Brain-Computer Interfaces for Artistic Expression

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Abstract
Artists have been using BCIs for artistic expression since the 1960s. Their interest and creativity is now increasing because of the availability of affordable BCI devices and software that does not require them to invest extensive time in getting the BCI to work or tuning it to their application. Designers of artistic BCIs are often ahead of more traditional BCI researchers in ideas on using BCIs in multimodal and multiparty contexts, where multiple users are involved, and where robustness and efficiency are not the main matters of concern. The aim of this workshop is to look at current (research) activities in BCIs for artistic expression and to identify research areas that are of interest for both BCI and HCI researchers as well as artists/designers of BCI applications.

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Brain-computer interfaces; artistic expression; mind music; brain painting; artistic tools; artists' control of tools; joint performances; multi-brain control.

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H.5.m. Information interfaces and presentation (e.g., HCI): User Interfaces.

Introduction and Background
In recent years BCI technology has entered mainstream human-computer interaction (HCI) research, in particular multimodal interaction research (for example, in entertainment computing) [1]. Apart from communication and control [2], monitoring the

affective/cognitive state of a user can help to tune an application environment to the needs and preferences of a particular user or to modify an artistic environment to express a user's emotional desires. Artistic BCI applications date further back than assistive and clinical BCIs. Many years before Kamiya's and Vidal's influential papers on monitoring and controlling alpha activity [3] and using brain activity for control and communication [4] there were experiments by artists on musical composition, fine art, and other creative applications that required brain activity patterns as input [5]. Currently we see renewed interest in artistic BCI applications.

Users of artistic BCI technology can be artists who compose art in real time using BCI signals (usually in a multimodal and multimedia context), performers, audience members, or a full audience [6]. Artists are using reasonably cheap commercial BCI devices to design installations that require active or passive input from the brains of multiple users or participants in artistic events. Participants receive feedback from the artistic application which helps them to control their brain activity in order to create or modify pieces of interactive art. In addition to artistic BCI environments that allow users to play with and modify animations and musifications [7,8,9], there are examples of BCI control of instruments and tools for artistic expression and exploration [10,11]. Adaptive musical interfaces based on a user's brain state have also been introduced [12,13]. A special issue of the journal Brain-Computer Interfaces devoted to the use of BCI for artistic expression appeared in 2015 [14,15,16]. However, in that issue the HCI aspects of such interfaces didn't get much attention.

Workshop Goals

The workshop is intended for HCI and BCI researchers who are interested in non-clinical BCI applications [1,17], in particular applications that invite users to play and to be creative, using BCI technology (EEG, fNIRS [18]). The workshop addresses an audience that is interested in research that focuses on non-traditional and challenging interactions using BCI as a channel for artistic expression of moods, emotions, and other outlets of expressed creativity. The organizers will invite artists and performers to contribute to this workshop with demonstrations and performances.

The workshop aims at having contributions that cover the various areas of BCI and Arts (music, painting, composing, performances, and interactive installations) and, in particular, the user interface of such applications. We want to address contemporary challenges involved in designing BCIs, using EEG or fNIRS, related to the creation and experience of art. Contributions from both the artistic and the scientific community are encouraged. Topics of the workshop include:

(1) Design, implementation and evaluation of artistic BCIs;
(2) Multibrain and multimodal interaction with artistic environments;
(3) BCI modification of artistic environments;
(4) BCI environments for self-reflection, multiparty synchronization, empathizing, collaboration, and competition;
(5) BCI control of instruments and tools for artistic expression and exploration; and

(6) Affect and interaction-based art, digital art and playful interactions in affective BCI environments.

We also aim to address some more fundamental questions on control and experience of using a BCI for artistic expression. Questions we want to discuss in papers and with the participants include:

(1) What makes a BCI application an artistic application?
(2) How does a user of an artistic BCI control the application and can therefore consider the result as a work of his or her own?
(3) What is the role of the audience or someone interacting, using BCI, with the artist's work?
(4) How can lack of robustness and the presence of artifacts play a positive role in creation, performance and experience of an artistic BCI?
(5) What makes BCI created art different from art created in more traditional ways?

