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# #Scanners: A BCI Enhanced Cinematic Experience

**Matthew Pike**

**Max L. Wilson**

**Steve Benford**

The Mixed Reality Lab  
University of Nottingham  
Nottingham, UK

[matthew.pike@nottingham.ac.uk](mailto:matthew.pike@nottingham.ac.uk)

[max.wilson@nottingham.ac.uk](mailto:max.wilson@nottingham.ac.uk)

[steve.bendford@nottingham.ac.uk](mailto:steve.bendford@nottingham.ac.uk)

**Richard Ramchurn**

Horizon CDT,  
University of Nottingham  
Nottingham, UK  
[richard.ramchurn@nottingham.ac.uk](mailto:richard.ramchurn@nottingham.ac.uk)

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## Abstract

#Scanners is a bio-responsive digital arts experience that blurs the lines between cinematics and neuroscience. Using a commercially available wireless EEG device, #Scanners presents a specially commissioned film that is dynamically altered both visually and aurally in accordance with the viewer's levels of Attention and Meditation, as calculated by the EEG device. The system has been demonstrated to audiences across Europe and has allowed us to explore design opportunities around both extents of, and awareness of control with otherwise passive multimedia experiences. At CHI2016, viewers will be able to experience the #Scanners system, watch their own personalized version of the film. Spectators will be able to see viewers, their levels, and their effect on the film.

## Author Keywords

BCI; Experience; Control; Interaction; Film; Art

## ACM Classification Keywords

H.5.1. Multimedia Information Systems: Artificial, augmented, and virtual realities

## Introduction

#Scanners is an innovative digital arts installation that blurs the lines between cinematics and neuroscience. Using a wireless EEG brain monitoring device,

#Scanners presents each viewer with a personalized variation of a specially commissioned film, shot in several layered components, which are dynamically altered according to measures of the viewer's physiology. Dream and Reality layers within the film are mapped to the viewer's levels of Attention and Meditation levels respectively, as measured to a commercial Neurosky EEG brain sensor, and blinking is used to switch between them. The result is that viewers each experience a unique version of the film, based upon their own response to watching it.

The motivation for such a system was inspired by the work of Shinji Nishimoto and the writings of Walter Murch. Nishimoto was able to reconstruct visual experiences from brain activity evoked by natural films using an fMRI machine and advanced machine learning algorithms [1], demonstrating the role neuroimaging can play in gaining an insight into film viewers engaged brain. Walter Murch postulated that blinking is an automatic response that can reveal rhythms of thought and likens blinking to cuts in film [2]: *"If it is true that our rates and rhythms of blinking refer directly to the rhythm and sequence of our inner emotions and thoughts, then those rates and rhythms are insights to our inner selves and therefore as characteristic of each of us as our signatures."*

In addition to stating the role of blinking in expressing our inner emotions and thoughts, Murch also likens film to dream; thoughts to a shot; and a blink to a cut - a set of relationships we explored in detail with #Scanners. Amongst the related work, the most similar was by Hillard et. al who varied a film's brightness, size and continuation according to the participant's EEG [3]. #Scanners, however, alters the footage that

participants see around a continuing linear narrative, giving the user some control over what perspective they see of each scene.

### #Scanners System

The #Scanners system is used to define the mapping of a viewer's physiology to the mixing of an audio/visual cinematic experience. The system accepts a number of audio/video layers, which the experimenter designer can then map to the viewer's physiology, as informed by the EEG headset, as shown in Figure 1.

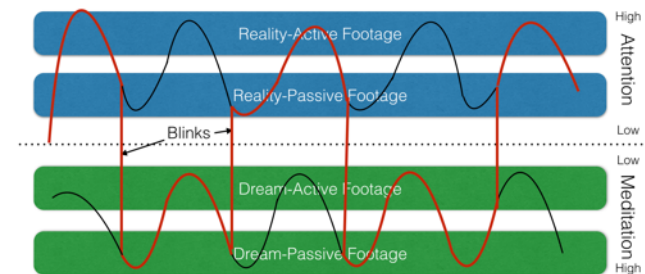


Figure 1 - #Scanners Concept Diagram

To demonstrate the system, we commissioned a short 15-minute film, which was filmed with around 30 actors, 6 crew, over 10 days, and with a budget of £20,000. The resulting film is composed of 4 parallel layers: two showing perspectives of Reality, and 2 showing introspective Dream-like reflections of the scenes or main character. This utilized 3 predefined outputs from the EEG device: 1) Blinking, 2) Attention and 3) Meditation. Blinking, as detected by the EEG device, was used to switch back and forth between Reality and Dream groups, as the film progressed; each time the viewer blinks they move from Reality to



Figure 2 - Still captured from 1 viewers experience of #Scanners.

