

# BioS-Play: Workshop on Multiuser and Social Biosignal Adaptive Games and Playful Applications

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## ABSTRACT

BioS-Play is a workshop targeted to explore the focused domain of biosignal adaptive games and playful application in a multiuser or social context. Using biosignal instrumentation is an established process in medical domains and experimental psychology. During recent years there have been many efforts in industry and research to develop applications, games and various kinds of interfaces which use biosignal analysis in real time. However, most of these applications are single user setups. According to our earlier work we have realized that there is great potential in developing biosignal adaptive applications for multiuser and social scenarios.

The applications we have been developing have been either games or playful applications. Games have unique characteristics, which work well for biosignal augmentation. In addition, games can be used in a laboratory setup for exploring the social biosignal interaction design elements overall in a structured and efficient way. Ultimately, we believe that combination of biosignal adaptation, social and multiuser context, and playful interaction is useful for various kinds of situations and can elicit never before-seen experiences.

The workshop organizers have several years of experience in researching games, psychophysiology, multiuser application development, and combination of them all. The workshop will be organized with a help of the Presemo presentation environment, which is also a biosignal, adaptive, social, and playful system. The workshop aims at creating new collaborations by facilitating networking of interested researchers and discussing research future research ventures in this domain, distributing knowledge among participants and developing a roadmap related to the future development in this field. Workshop participants are expected to show interest in developing biosignal prototypes or running experiments with experimental psychophysiological systems. In

addition to game researchers and individuals with experience in analyzing and working with biosignals, we hope that also people with experience or strong interest in multiuser applications and social interaction will join the session.

## Categories and Subject Descriptors

H.5.2 User Interfaces: Input devices and strategies;

B.4.2 Input/Output Devices: Channels and controllers;

## General Terms

Algorithms, Design, Reliability, Experimentation, Human Factors, Theory, Verification.

## Keywords

Multiuser systems, adaptive systems, biosignals, biofeedback, emotional adaptation, BCI, HCI, games, playing, playful applications

## 1. INTRODUCTION

During the last ten years there has been phenomenal progress in the development of adaptive biosignal interfaces. For example, the work at the University of Pittsburg MotorLab by Andrew Schwarz [1] and his team that demonstrated a monkey self-feeding with a large BCI<sup>1</sup> controlled robotic arm has gained much attention lately. In addition, companies like Emotiv<sup>2</sup> and NeuroSky<sup>3</sup> have been very visible with press releases related to their easily

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<sup>1</sup> BCI = Brain Computer Interface

<sup>2</sup> Emotiv EPOC. <http://emotiv.com>

<sup>3</sup> NeuroSky Mindset. <http://www.neurosky.com>

accessible BCI kits for fun and leisure applications. A few commercial products have used biosignal sensing as means of player-game interaction. Star Wars Force Trainer<sup>4</sup> and related products were very popular Christmas presents in the United States in 2009. Nintendo has several times shown some material about their potential new interface called Nintendo Wii Vitality sensor<sup>5</sup>, which is probably a combination of heart rate (peek-to-peek via pulse oximeter) and GSR<sup>6</sup> sensor. Actually, a similar product called the Lightstone sensor bundled with the game "Journey to Wild Divine"<sup>7</sup> has been on the market since 2001.

In academia there has been also quite significant amount of interest in this field. This is shown by the existence of several workshops such as Brainplay at ACE 2006 [1], Enterface [2], and Brain-computer interfaces for HCI and games in CHI 2008 [3] or upcoming events such as the Brain, Body and Bytes workshop at CHI 2010 [4]. Also, for example several large EU projects have explored this domain (see for example the list in chapter 4). Starting from a pioneering book by Picard [5] to fairly recent review article by Fairclough [6] we have seen several research statements and projections of the vast potential use of biosignals in HCI and games [12]. As a summary, we can say that many companies and academia develop biosignal control or adaptive applications for several different purposes, they gain a lot of press attention, and people are already interested on buying them for home use also.

However, the great majority of these applications are for single user systems and only a few biosignal adaptive multiuser or social applications exist. In our opinion there is a lot of potential to use biosignals in multi-user applications. We have been developing several different kinds of biosignal adaptive game prototypes in our research project. During these studies we have realized that biosignal adaptation would be useful in a multiplayer gaming context because of the following reasons:

- Biosignals can be used to enhance body language mediation and interaction, which may significantly widen the mediated communication;
- Biosignals can be used to produce new types of game challenges, especially when a social component is present in the game;
- In a multiuser situation the biosignal analysis can be more informative than in the single user situation
- Multivariate analysis of biosignals will help to better understand the social interactions taking place during gameplay.

These four motivations are just a sample of the vast potential of social and multiuser biosignal adaptive games and playful applications. We would like to provoke and expand the discussion related to these possibilities.