Organizers

Anton Nijholt received his PhD in computer science from the Vrije Universiteit in Amsterdam. He held positions at various universities, inside and outside the Netherlands. In 1989 he was appointed full professor at the University of Twente in the Netherlands. His main research interests are human-computer interaction with a focus on entertainment computing, affect, humor and brain-computer interfacing. He edited various books, most recently on playful interfaces and brain-computer interaction. He is co-editor of the Handbook on BCI that will appear (Taylor & Francis) in 2018. Nijholt, together with many of the more than fifty PhD students he has supervised, wrote hundreds of conference papers on these topics and acted as program chair and general chair of large international conferences on affective computing (ACII), intelligent virtual agents (IVA), multimodal interaction (ICMI), advances in computer entertainment (ACE), entertainment computing (ICEC), et cetera. Nijholt is Chief Editor of the section Human-Media Interaction in the journal Frontiers in Psychology and editor of the Springer Book series Gaming Media and Social Effects.

Anton Nijholt will act as the main organizer. In the past he organized four CHI workshops (humor, virtual reality, ambient intelligence, and BCI) and many workshops on HCI, BCI and entertainment issues at other conferences.

Robert J.K. Jacob is a Professor of Computer Science at Tufts University, where his research interests are new interaction modes and techniques and user interface software; his current work focuses on implicit brain-computer interfaces. He has been a visiting professor at the University College London Interaction Centre, Université Paris-Sud, and the MIT Media Laboratory. Before coming to Tufts, he was in the Human-Computer Interaction Lab at the Naval Research Laboratory. He received his Ph.D. from Johns Hopkins University, and he is a member of the editorial board for the journal Human-Computer Interaction and a founding member for ACM Transactions on Computer-Human Interaction. He has served as Vice-President of ACM SIGCHI, Papers Co-Chair of the CHI and UIST conferences, and General Co-Chair of UIST and TEI. He was elected as a member of the ACM CHI Academy in 2007 and as an ACM Fellow in 2016.

Beste Filiz Yuksel is an Assistant Professor of Computer Science at the University of San Francisco. She received her PhD in Computer Science from Tufts University, Boston, working with Professor Robert Jacob. Her research was on the next generation of brain-computer interfaces (BCIs) that detect and evaluate real-time brain signals using machine learning classification of functional near infrared spectroscopy (fNIRS) to build adaptable user interfaces for the general population. Her work won a Best Paper Award at ACM CHI 2016. She has also worked with Mary Czerwinski at Microsoft Research, investigating user-virtual agent interactions for the next generation of intelligent personal assistants. Beste works on building intelligent, adaptive interfaces that respond to both user cognitive and affective state in her Human-Computer Interaction lab.

Marvin Andujar received his Ph.D. in Human-Centered Computing from the University of Florida. He is an Assistant Professor in the Computer Science and Engineering Department at the University of South Florida. He is leading a research lab on Brain-Computer Interface with an emphasis on Human-Computer Interaction. Marvin's research concentration is on Affective Brain-Computer Interfaces (aBCIs) where he measures attention levels with wearables electroencephalographic (EEGs) to provide feedback to users for self-regulation. His work led to a $300,000 research grant from Intel granted by the CEO to pursue work on BCI and Brain-Controlled Drones. He co-founded the world's first Brain-Drone Race, which was showcased in more than 550 media outlets across the world such as Associated Press, New York Times, Discovery Channel, The Verge, among others.

Grace Leslie is Neukom Fellow at Dartmouth College. As a Neukom Fellow she employs brain-music interfaces to promote wellness for healthy and clinical populations. She was most recently a postdoctoral fellow in the Affective Computing Group at the MIT Media Lab where she developed musical brain- and body interface systems to invite expression and experience of emotion. As a flutist and electronic music improviser she maintains a brain-body performance practice. She performed Brain-Body Music in nine countries and released three albums. She was mentioned in 2016 MIT Technology Review among the 35 Innovators under 35. Grace completed her Ph.D. at UCSD, where she studied the expressive movements and brain dynamics supporting music engagement at the Swartz Center for Computational Neuroscience.