Dream or vice versa. When the viewer is watching Reality, their level of measured Attention controls the mix of the two Reality layers. When the viewer is experiencing the Dream footage, it is the measure of Meditation that controls the mix if the two Dream layers. Figure 2 shows examples of stills, as seen by a viewer, where two layers are overlaid. Thus, in line with the inspirational sources for the film, Meditation is associated with the control of Dreams, and Concentration with the control of Reality, while Blinking triggers major transitions between them.

The #Scanners system contains a software component that handles the mapping of the viewers physiological data and applies the appropriate "mixing" of audio and video. The system is developed within QuartzComposer, a graphical programming language designed for developing multimedia experiences.



Figure 3 - A viewer experiencing #Scanners @ FACT, Liverpool UK in July 2015

### System Deployment

The system was initially developed as a prototype system, which was piloted at 4 events (W00t festival,

Copenhagen 2013; Manchester University Faculty of Science open day; AlbinoMosquito Studio, Manchester and IEX 2015), which engaged with roughly 100 individuals of a broad demographic between the ages of 12 to 60. The pilot was conducted informally as a feedback-gathering exercise where participants would first engage with the system and then would informally reflect on their experience in a conversational setting with the authors.

Using the feedback from piloting the system, we proceeded to develop the final #Scanners system, which we propose to present as an Installation at CHI2016 Interactivity. The final system has been debuted, in a functional way, at Creativity and Cognition 2015 [5] in Glasgow, UK, and received very positive comments from an academic and artistic audience – *"This is a unique and very considered experience"* and *"Unique, I haven't seen anything like it. I really like it"*. We also demoed the system at a prestigious arts venue: FACT in Liverpool, UK. The experience was installed within a cinema-environment caravan (shown in Figure 3) placed on a public street, allowing general members of the public to walk in and enjoy the experience. Again, we received very positive comments from the experience – *"I felt like I could slow it down, speed it up and I could move on and it seemed."*, where one viewer went so far as to say - *"It'd be great to watch on drugs."*

### CHI2016

We believe that #Scanners will provide an interesting point of discussion to the CHI audience. The system raises a number of unsolved interaction issues that we the CHI community will find interesting. One such issue is Affect Loops [4]. Typically, when designing a

cinematic experience, a film director will use film to stimulate the emotions of the viewer. With #Scanners however, the viewer has the unique ability to affect the composition of the film, raising a number of interesting unresolved research questions: How do we design experiences to facilitate this type of interaction? How is this interaction perceived and received in the general population? Anecdotal evidence has been positive. These questions will be of interest to experience design and interaction researchers.

There is also the question of the social and privacy implications which arise from this type of intersection: What are the social implications of such an experience? Should viewers be conscious of being monitored? These questions will likely appeal to Sociology and Privacy researchers. There is also a clear interest for Psychology and Neuroscience researchers, whom may be interested in exploring the mapping of brain signals to film: What is the optimal mapping for brain signals to dynamic film? What technique/technology is best suited to this type of interaction?

Further, researchers at CHI2016 will be interested in the opportunities to utilise different physiologies to different types of cinema genres: fear in horror films, attention in crime, happiness in comedies, and stress in thrillers. Beyond movies, researchers may also imagine how the #Scanners experience might expand into other domains, such as individual or social music listening experiences.

We believe the diverse range of questions we propose here will appeal to a wide variety of CHI attendees and will hopefully stimulate interest in this form of interaction.

## References

1. Shinji Nishimoto, An T Vu, Thomas Naselaris, Yuval Benjamini, Bin Yu, and Jack L Gallant. 2011. Reconstructing visual experiences from brain activity evoked by natural movies. *Current Biology* 21, 19 (2011), 1641–1646. <http://dx.doi.org/10.1016/j.cub.2011.08.031>
2. Walter Murch. 2001. *In the blink of an eye: A perspective on film editing*. Silman-James Press.
3. Hillard, B., El-Baz, A. S., Sears, L., Tasman, A., and Sokhadze, E. M. Neurofeedback Training Aimed to Improve Focused Attention and Alertness in Children With ADHD A Study of Relative Power of EEG Rhythms Using Custom-Made Software Application. *Clinical EEG and neuroscience* 44, 3 (2013), 193–202.
4. Matthew Pike, Richard Ramchurn, and Max L. Wilson. 2015. Two-way affect loops in multimedia experiences. In *Proceedings of the 2015 British HCI Conference* (British HCI '15). ACM, New York, NY, USA, 117-118. DOI=10.1145/2783446.2783595 <http://doi.acm.org/10.1145/2783446.2783595>
5. Matthew Pike, Richard Ramchurn, and Max L. Wilson. 2015. # Scanners: Integrating Physiology into Cinematic Experiences. In *Proceedings of the 2015 ACM SIGCHI Conference on Creativity and Cognition(C&C2015)*. ACM, New York, NY, USA, 151-152. DOI=10.1145/2757226.2764546 <http://dx.doi.org/10.1145/2757226.2764546>