iMORPHIA: A PROJECTIVE PERFORMANCE SYSTEM

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ABSTRACT

In this paper I describe the development and evaluation of *iMorphia*, a prototype projective performance system. The system has been created as part of a practice led PhD investigating Multimodal Performance and Improvisation. Using a combination of body projection and body tracking, *iMorphia* creates the illusion of an embodied three dimensional character simultaneously visible to both performer and audience.

Keywords: projection, body tracking, performance, gaming, Kinect, Unity, illusion, the uncanny, suspension of disbelief, immersion.

1.   INTRODUCTION

The paper begins with a description of the artistic motivations that led to the development of the iMorphia system, examples of productions that were inspirational in the early formulation of the system and the identification of the Kinect as an appropriate performative technology. The practice led research and its methodology are described with significant findings drawn from the first year of research, leading to a participatory workshop and an ethnographic study. The paper concludes with a series of plans for future developments drawn from the findings of the study.

2.   RESEARCH BACKGROUND

Prior to commencing the PhD, I developed and exhibited a number of computer based interactive art installations using projection, real-time 3D graphics and various forms of gesture sensing. Figure 1, below, illustrates a projected interactive starfish extending its tentacles to touch people's hands.

Figure 1: Mimetic Starfish, Bonington Gallery, Nottingham, UK, 2014.

A growing interest in the immediacy and temporality of live performance influenced a move away from interactive art, where the audience acts as performers, towards the idea of an audience witnessing an interactive experience mediated by performers.

Though relatively unfamiliar with the history of performance art, I recognized that the concepts of mimesis, illusion, magic and spectacle shared a common ground with my artistic practice. However the application of technology in performance also resulted in a new set of theories dealing specifically with performative notions of authenticity, liveness, presence and mediation [1], [2], [4], [9]. I found these ideas immensely appealing and began to formulate a research project combining performance with interactive art that would serve to investigate the tensions between mimesis, illusion, authenticity, liveness and mediation.

The following three productions embody these concepts and are seen as influential in the development of my practice led research.

1. D.A.V.E. (Digital Audio Video Engine) a dance work by Klaus Opermaier. I had witnessed this production in 1998, where a pre-recorded video projected on a highly choreographed dancer creates illusions of body distortion, gender changing, aging and physically impossible dance movements. [19]

2. Sweater by Willow, a pop video using live projection mapping, demonstrates how suspension of disbelief can be created when a performer acts as if projected illusions are real. [22]

3. Alchemy of Light by a Dandypunk. The video of a live performance using projection mapping illustrates the effectiveness of actor engagement with illusions projection mapped onto real objects. [7]

All three examples make use of projection mapping and performances that engage with illusions as if they were real, producing a suspension of disbelief in the observer. The suspension of disbelief created by these illusions is not static, it is a tension and dynamic that oscillates between the real and the virtual according to the veracity of the illusion and the performer's interactions.

My initial proposal synthesised these ideas in the form of a surreal performance combining projection mapping, virtual characters and real objects. The performance would be set on a white stage with actors wearing white costumes onto which body responsive projections were made which would enable a performer to instantly change character and interact with virtual objects in the scene. The production would not simply be the creation of spectacle, I feel it is important that the audience is made aware of the mimetic effect, that their suspension of disbelief should be tested by pushing the illusion into impossible and dark places, the shocking and the macabre.

A key challenge in the early stages of the research was the identification of an appropriate research methodology. It is beyond the scope of this paper to go into great depth here, but after examining traditional PhD methodologies involving qualitative, quantitative analysis and alternative practice based, practice led, practice as research methodologies, I identified most with the performative research methodology proposed by Haseman [11]. a research methodology that has been singled out as being particularly applicable to the creative arts.

"A performative paradigm potentially offers the creative arts a radical new vision and a way of distinguishing its research from the dominant models of knowledge." [3]

Inspired by Haseman's concept of an artistic audit and because much of my research evidence was in the form of online videos, I began documenting the research on a WordPress based website [5]. The website includes sections that provide a historical context to the research, performative examples of work, performances and theatre that make use of interactive projection mapping and academic research in interactive, digital, augmented and virtual theatre.

With the view of creating a prototype performance I investigated the technologies that would make this possible. My research led to the conclusion that an affordable and accessible platform supporting body tracking was the Microsoft Kinect, a gaming device released in 2010 for the Xbox console which enabled games to be played simply by moving the body. Shortly after its release, a number of independent software hackers began to create software so it could be used as an off-the-shelf performative device. In 2011 the website "Kinecthacks" was established and lists many inspiring examples of the device being used to control light, music and video [16].

