

Somebody on stage: Reviewing interactive body augmentations in performing arts.

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Abstract

This paper examines how interactive technologies contribute to artistic reflections on human body augmentation. It introduces digital performance, the reference field for this study, and narrows it to interactive practices. It outlines non interactive body augmentations and discusses how the incorporation of real-time interactivity led to the creation of new artistic explorations. It presents interactive on-body projections and human-machine systems as novel art practices that extended the state of art in body augmentation.

Keywords

Digital performance, human-computer interaction, staged interactivity, augmented bodies.

Introduction

Many artists look for new ways to augment and intensify their performances with technological artefacts (Birringer, 2008; Broadhurst & Machon, 2006; Dixon, 2007). Such artefacts contribute to the creation of unparalleled aesthetic and new perceptual experiences (Salter, 2010). In the past decades, we have experienced advances in hardware and software applications (Poole & Le-Phat Ho, 2011) that have an evident influence on performing arts. The popularisation of computer technologies facilitates their integration into traditional performing arts like theatre, dance or performance. Musicians, dancers and choreographers apply digital technology on stage. Furthermore, new art genres such as virtual theatre (Reeve, 2000), augmented dance (Sparacino, 1999) or telematic opera (Deal & Burtner, 2011) appear. Digital performance is a term that includes all these art practices. According to Dixon (Dixon, 2007) digital performance includes “all performance works where computer technologies play a key role rather than a subsidiary one in content, techniques, aesthetics, or delivery forms”. Digital performance constitutes a reference field for this study, because (in its wide spectrum of artistic activities) it includes staged performances that involve live human-computer interaction: artistic practices that we analyse and discuss in this work. Current human-computer interfaces based on computer vision, external or wearable sensors allow to sense the properties of the human body and register

its actions without any need of manipulating a physical device (like in the case of a mouse or joystick). They use as input data gestures, body proximity and location, eye gaze position and even physiological data like blood pressure or heart beat rate (Jain, Lund, & Wixon, 2011). They are especially suitable for performing arts since they have no arbitrary constraints on performer’s actions.

The union of digital performance practices and technology able to mediate real-time interactivity resulted in new insights into already existing artistic explorations. In this work we focus on one particular area that showed new creative possibilities with the incorporation of interactivity on stage – we present practices that explore body augmentation. We define body augmentation as practices that make use of physical and digital resources like costumes, light projections, fabric and metal constructions, robotic extensions, wooden or wire appendages to overcome the limitations of the human body and extend its possibilities. In the following sections we present examples of diverse approaches to body augmentation in both non-interactive and interactive context.

Non Interactive Body Augmentation

First, we present three artists and performers that reflect on body augmentation without usage of any interactive technology. Each of them worked on body extension with particular artistic purposes and technical means, so we have decided to present their works as interesting examples of different approaches to body augmentation in performance.

Loie Fuller

American dancer Loie Fuller is known for innovative experiments with technology with the aim of transforming and enhancing her body (Anderson & Pantouvaki, 2014). In her performances, she works with coloured lamps, reflector technologies and cane-shaped wooden appendages below her ample costumes. She uses them to augment the natural range of movement of her body and so, to add volume, dynamic flexibility and an airy quality to her dance (Veroli, 2009).

By projecting coloured lights onto her spacious dresses, she extends the bodily art form of dance with elements of visual

language like colour and form, introducing threedimensional rotating and morphing screens formed from her loose costume's cloth (Brandstetter, 2015). She uses the combination of light, mechanics, bodily gesture and fabric to transfigure her body into metaphors of animals or flowers (Schiller, 2003). In her body augmentation experiments she converts her costumed body into a rhythmically moving shape of changing forms.

Oskar Schlemmer

Another artist that aims to "enlarge it [the body] beyond its dimensional and temporal limitations" (Gropius, 1961) is German painter, sculptor, designer and choreographer Oskar Schlemmer. In his dance performances, he uses wooden sticks, wire and abstract costumes as technical augmentations of the body to amplify and alter the human form and extend it into space. With this means, he aims to explore the relationship between the organic geometry of the human body and the abstract geometry of the surrounding space (Lahusen, 1986).

He explores the potential of physical transformations inherent in costumes and masks to transform the body and convert dance movements into spatial sculptures (Brandstetter, 2015). In his performance pieces the body becomes a costumed instrument in motion which acquires a nonrealist, abstract and metaphysical dimension (Birringer, 1998). He uses these resources to "free man from his physical bondage and to heighten his freedom of movement beyond his native potential" (Gropius, 1961).

