ANIMA OBSCURA

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ABSTRACT

This technical paper presents the results of the past three years research and development work by an interdisciplinary team of artists, scholars, disability empowerment experts, engineers, computer scientists and medical doctors, working together to invent new cutting edge technologies for real people's needs. The group has called itself SPIRITlevel (see www.smartlabcentre.com) and has aimed to harness and share the power of technology when invented by and for people with unlimited imaginations despite physical limitations.

The project discussed is 'ANIMA OBSCURA': a showcase performance designed to demonstrate the empowering abilities of new technology in the performing arts, where bio-affective feedback systems and motion tracking technologies can be usefully (and invisibly) combined with live performance by disabled and able-bodied dancers, to allow every person to dance, move, and bring an augmented world to life. The showcase has broadcastable elements and scaleable format that makes it suitable for demonstration in hospital settings, rehabilitation units, art galleries, museums, and main stages. It can be utilised by individuals for personal therapy and healing, or used collaboratively in online game-playing between hospital beds or, in the 'mainstream', through webcast and broadcast formats.

ANIMA OBSCURA: THE SHOW, THE PROCESS

In late 2003, The SMARTlab team was awarded the coveted WSIS Award platform: an invitation to perform live at the Geneva World Summit of the Information Society in December 2004. In response to this award, Lizbeth Goodman wrote a show called ANIMA OBSCURA, and invited devised elements from the collaboration team of SPIRITlevel.

Anima Obscura was originally conceived in the broadest terms as a show, an interactive experience, and an experiment in community interaction. I dreamt up the project name in 2000, while working on the Virtual Interactive Puppetry Project and imagining new ways to play with screenic and live embodiment, movement, absence and presence. The idea evolved over a period of four years as the SMARTlab team of artists worked with engineers from many cultures, and debated the pros and cons of each new technology tool we created and tested together. Much of that process of development has already been documented. We focus in this paper on the history of the show and the linked technology showcase or 'tool kit' that has become known as ANIMA.

A TECHNICAL APPROACH TO ARTS AND SOCIAL INCLUSION

While it is perhaps unusual to share the story of a project in a technical paper, that is a necessary and inseparable element of this technical paper, which aims to describe not only a portable technology platform but also a methodology for working in art-science collaborations, and strategy for empowering communities with technologies built specially for people with distinctive stories to tell.

The SPIRITlevel team aims to reach through the screen, to bring stories to life and enable each citizen to engage in art, therapy, and daily life in the most vibrant and energising ways. But to achieve that large aim, we have to take many small steps. This paper therefore outlines the steps taken by artists working with engineers and with communities of people with disabilities around the world. The show we document here, 'Anima Obscura', was developed in an iterative process by four collaborating teams of artists and engineers working in tandem from London, Dublin, New York and Colorado; with four teams of performers contributing to three live and augmented performances to date, resulting in four process-based approaches to making and customising technologies on the fly, to suit the needs of the live moment of improvised performance in each culture. The technology tools that make up the platform are described below.

THE SHOWCASE-TECHNOLOGY PLATFORM

Anima Obscura' is a scaleable interactive performance showcase, customisable for restaging in any space with any technical set-up and any group of local performers (of any level of physical ability).

The show has been staged three times to date: in Geneva, Dublin and New York. The scaleable and portable performance system includes 3d avatars responding to colour, motion, breath and other inputs, so is equally accessible to people with disabilities and those with unlimited physical movement. It can be played with real-time full motion responsive screens, in lower-tech (PORT- or Performance Online in Real Time: a webcam activated low tech motion tracking system often used by SMARTlab-developed by Vesna Milanovic et al in collaboration with dancers, biologists, and motion tracking experts as part of the Extended Body Project-see Goodman, Kozel and Milton 2003a) or in the higher-tech version known as Symphony (created by Rob Burke, with Scott Eaton et al), and can integrate the projection of 'flying avatars' authored in Maya and other 3D modelling programs, which are then triggered by dancers or puppeteered. A robotic character (created by Brian Duffy et al) performs in the piece with the live dancers and can be programmed to run in low or high tech settings.

The Show

'Anima Obscura' presents a vibrant world of mad inventors and their rebellious creatures, vying for the power to control their own images in a rich 3d world. The story is also a fable for communication and miscommunication in a world of prejudice, where people are still expected to conform to agreed 'norms' of physical appearance and movement styles, and where over-expressive body language is often considered subversive or dangerous.

Presented by the SPIRITlevel team of performers, interaction designers and engineers, with equal representation by women and men of a wide range of physical abilities, body types and communication styles, this interactive show integrates live counterbalance movement and wheelchair dance with responsive screens, biosensor input systems and 3d graphic character interactions with music, morphing and more. . . The show demonstrates real world applications for the use of motion capture in dance and rehabilitation, using biometric data and cameras to capture and create energies and flows in the modified MindGames Symphony visualisation engine. These energies impact upon the virtual world, reaching through the screen to

reward human movement & touch.

Background

The performance showcase system Anima Obscura has drawn upon the work of three teams of researchers across the disciplines of electrical engineering and signal processing, robotics and animatronics, 3d visual systems and computer animation, performance theory and practice, dance and motion capture, and disability outreach/assistive technologies (for a full history of the project's development and account of related systems, performances and applications by this team see Goodman 2003 [1], Duffy, Goodman & Perlin 2003 [2], and Goodman 2002 [3]).

