Neu: how brain activity can change an animated scene

Marco Marchesi*
University of Bologna, Italy

CR Categories: H.5.2 [User Interfaces]: Input devices and strategies—User-centered design;

Keywords: Brain-Computer Interfaces, interaction, animation, games

1 Introduction

In the last years the advances in animated cinema and videogames have suggested the possibility of creating virtual worlds with an high quality real-time rendering. Thus it is reasonable to think that all the properties in a scene could be modified in real-time.
In such a scenery a new generation of controllers have been introduced for creating more engaging interactive experiences.
Brain-Computer Interfaces seem to be a valid solution to be applied in the entertainment and educational fields, not only for people afflicted by deficits in attention or motor control, but even for healthy people [Lécuyer et al. 2008].
In this paper we introduce *Neu*, a tool that acquires brain signals from a commercial BCI and uses them to influence properties of a game or, more generally, an interactive real-time animated scene. *Neu* is the evolution of Mobie, an editor/player for changing narration in interactive movies using the signals acquired by a single EEG channel BCI [Marchesi et al. 2011].
Specifically, attention and relaxation levels was useful for creating a vocabulary of 8 brain states that can be connected to any part of the movie and reveal the amount and the variation slope of the two measures. We will keep this vocabulary in *Neu*, as the simplest set we can work with. A new complex vocabulary will be designed for applications with EEG multichannel BCIs.

2 *Neu* approach

If we consider a story and a 3d world where characters act to modify it, in mathematical terms the attention (or the relaxation) level of a user can be seen as a *field*, able to transform a virtual space, the objects, the characters and the properties included in it.
Thus any shader, light source, the rendering quality as well may depend on attention and relaxation levels. Complex properties like character's emotions are parameterizable too. For example, we could imagine a story where the user meets characters that react differently to his brain states. In a *First-Person Shooter* game the enemies could become smarter and more aggressive if the player's attention goes down, in order to involve him in the game. In this sense we can say there is a *brain influence* in it.
Simplifying, any property p of any object is a temporal function of the coordinates and the brain states of the user,

$$p(t) = g(\overrightarrow{X}, \overrightarrow{D}, A, M; t)$$

with $\overrightarrow{X}$ the user's position, $\overrightarrow{D}$ the view direction, A and M the attention and meditation states calculated by the levels (scalar values)[1].

*e-mail: marchesi@neu-project.com

[1]Actually g should be a recursive function. Considering the example above, a game character should learn from his past behavior (and mistakes) and change it consequently.

SIGGRAPH 2012, Los Angeles, California, August 5 – 9, 2012.
ISBN 978-1-4503-1435-0/12/0008

With *Neu* the concept of *controller* is reconsidered. BCIs in games are still viewed mainly as substitutes of classic directional controllers and the user is usually encouraged to imagine the movements to do or improve the attention level to go forward or backward.
Unfortunately this traditional approach works slowly and it needs a lot of training to reach an acceptable control. Part of research of *Neu* is to explore what are the properties that it would be interesting to modify, keeping an high interactive user experience.
Neu works in 3 steps: a) creation and population of the scene with objects and characters rendered with a 3d engine; b) setup of the properties that the brain activity can influence through a BCI; c) acquisition of the brain signals and playing.

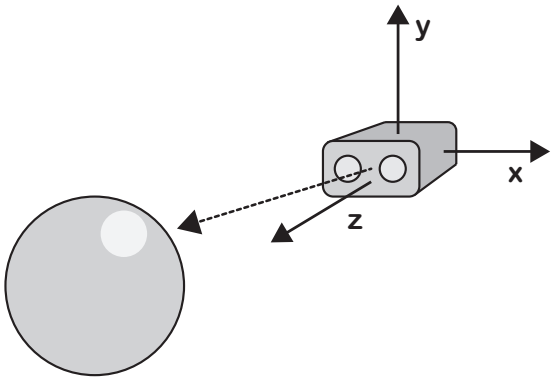

Figure 1: *In Neu any user can be sketched as a box, oriented to the z-axis, that moves within a 3D environment and focuses the attention to a specific direction, most affecting the behavior of objects that are being observed or the ambient sounds, for example. Relaxation states can influence mainly global variables of the environment, like light emitters or soundtracks.*

3 Conclusions

A short overview of *Neu* has been made. As a standalone tool, it provides a quick graphical solution for editing virtual reality environments where the objects can be influenced by the brain activity. Future efforts will be focused on transforming *Neu* in a API, to add functionality to other softwares that create games or movies.
Other multichannel BCIs will be considered, and we will investigate how the additional information acquired from the brain activity could improve any narrative multimedia experience.

References

LÉCUYER, A., LOTTE, F., REILLY, R. B., LEEB, R., HIROSE, M., AND SLATER, M. 2008. Brain-computer interfaces, virtual reality, and videogames. *Computer 41* (October), 66–72.

MARCHESI, M., FARELLA, E., RICCÒ, B., AND GUIDAZZOLI, A. 2011. Mobie: a movie brain interactive editor. In *SIGGRAPH Asia 2011 Emerging Technologies*, ACM, New York, NY, USA, SA '11, 16:1–16:1.