Rebecca Horn

Rebecca Horn's body augmentation practices focus on the renewal of her perceptual possibilities through wearable physical appliances (Wright, 2009). In her performance *White Body Fan* (Media Art Net, 2018b) she uses winglike fabric and a metal construction that allows her to extend her body capacities and feel the movements of the surrounding air (Art and the Imaginative Promise, 2018). Besides the *White Body Fan*, she works on body augmentation in the performances *Unicorn*, *Head Extension*, *Pencil Mask*, *Cockfeather Mask*, *Arm extensions*, *Finger Gloves* and *Cockatoo Mask*, where she explores the perceptual relationship between the body and the mind (Wright, 2009).

Fuller, Schlemmer and Horn make use of body extensions with different artistic goals: to extend body possibilities and movement range and to enhance the performer's perceptions. They achieve their goals through illumination techniques and concrete physical materials. Real-time interactivity enables new different types of body augmentation that we discuss in the following section.

Interactive Body Augmentation

In this section, we discuss two new means of artistic expression that emerged with the incorporation of interactive technologies on stage: interactive on-body projections and

interactive human-machine systems. They are examples of how we can augment the body by both invasive (humanmachine systems) and non-invasive (on-body projections) solutions.

Interactive On-Body Projections

Live on-body projections have been on the performance stage since the early experiments of Loie Fuller at the beginning of the twentieth century (Dixon, 2007). Her wide, illuminated dresses become changing dynamic costumes. However, there is no exact coincidence between the projection and the dancer's body or costume. Part of the projection illuminates the performer and the rest, the stage. To synchronise both parts (the body and projection) a system capable of analysing in real-time the position of the performer and generating the corresponding graphics is needed. This becomes possible with the appearance of whole-body tracking techniques based on computer vision, depth sensors or wearable sensors. These technologies enable the usage of interactive costumes perfectly fitting

the performer's body. Performers become moving projection surfaces (Beira, Carvalho, & Kox, 2013). Due to the possibility of an instantaneous adaptation of the projection's position and dimensions, live on-body projections leave room for improvisation and the personal voice of the performer (Barnett, 2009). They enhance the expressive potential of the performer whose body becomes extended and reconfigured through digital images (Mocan, 2013). The projections make the performer visually transcend the limitations of his/her physical body, while at the same time the living, breathing body of the performer used as a screen "humanizes the digital image" (Barnett, 2009). This combination transforms the performer into "something other than purely human or purely digital" (Masura, 2007) and is an example of a new powerful tool for artistic expression in the area of body augmentation. Interesting examples of on-body projections are the works of Klaus Obermaier. For example, in his interactive dance performance *Apparition* (DeLahunta, 2018), he combines frontal on-body projection and almost ten meters wide background projections, leading the aesthetics of the piece towards immersion (Boucher, 2014). His idea of the piece is to reflect about how we interact with digital systems (Mocan, 2013). Obermaier do not just simply project a pre-rendered video onto the body, he creates the projected content in response to the performer's body dynamics. The body features transform the architecture of the realtime generated space projected onto the dancers. The visual effects are rendered more fluidly or rigidly depending on the performer's movement. Obermaier states that in this configuration "the overall interactive system is much more than simply an extension of the performer, but is a poten-

tial performing partner" (DeLahunta, 2018). This piece is an outstanding example of on-body projections, where the interactive relationship between the performer and the

projected image merge both parts in a “visually and dramatically coherent whole” (Boucher, 2014).

The human body augmentation techniques that we have presented so far serve to enhance the perceptual and expressive potential of the human body through physical appliances or interactive projections. They are used as an artistic resource to intensify performers’ interpretation in dance, performance or theatre pieces. However, body enhancement through technology itself becomes an important field of artistic exploration in digital performance, as it encourages artistic reflections on the nature of the body, robotic body extensions and cyborg bodies.

Interactive Human-Machine Systems

With the appearance of interactive technologies artists start to experiment with body augmentation using robotic prosthesis and hybrid human-machine systems and presented them on stage (Featherstone & Burrows, 1996). These practices are frequently motivated by the desire to explore the possible fusion of the human body with technology (Parker-Starbuck, 2011) and to reflect on body condition, evolution and adaptation in a technological environment (Kac, 1997). The integration of artificial components or technology and the human body is a complex subject involving the hope of enhancing human abilities, but also has negative connotations, as it displaces the biological, live or real (Masura, 2007). It has been discussed from the philosophical, ethical and artistic points of view by many writers, artists and performers (Cleland, 2010; Giannachi, 2004; Macneill, 2011; Zylinska, 2002). Here we present two human-machine systems that approach body augmentation differently: using the body as a source of input data for robotic extensions and using body as an output device.