One striking example I found was the modification of a Japanese dance programming tool, MikuMikuDance [23] enabling a performer to directly control the virtual body of a MikuMiku character using the Kinect [12].

The Kinect enabled MikuMiku system became the basis for my first prototype demonstration and acted as a proof of concept in my practice led research.

3. PRACTICE LED RESARCH

The practice led research centers around a three stage process; i) formulating a creative idea, ii) technical implementation and iii) trialing the working concept with performers. The process is iterative; each realisation produces new ideas, and working with performers confirms potential directions for the next iteration of the process. The process is documented on the website as a "research blog", a series of diary like pages with video recordings of prototypes, critical assessments and outlines for future directions. The blog serves as an ongoing record of the practice led research and will inform an exegesis towards the end of the research.

The first working prototype was created in November 2013, the illustration below (Fig. 2) represents a block diagram of the system.
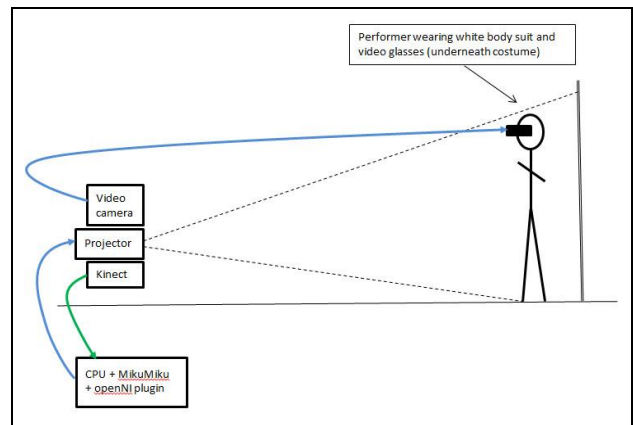

Figure 2: Diagram of the projective performance system

A performer wearing a white bodysuit and video glasses see themselves overlaid with a projection of a virtual character that closely mirrors their movements. The visual feedback of the projected character mapping has the effect of immersively transforming the performer into another character.

**Figure 3: MikuMiku projection
on performer in white body suit**

As a performer trialing the system I found myself totally engaged and immersed through the video feedback, unlike looking in a mirror, one sees oneself transformed from the perspective of a third person, identical to the viewpoint of an audience. The physical properties of the long hair influenced my performative behaviour and I found myself making exaggerated body movements that would cause the hair to flow and swirl. I was however somewhat uncomfortable with the stylised and provocative anime imagery of an idealised female, but also recognised the seductive and transformative power of the mimetic effect produced by the body projection. (Fig. 3, above).

The mimetic effect produced by the body projection has greater potential effects in terms of signifiers than that produced by donning theatrical clothing, the actual shape of the body appears to be transformed and the performer is influenced by the inherent physical and dynamic characteristics imbued in the virtual body. Dynamic qualities such as the simulated hair, or the way the virtual body moves are entirely virtual, yet profoundly affect the performer's behaviour; it is almost as if they become possessed by the virtual character.

I felt that the immersive illusion created a sense of the uncanny, the projection onto the performer's body of a dynamic three dimensional character closely following their movements produced a convincing portrayal of an artificial, yet human like figure. The uncanny effect resulting from the dynamic projection was also acknowledged by colleagues seeing the transformative illusion.

The concept of the uncanny is a familiar term within literature and was first analysed by Jentsch in 1906 [14] and then taken up by Freud in 1919 [10]. The uncanny has more recently made an impact on computer graphics and robotics research in the form of "The Uncanny Valley" where a representation of the human form appears almost human but not quite, producing a sense of disturbance and uncomfortableness in the perceiver [18]. Within the crossover genre of performance and technology, Causey [6] describes how technology when combined with performance brings forth notions of the uncanny and the double.

What is it that creates a sense of the uncanny – is it when a virtual or an artificial form appears almost human but not quite, is it that it brings forth associations with the dead made living?

Is it perceived as uncanny when the projected illusion deforms in such a way that the figure jumps between human and monstrosity? Is it a result of gender transformation?

The uncanny is rich with meaning and ambiguity; it is a potentially interesting and inspirational notion for the creation of works that might invoke a sense of unease.