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<sup>4</sup> Star Wars Force Trainer is a toy device, which utilizes EEG interaction. System is developed by Uncle Milton

<sup>5</sup> Nintendo Wii Vitality sensor is a prototype presented by Nintendo Corporation for example in E3 conference.

<sup>6</sup> GSR = Galvanic Skin Response. Also known as EDA = Electrodermal Activity

<sup>7</sup> Wild Divine relaxation system. <http://www.wilddivine.com>

Finally, we would like to clarify some of the (e.g., psychophysiological) concepts we have been using and how they relate to some other concepts used in academia and industry.

With the term "biosignals," we mean primarily psychophysiological measures such as EEG, ECG, GSR, respiration and EMG<sup>8</sup>. However, we believe that strict distinction is not purposeful and, for example, behavioral measures (such as movements, postures, gaze, gameplay metrics measures), audio, contextual measures (location, ambient light, surrounding temperature) and more advanced brain imaging systems like fMRI, MEG, and fNIRS<sup>9</sup> are equally proficient measures and devices of interest. Each measure has unique capabilities and often it is useful to combine measures in a multimodal framework. One primary concern however is that biosignal capturing should be fairly easily usable and robust. This is improving with commercial off-the-self biosignal capturing devices.

We have selected adaptation as the concept for describing the link between the application and the biosignals. We use this concept in a relatively vague manner. In some cases it might be more relevant to talk for example about emotional adaptation, control interfaces, or signal measurement.

Finally, we target the specific application domain of games and playful applications. Game interaction has unique characteristics in terms of player engagement and experience overall. We believe that these unique characteristics of games significantly impact biosignal adaptation design and, for example, what kind of signal analysis algorithms should be used. However, we do not want to limit the scope of the workshop to games but allow playful interactive applications in general. The wide range of what playfulness can mean is described for example by the PLEX-model [8]. We also have found out that games can be used as an instrument in the experiment setup in order to create structure and or provide social stimulæ, which rare or hard to provoke otherwise.

## 2. WORKSHOP GOALS

The goal of this workshop is to increase the awareness of the various designs that can be used for developing biosignal adaptive social applications and games. The workshop will gather people who are interested on this domain, and who have been working earlier on related topics. The goal is to create new knowledge, sharing and networking opportunities, which can directly lead to new international research projects.

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<sup>8</sup> Psychophysiological signals are usually measuring skin-related electrical activity

EMG = Electromyography

EEG = Electroencephalography

ECG = Electrocardiography

<sup>9</sup> Advanced brain imaging is usually expensive and procedures are complicated, but for example NIRS is already relatively affordable

fMRI = functional Magnetic Resonance Imaging

MEG = Magnetoencephalography

fNIRS = functional Near Infrared Spectroscopy

In addition to sharing the ongoing work, there is also a component in the workshop, which focuses on developing a common view on future directions and related concepts in the field. We call this section as *road and mind map (RMM)*. The RMM development will be facilitated with the Presemo platform<sup>10</sup>, which is a presentation and workshop environment, which utilizes game-like interaction and is also biosignal adaptive. Presemo uses biosignal primary to annotate and comment different episodes in the workshop. In this way the workshop participants will be able to have a concrete feeling on the possibilities of biosignal adaptive social and playful application. During the morning episode we will provide and encourage also participants to show demonstration of other ongoing work in the domain. The Presemo platform will be used during the morning session to provide real-time feedback channel to all participants during the presentation. This way we can increase the amount of shared knowledge and information.

Finally, the end result of RMM session will be documented and will be printed as a poster, which will be shown then in the Fun and Games conference.

### 3. WORKSHOP SCHEDULE AND PROCESS

Workshop time is divided in to five parts, which are shown in the following timetable.

Morning session (9:00-12:00):

- Introduction (30 mins)
- Individual presentation (15 \* 10 min = 150 min)

Lunch break (60 min)

Evening session (13:00-16:30):

- Road and mindmap development (60 mins)
- Concepts clarification and collaboration ideas (60 mins)

Break (30 min)

- Final discussion (60 min)

Hence, the morning session is laying the grounds and introducing the topics and people, when the afternoon session is reserved for collaborative work. We believe that this structure will enable us to produce significant outcomes from the workshop and actually synthesize knowledge instead of just sharing it. The session schedule is tight, but we believe that utilizing the Presemo system will help manage the specified tasks in time.

### 4. WORKSHOP ORGANIZERS

Workshop organizers represent various backgrounds, but share a common interest in developing biosignal adaptive games and playful applications.

Helsinki Institute for Information Technology (HIIT) Digital Content Communities research group is a multidisciplinary group focusing on four research themes: enactive applications (includes biosignals), play-interaction, future of video and service design. The research in HIIT/DCC is primarily constructive. The group is lead by professor Marko Turpeinen who is also research director in HIIT's network society research program and professor of

Digital Media in KTH, Stockholm. Kai Kuikkaniemi from DCC is primarily responsible in organizing the workshop. Kuikkaniemi has seven years of experience in developing experimental games and doing games research. Currently Kuikkaniemi is visiting scholar in UC Berkeley.

