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Augmented Human Experience: Spatial Augmented Reality and Physiological Computing

Joan Sol Roo
Inria
Bordeaux, France
joan-sol.roo@inria.fr

Jeremy Frey
Bordeaux university
Bordeaux, France
jeremy.frey@inria.fr

Renaud Gervais
Inria
Bordeaux, France
renaud.gervais@inria.fr

Martin Hachet
Inria, Labri
Bordeaux, France
martin.hachet@inria.fr

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Abstract
Human Computer Interfaces are in constant advance. Current research focuses on moving the interaction out of the limited reach of computers into the environment, but the focus is still on performance. The maturity of physiological sensors enables interaction that takes into account the user's inner state, but users are not really aware of such states. It is possible to take a step further and expose those inner states to the user, which have been shown to increase well-being. This talk will include an introduction to the joint field and a set of projects that work towards building an augmented human experience.

Author Keywords
Spatial Augmented Reality; Calm Technologies; Physiological Computing; Tangible Interaction.

ACM Classification Keywords
H.5.1. Multimedia Information Systems: Artificial, augmented, and virtual realities; H.5.2 User Interfaces: Prototyping.

Introduction
Twenty-five years ago, computer interfaces were composed mostly of text based applications or simple

Figure 1: *Teegi* (tangible EEG interface) enables to explore our brain activity in real time.

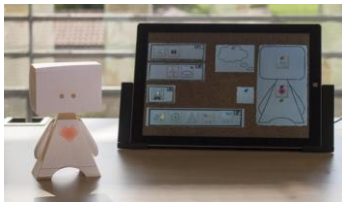

Figure 2: *Tobe* (Tangible Out of Body Experience) enables users to customize representation of both low level signals and high level metrics.

Figure 3: *Inner garden*, a world in miniature that evolves according to the user's inner state.

Graphical User Interfaces (GUI), restricted to desktop computers. Nowadays, computational devices such as notebooks, smartphones and tablets are ubiquitous. These devices allow us to access powerful and flexible applications whenever required, but these applications still live on a different —virtual — realm, and can only be reached through special windows — screens — that require an interaction approach that greatly differs from our experience on the real world.

Several research areas look to reduce the gap that separates real and virtual realms, such as Spatial *Augmented Reality* (SAR, complementing the real world with computer generated information, placing the information directly onto the environment) [1], *Tangible User Interfaces* (physical handles coupled with virtual information) [2] and *Ubiquitous Computing* (computational power available whenever required, anytime and everywhere) [3]. These research areas share a view that takes into account the integral role of the human on the interaction: which of the already available capabilities of the user can we leverage, while taking into account the user's experience.

The maturation of physiological computing on recent years have opened yet another realm on interaction: interfaces that are aware of the user's inner-state [4]. While promising, they are transparent for users that are not really aware of what is happening inside of them [5]. Using the same sensing capabilities, we can create interfaces that expose the user's inner state in different ways. Instead of focusing on performing tasks, we can foster awareness of our own humanity.

Computer interfaces should not be only measured in performance. One of the cornerstones of the Ubiquitous Computing vision was about creating *calm*, but we seem to have used productivity tools to increase our overall pace of life instead of using the extra time to relax and make our lives easier. As knowledge work is getting more prevalent, this is becoming a problem, especially knowing the increasing body of research showing the negative impact of stress on health and productivity [6].

Mindfulness, contemplation and overall interoception – the ability to sense the origin of one's bodily signals – have been shown to have a positive impact on the ability to cope with stress and increase well-being [7]. *Calm computing* [8] and *slow technology* [9] have the potential to be a great medium to foster self-reflection [10, 11].

Augmented Human Experience

The same way that Augmented Reality provides complementary virtual information to the real world, we can work towards providing complementary external world information about the user's internal world; we will call this "augmented human experience".

This talk will include the presentation of three works that build on an augmented humane experience: Teegi [12] (Figure 1), Tobe [13] (Figure 2) and Inner Garden [14] (Figure 3). These works focus on exposing inner states at different levels (from brain signal lectures to high level metrics such as workload or attention, from lung inflation to breathing variability), using a form factor that foster manipulation and playful learning (tangible avatars and a sandbox). For this end, Tangible User Interfaces offer a perfect support, providing a physical representation, which we can explore with our hands; fast prototyping is performed

using SAR, once validated it is possible to move towards instrumented objects instead of SAR.

The objective of this talk is to foster dialog about the potential of these interfaces, and how we can move towards a more humane experience, instead of restricted by computers, empowered by them.

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