In order to explore the potential of the uncanny further, I moved away from the constraints inherent in the anime aesthetics of the MikuMiku software and investigated the use of the Unity Games Engine [20] with the Kinect which would allow the import of characters with differing aesthetics. A variety of virtual characters were freely available on the internet, however most of these turned out to be unsuitable as they did not possess the appropriate internal skeletons that would work with the Kinect. I considered creating my own characters, but after some research it became apparent that this would be a non-trivial and time consuming exercise requiring specialist skills in 3D software

such as 3DStudio Max, Maya or Blender. Fortunately I discovered two character creation tools designed specifically for artists, Daz3D Studio [8] and the open source package MakeHuman [17]. However though these supported the creation of rigged 3D characters that could be exported into Unity, they both had limitations. Daz3D Studio embodies an aesthetic of idealised fantasy figures, especially females, its library is full of 'sexy' clothing and provocative poses. MakeHuman on the other hand being open source and under continual development gave rise to technical issues and incompatibility between releases. In addition there was little in the way of clothing, unless one was prepared to import models into Blender and spend time designing one's own. MakeHuman despite its problems is a powerful tool enabling the creation of an infinite range of characters with tools to dynamically alter age, gender, body types and body proportions.

I created a number of prototype demonstrations using the new semi-realistic figures and trialed these in the Mixed Reality Lab with colleagues and invited performers. Feedback from invited performers gave rise to the following research questions:

i) How might the aesthetic form of a virtual character affect the behaviour of a performer?

ii) Can a projected character produce a sense of the uncanny in a performer and/or an audience?

iii) What are the conditions which produce the sense that a character is controlling the performer versus that of a performer controlling the character?

A participatory workshop and an ethnographic study were devised as means of addressing these questions and evaluating the effectiveness of the system.

4. PARTICIPATORY WORKSHOP

It was envisaged that there would be a series of workshops with between two and five performers attending each session. The performers would be given the same set of characters to inhabit and two exercise to follow. A webpage describing the workshop was created and a call out made to performers for expressions of interest through colleagues, performance groups, social networks and the SCUDD list (The Standing Conference of University Drama Departments).
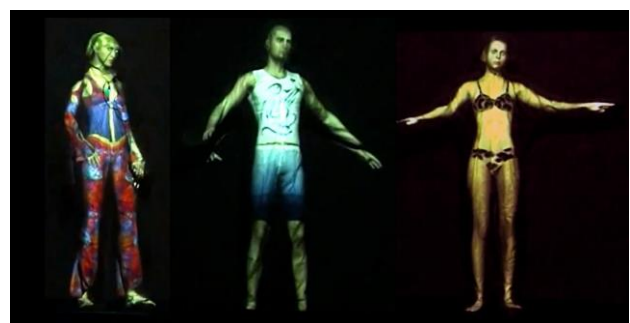

**Figure 4: Three projected body mask characters.
Daz3D Studio female and male, MakeHuman female.**

Three characters were selected for each performer to inhabit (see Fig. 4). The first two are semi-realistic figures - a female and a male from the Daz3D Studio package, whilst the third is a realistic rendering of a female in a bikini. These were chosen specifically so both males and female participants could try out gender transformations and also to see how degrees of realism might impact on the performers. It is acknowledged that all three characters are somewhat idealistic and present stereotypes, but due to time constraints it was not feasible to produce a range of characters with more realistic body types.

Two exercises were given to each performer, one where the performer controlled the character and the other where a performer tried to follow a movement pre-recorded via Motion Capture. This "following exercise" represented an attempt to investigate an earlier observation where performers remarked that they could not tell whether they were following the movements of the projected character or it was following them. The observation gave rise to the idea of imbuing dynamic qualities in a character such that they influenced how a performer might interact – an old character for instance might only be able to move slowly and would not respond if the performer moved too quickly. It is hoped that this potential research strand be will be investigated in the next phase of the research.

Between 14th and 18th April 2014 sixteen participants took part in four workshop sessions. An ethnographic study based on video and audio recordings made of the performances and group discussions after each session resulted in the following conclusions.

i) Changing projected gender had a remarked effect on performer behaviour. The reaction to changing gender seemed to be polarised, although the majority of male and female participants expressed enjoyment and a sense of freedom when performing in the opposite gender. Both males and females commented on the feeling of nakedness and vulnerability when in the bikini figure.

ii) The illusion of a projected body is sufficiently convincing and effective in creating a suspension of disbelief in both performer and audience. However performers reported a stronger emotional response seeing themselves transformed than that of the more objective position of viewing the transformation as an audience member. Many audience members commented on the disturbing or uncanny nature of the projected illusion.

iii) System artefacts such as lag and tracking errors were exploited by performers to explore notions of the double and the uncanny. It was surprising and rewarding to see how performers exploited and made creative use of system defects, rather than seeing them as problematic barriers to performance.

iv) The "following exercise" proved difficult. Performers were not aware of how well or how badly they were doing in following the movement of the pre-recorded body movements, suggesting the need for visual or audio feedback of mapping coherence. Even in the first exercise when performers were controlling the dynamic body mask, comments were made that they were at times unsure of what or who was controlling whom.