Center for Knowledge and Innovation Research (CKIR) is an international, multidisciplinary research institute based in the Aalto university and belongs to the international Media, Interface, and Network Design Labs (M.I.N.D. Labs) consortium. The Knowledge Media Laboratory (KML) of CKIR is specialized in experimental media psychology. The conducted research focuses on the interaction of humans with media services, digital games, social communication technologies, and the user experience of technology. The research of CKIR yields design-rules for creating, and facilitates the innovation of, media technologies and services that are optimal for human beings from the perspective of emotional and cognitive processes and social interaction. Niklas Ravaja is Director of Research in CKIR and has extensive experience in applying psychophysiological measurements. Guillaume Chanel did his PhD on affective computing, using EEG and peripheral signals for emotion assessment. He is now interested in the study of physiological measures for analyzing the social interactions taking place in digital games.

Lennart Nacke, PhD, received one of Europe's first Ph.D. degrees in Digital Game Development from Blekinge Institute of Technology, Sweden. He has been working in the field of psychophysiological analysis for the last 4 years as well as chaired and co-organized several expert panels on psychophysiological player measurement and UX at academic conferences (e.g., DiGRA, Future Play) and industry venues (e.g., GDC Canada, Quo Vadis Berlin). As much as an avid gamer, he is a passionate scientist, whose research interests are psychophysiological player testing for example with EEG (i.e., brainwaves) and EMG (i.e., facial muscle contractions) or eye tracking as well as quantification of gameplay experience in player-game interaction, technology-driven innovation (e.g., playability metrics, physiological computing) and innovative interaction design with digital entertainment technologies

Hannu Korhonen is a senior researcher at Nokia Research, Finland. He has been working in game research area since 2005, focusing on developing playability heuristics that are used with expert review method. Currently the method is used to evaluate mobile games on Nokia's N-Gage platform and Hannu has been involved in playability assessment of mobile game titles such as Dance Fabulous, Snakes Subsonic, and Dick Dagger and the Fallen Idol. He has published several scientific articles on playability issues and other topics in mobile game research. He has given tutorials on the expert review method on mobile games at the MobileHCI'07 conference and local universities. He is also a Ph.D. student at the University of Tampere and his re-search topic is playability evaluations of mobile games with an expert review method. His other research interests include various areas of mobile interaction. Recently, he has been studying the nature of user experience, especially playful experiences on mobile devices, which applies game research knowledge to regular software design to make them more engaging, attractive, and most importantly, more playful for the users.

Together the organizers have participated in following international and domestic research projects related to the domain during the recent years:

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<sup>10</sup> Presemo platform is developed in Emokeitai project utilizing XMPP server, Conduit presentation client, and Polar biosignal capturing system.

- TARGET, Transformative, Adaptive, Responsive and enGaging EnvironmenT, FP7-ICT-231717. <http://www.reachyourtarget.org/>
- FUGA, The fun of gaming: Measuring the human experience of media enjoyment, FP6-NEST-28765 (KML coordinated the FUGA project). <http://project.hkkk.fi/fuga>
- PASION, Psychologically Augmented Social Interaction over Networks, FP6-IST-27654. <http://www.ist-pasion.com>
- MINET, Measuring the Impossible NETwork, FP6-NEST-43297. <http://minet.wordpress.com>
- MEC, Presence: Measurement, Effects, Conditions, FP5-IST-37661. <http://www.ist-world.org/ProjectDetails.aspx?ProjectId=47778469a6b74c3cb612e6fca5640b5>
- Emokeitai, Funded by Finnish national Innovation agency TEKES. <http://www.hiit.fi/emokeitai>
- Enactive Social Media and Games. Funded by Aalto-University foundation. Part of Media Factory. <http://www.mediafactory.fi>

Some of our key publications in the domain can be found from references [9],[10],[11],[12],[13],[14].

## 5. WORKSHOP PARTICIPANTS

We encourage people to participate from various backgrounds. Prior experience on developing multiuser applications is not needed, but we expect that people are interested in performing experimental studies with related systems. Especially we hope that people who are interested on social interaction and multiuser systems would join the workshop. For those researchers, this workshop can provide practical new tools and modalities for expanding the social experience and communication. Meanwhile we hope that they can contribute in providing insight and new perspective on the unique dynamics of designing for multiple users.

We hope that those researchers who have experience in human-computer interaction with biosignals, in psychophysiology research overall or in experimental interfaces can share their experiences both related to technical details as well as to overall design patterns. For them, this is a great chance to change the context of their prior work with single users to multi-user context, and exploring the vast and varied potential of biosignal adaptation in domains such as social media, massive multiplayer gaming and in computer supported collaborative work.

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