Robotic extensions Different artists experiment with the conjunction of the natural and the technological using robotic body extensions (Antúnez Roca, 2018; Bokowiec & Wilson-Bokowiec, 2008; Kac, 2000; Kevin, 2018). As an example of a robotic extension used for artistic purposes we present one of the best-known performance objects of the Cyprian performer Stelarc: *The Third Hand* (Stelarc, 2018). It is a mechanical human-like hand, controlled by electrical signals from his abdominal and leg muscles. This robotic device is capable of grasping and rotating and has a tactile feedback system intended to provide a rudimentary “sense of touch” (Stelarc, 1991). He developed it to explore the conjunction of technology and media with the body (Stelarc, 2018) and to expand his power and reach (Stelarc, 1991). Stelarc used it in one of his first robotic performances in 1981 at Tamura Gallery in Tokyo where he investigated the possibility of writing “THE THIRD HAND” with his right and artificial hand at the same time (Kac, 1997). This work incites reflection on the human body by focusing on its limitations and then visualising its potential extension through technology. Although Stelarc’s performances are frequently viewed as controversial, without doubts they helped open the debate on body limits and our changing

nature as humans (Masura, 2007). They are relevant examples of the usage of interactive systems on stage where the human-computer interface is a subject of artistic reflection.

The exploration in the field of human-machine systems takes another interesting track when the human body is used as an output interface.

Body as an output device We use the term body as an output device, to denote practices that use the body as an output interface of an interactive computer-mediated system. In these practices, the performer’s body becomes an object of manipulation using, for example, computerinterfaced muscle stimulation systems. The body is presented as an operational structure connected to a computational system and controlled by external factors (Elsenaar & Scha, 2002).

The use of the body as an output device presents an intriguing example of a new configuration of computational systems and the human body, completely opposite to the classical human-computer configuration where the human body is the source of input data and the computer generates digital output as a response. It is a significant new mean of artistic expression grounded in a novel interpretation of human-computer interaction systems. Artistic explorations that use human body as an output device contribute provocative reflections on the manipulation of the human subject (Masura, 2007), on the consequences of reducing the body to a display device and on the relation between the human and the computational system including the Internet (Farnell, 1999).

Stelarc’s *Ping Body* (Media Art Net, 2018a) performance premiered in 1996 in Sydney is an interesting example of this kind of practice. In this piece, a computer program sends messages over the Internet to more than 30 domains around the world and measures the time of response of each domain (Elsenaar & Scha, 2002). The measured delays (from 0 to 2 seconds) are then transformed into electrical discharges between 0–60 volts and applied to the multiple muscle stimulators attached to the performer’s naked body (Media Art Net, 2018a). The involuntary gestures caused by the electrical shocks turn the performance into an odd dance choreographed by data streams. This performance presents an interesting inversion of the usual relation between the body and Internet: “instead of collective bodies determining the operation of the Internet, collective Internet activity moves the body” (Masura, 2007). It is also an important example of body augmentation where the body “is no longer the body as a closed unit but a data-body and an every-place body” open to external information and interaction (Masura, 2007).

Conclusions

The term performing arts includes many very diverse practices, but all of them are carried out in front of a live audience and use the performer’s body and presence as a medium of artistic expression. How this body can be

augmented to cause new aesthetic experiences and reflections, is a fascinating question that leads to many diverse artistic explorations.

We presented and analysed both non interactive and interactive examples of body augmentation. In non interactive practices we identified artistic explorations that enhance human body presence, movement range and perception through light projections and physical appliances.

The appearance of interactive technologies related to body sensing and tracking, as well as the possibility of manipulation of digital sound, image and robotic systems, introduce a new type of real-time interactivity into live performances: interactivity between the performer and digital media presented on stage. It enables new approaches to body augmentation: interactive on-body projections and human-machine systems. In interactive on-body projections, videos and graphics projected onto the body surface create a mixture of the virtual and the in-the-flesh performer that visually transcends the limitations of the human body. Finally, human-machine systems augment the capacities of the body and inaugurate reflections on body condition in this new human-machine relationship. Performers are reflecting on the place of the human in this new relation by using the body as both, a source of input data and an output device. It is important to stress that these art practices could not have emerged without humancomputer interfaces that are both: the subject of artistic contemplation and a technological tool used on stage. We hope that this kind of reflections will be constantly contributing to critical judgment of this, still quite incipient human relationship: relationship with computers and information technology.

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