In response to the three research questions formulated before the workshop, the following conclusions were drawn.

i) The aesthetic form of the projected virtual character affects performative behaviour. Gender transformation appeared to consistently have an effect on all performers. The bikini character appeared to have the strongest effect on performers, partly due to its realism, but potentially also as a result of its lack of clothing. The effect of the visual aesthetics of the projected character raises questions as to how body type, gender, age, and clothing might affect the behaviour of a performer and is a challenging and potentially fraught area with the danger of being difficult to scope.

ii) The dynamic projected body mask produces a sense of the uncanny in audience and performer alike, more so in the immersed performer creating a more emotional response to the transformation than when an audience member. Uncanniness appeared to be enhanced by certain system defects, such as movement of the underlying material and inhuman body distortions resulting from system glitches.

iii) The concept of effective or affective control is an interesting phenomenon embracing notions of immersion, illusion, interaction, kinematics and proprioception. It is not yet clear as to the exact conditions that result in a performer feeling totally in control of the virtual character or feeling as if they were under its control. One possible explanation is system lag, resulting in the virtual limbs lagging behind the performers so they are continuously playing catch up. Another factor might be the performer's inability to distinguish their body from the projected. A method for changing the dynamic and interactive characteristics such that the control could be moved from affect to effect represents a potentially interesting area for further research.

5.   FUTURE DEVELOPMENT

As a result of feedback from the workshops, a number of potential avenues for future development have been identified, these are summarised as follows:

i)   Support for two performers so as to encourage interaction and improvisation.

ii)   A library with a range of characters (age, gender, body types, clothing) to better investigate the effect of content and stereotyping.

iii)   Characters with controllable and imbued dynamic characteristics in order to further investigate the control/controlling dialectic.

iv)   Improved tracking and reduced lag so as to remove random artefacts such as limbs jumping through tracking errors.

v)   Facial expression – this was raised by performers as an important enhancement for the communication of emotions.

One of the original aims of the practice led research was to examine how improvisation might be supported using multimodal technologies. In group discussions after the workshop a number of performers suggested that improvisation might be enabled given a scenario or structure or having another performer to work with.

It is envisaged that the development of support for two performers (i) with a greater range of characters (ii) is likely to encourage performer improvisation.

In April 2014, Unity announced that it will be supporting the new version of the Kinect which has reduced lag and better tracking, so aim iv) is likely to be met in the near future. [21]

Facial expression (v) is certainly possible and raises challenges on how a performer might control the expression of the avatar. This potentially interesting area opens up a range of possible paths of investigation and associated technical issues. However this avenue is likely to be problematic in terms of timescales and out of scope for this research. In addition, it is felt that there are parallels between theatrical mask work and the concept of the digital mask where the face does not change and represents an interesting method of containing the research.

The addition and control of character dynamics (iii) represents an interesting and challenging line of enquiry for future research accompanied by technical issues concerning feedback and control. How might feedback be given so a performer knows when they successfully possess a character? How might the dynamic characteristics be implemented in the Unity engine?

The development of a character imbued with complex dynamics and feedback might also find application in the teaching of performance, dance or exercises such as Tai Chi.

6. ADDENDUM

On the 29th of July 2014, an evaluation exercise was carried out to determine whether a greater range of characters and two people being transformed at the same time might encourage improvisation. (Fig.5, below).

Figure 5: iMorphia projection with two characters

Although this was more of a systems test rather than an ethnographic study, early observations suggest that enabling two transformed performers to appear on stage at the same time does not result in immediate improvisation. Perhaps this is unsurprising, placing two performers on stage without a script for them to work with or a scenario designed to encourage improvisation would probably result in the same observation.

Conversation about why there was a lack of improvisation led to the suggestion that the addition of a third element for the performers to work with would encourage improvisation. The third element could take on a number of forms, the entry of a virtual character or perhaps a virtual object that the performers could pass to each other. We all felt that a game like scenario, the throwing of a virtual (or real) ball for instance would immediately encourage play and improvisation.

There is a wealth of techniques and games designed to encourage improvisation, examples can be found in Impro by Keith Johnstone [15] and the online resource Impro Encyclopedia [13]. These techniques could be used as a basis for creating improvisational interactive scenarios using the iMorphia platform and adapted to exploit the power of virtual scenography and the interactive gaming potential inherent in the Unity Games Engine.

In order to explore the potential of interactive improvisational scenarios and game like performances it is envisaged that the next stage of the research will investigate the addition of interactive objects able to respond to the virtual projected iMorphia characters.

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