Website, Publicity, and Pre-Workshop Plans

The Call for Papers will include a website URL that will give more information about the workshop and the position papers that are to be expected. It will include links to the main CHI 2018 website pages about submission, registration, and program of the CHI conference and its workshops and tutorials. Marvin Andujar (University of South Florida) will act as web master for this workshop. We will advertise this workshop in the BCI Journal, the BCI community, and in SIGCHI mailing lists. From the previous events we organized (special issues, workshops, edited books) we have an extensive list of contacts.

Website URL: *artisticbci.wordpress.com*

The website will provide the following information:

- Information about the field of Artistic Brain-Computer Interfaces and the paper abstracts.

- A call for participation process, position paper template, and topics the workshop organizers are hoping to see in the submissions (topics are not limited to the list).
- The goal of the workshop and other relevant information (location, date, time, and important dates)
- The organizers' information (name, affiliation, and research concentration).
- A program for what the organizers will have prepared for the workshop. The program will be determined after the position papers have been submitted and accepted.
- Information about the participants of the workshop. The information will allow the workshop's participants to know what the others are working on, which may spark conversation at the workshop or during the conference.

Workshop Structure

Once position papers are submitted we will organize a discussion among the authors of accepted contributions. This discussion will serve as input to decisions about the structure and content of the final program of the workshop. The organizers intend to have a mix of demonstrations, performances, presentations, and discussions. We aim at participation of artists, performers, and HCI and BCI researchers. HCI researchers interested in the use of BCI in games and entertainment applications are certainly welcome to contribute. We expect to have one or two invited speakers/ performers that have been using BCI in music perfor-mance or education, performance art or visual arts.

- Introduction by organizers
- Invited talk
- Short talks
- Break
- Intro to demos and performances
- Demos, performances, audience participation
- BCI technology development and requirements
- HCI aspects, adaptive interfaces, passive vs active BCI
- Break
- Short Talks
- Invited talk
- Discussion and Conclusion

Recruiting Participants

The workshop organizers have extensive networks both in the HCI and the BCI communities. They have organized CHI workshops before and have been involved in the organization of special issues and workshops in the BCI community. This includes a special issue in the BCI journal and an Asilomar workshop on BCI and artistic expression, and involvement in the Brain on Art meetings in Cancun (2016) and Valencia (2017).

Post Workshop Plans

The open access journal Frontiers in Human-Media Interaction (Anton Nijholt, chief editor) is interested in having a special issue devoted to this workshop. Similarly, a special issue of the BCI Journal can be proposed and (verified) a proposal will be received positively (Chang S. Nam, chief editor).

Position Papers

We ask authors of position papers to follow the guidelines for CHI ACM Extended Abstracts. At least

one author of each accepted position paper must attend the workshop. All participants must register for both the workshop and for at least one day of the conference. The Call for Position papers will be issued before 1 December 2017. At that time the website will also be available.

Call for Participation

Artists have been using BCIs for artistic expression since the 1960s. Their interest and creativity is now increasing because of the availability of affordable BCI devices and software that does not require them to invest extensive time in getting the BCI to work or tuning it to their application. Designers of artistic BCIs are often ahead of more traditional BCI researchers in ideas on using BCI in multimodal and multiparty contexts, where multiple users are involved, and where robustness and efficiency are not the main matters of concern.

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More information about the workshop can be found at the website artisticbci.wordpress.com

We invite researchers/scholars, community members, and artists to submit a position paper, design provocation, case study (2 to 6 pages in the ACM Extended Abstract format), or a video contribution (max. 5 minutes), and a brief personal bio.

Send submissions to a.nijholt@utwente.nl. Deadline for submission is 2 February 2018. Participants will be notified of acceptance on or before 22 February 2018. The workshop will be held on either April 21 or April 22, 2018.

At least one author of each accepted position paper must register and attend the workshop. All workshop participants must register for both the workshop and for at least one day of the ACM CHI conference.

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