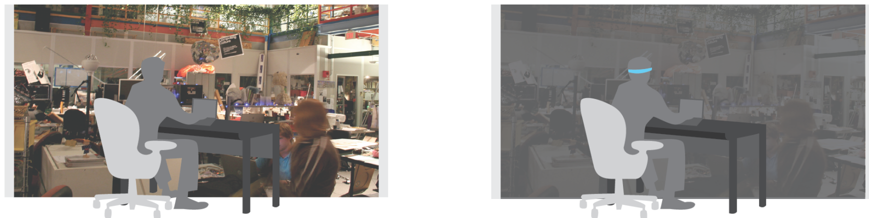

Figure 1: *(Left) A person is sitting at her desk in the office without Transparent. Distractions are visible through transparent windows. (Right) The Transparent system measures the brain activity and changes the window opacity according to the user's level of focus.*

Abstract

Transparent is an office window that varies its opacity in order to help a user maintain focus at work. By changing opacity, the window blocks distractions in the user's environment while subtly signaling the person's availability to others. The user's focus is determined via a neuroheadset that passively measures her brain activity through electroencephalography (EEG); the focus of the user is then algorithmically determined and wirelessly communicated to a smart glass module that changes transparency accordingly. Transparent explores opportunities to merge brain computer interfaces (BCI) with smart architecture to improve productivity at work.

1 Introduction and Motivation

Workers can find it difficult to concentrate in busy office environments, particularly spaces with open floor plans that may encourage social interaction at the cost of privacy (Figure 1a). This is especially the case at the MIT Media Lab's recently erected 2009 complex in which every office has at least one glass wall. The glass limits researchers' privacy and makes it easy for them to become distracted by outside activity. A system that conveys a person's availability to others while blocking outside distractions could help improve the user's focus and productivity.

To address this design problem, we have developed Transparent, a system that passively measures a user's level of focus by way of a neuroheadset. The user's focus is then communicated to others in the work environment through a changing opacity window; as the user becomes focused, the window becomes more opaque, helping to block out distractions while signaling to others that the user is occupied (Figure 1b). The window becomes more transparent as the user's level of focus decreases, communicating that the user is more available to be interrupted.

2 Related Work

The main contribution of this work is the application of BCI for social architecture. BCI, particularly EEG interfaces, have traditionally been used in the health sector [Tan and Nijholt 2010] but have recently moved into the consumer market with the development of low-cost, plug-and-play EEG devices. Consumer products are often packaged with software for helping users reduce stress or games in which users control virtual or physical objects with their mind. However, these interfaces are designed to help users monitor their own level of focus without communicating these levels to others. A classic example of a social application for communicating availability is Bill Buxton's Door Mouse in which a physical office door is coupled with a virtual icon that displays a user's availability to others online [Buxton 1999]; however, with this interface, the user is actively manipulating the icon by opening or closing her door. Transparent occupies the unique space of being a passive and social application; the EEG interface passively monitors the user's attention level in order to socially communicate the user's availability and help the user minimize unwanted distractions.

3 Design and Future Work

Transparent currently uses EEG input from a single user through a NeuroSkys ThinkGear ASIC Module[NeuroSky 2012]. The headset outputs a combination of alpha and gamma brain wave signals and attention and medication levels, which are algorithmically processed to determine the user's level of focus. The user's level of focus is wirelessly transmitted to a custom controller for an electrochromic smart glass tile, which consequently changes opacity anywhere between fully opaque and fully transparent.

Transparent's mapping of brain data to window opacity provides a subtle aid for users trying to prioritize social interaction and individual work. Furthermore, lower light levels can help users relax if they are stressed, so increasing the opacity of the window both acts as a signal to others and also helps adjust the lighting of the room to improve a person's emotional state.

As Transparent is developed, usability tests will be conducted to examine the tradeoffs between passive and active control and optimize for utility and comfort, both for the user and for other people in the work environment. Additionally, since EEG signals tend to be rather noisy, a statistical analysis of how well the signals map to the mental state needs to be performed.

References

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