The four main technological advances integrated into the ANIMA showcase system are:

1) the creation and customisable triggering of the 3d characters

2) the integration of these characters into the bespoke Symphony Engine

3) augmented performance integration with the robotic character (Josephine the Robot)

4) ANIMA on the Omniglobe

TECHNOLOGY PART 1: 2D INTO 3D – THE CHARACTERS ON SCREEN

Bringing the avatars to life consisted of a two-step process. First, the 3-dimensional models were created in Maya, which determined the principal components of the avatars (the head, wings, legs, hands, etc.) Their modular construction, although initially static, was intended for further processing and functional integration into a dynamic and *living* whole. Two approaches were used in actually bringing them to life. The simulation approach, which relies on the human anthropomorphisation of the avatar, used a combination of mathematical functions to simulate behaviours such as walking or flying. This involved manually defining concepts such as flying through specifications of the positions and rotations of each individual body part during the activity (based on some dynamic attributes like time or speed of flapping). Often these were combinations of cyclic waves modulated with controlled noise. The parameterized models were then easily manipulated through an array of controllers (joysticks, sliders, sensors, keyboards, etc.). This essentially was the process of creating the illusions of reasonable behaviour.

The alternative method of breathing life into the avatars was based on the use of a motion capture system to record humans performing specific activities and using that to drive the avatar model. This created a much more realistic perceived behaviour of the avatar, however limited the possibility of parameterized control over the avatar at low levels. Thus was is no longer a puppet which required complete low-level control, but more like a living creature concerned only with high-level guidance (walk there, run here). Nonetheless, integration of motion capture data into a controllable and well blended combination of behaviors is non-trivial (as opposed to simple playback of the one independent recorded action) and quickly complicates beyond the tasks of basic locomotion.

Defining Controls and Controllers

With the design for all paradigm in mind, we intended to allow access to control over the avatars to as wide an audience as possible. Thus, the interface is completely flexible to use many possible input devices, and configure their mappings accordingly to suit the needs of each user. The input devices in most cases are intended to be standard off-the-shelf devices such as various joysticks, buttons, midi controllers, game pedals, and even simple microphones (for

example a simple modification in software turns a microphone into a simple breath sensor, 1 degree of freedom). Flexibility with input devices allowed for immediate inclusion of many users otherwise often excluded from the realm of computer-mediated performance, or even performance in the more traditional sense. Ease of configuration with controls and wide availability of potential alternatives for control quickly dismissed focus from the technology itself to the actual content at hand, allowing the participants to better immerse in the activity.

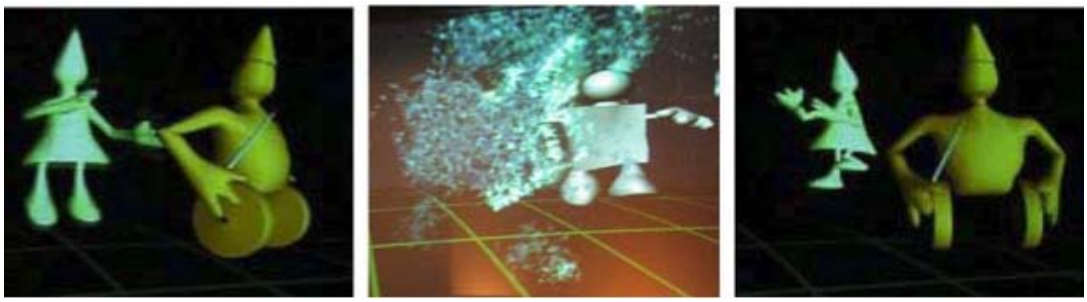

Figure 1: HOPE (left, in blue) and TRUST (right, in gold) now move in 3d in the Symphony Engine, and can be revealed and summoned through the screen by any number of simple movements made by disabled dancers in the ANIMA choreography. The characters were first sketched in 2d by Chris Bregler (NYU) and were then reworked in 2d and 3d iterations by a transciplinary team: Jeremi Sudol (NYU), Rufus Kahler, Armin Ruede, Jana Riedel and Taey Kim (SMARTlab) & Phil McDarby (MLE)

TECHNOLOGY PART 2: THE SYMPHONY ENGINE AND RESPONSIVE SCREENS

Symphony is a suite of tools that allows for the rapid design, prototyping and implementation of applications that interpret and visualize a variety of biological signals. Symphony seamlessly integrates a real-time signal processing framework, a 3D visualization package, and the foundation required to rapidly develop applications. An important component of Symphony is a real-time signal processing framework that has been used to process everything from live video to brainwaves. Other important components of Symphony are a networking layer that allows the signal processing components to dynamically allocate resources on a local area network; and support for compact devices [12].

These features have made Symphony an ideal platform for the development of a number of diverse applications, including “Still Life,” a project developed by the MindGames group in conjunction with physiotherapists at the Central Remedial Clinic in Dublin. The project uses a movement interface designed to creatively reward a participant for controlling their physical movements in a calm and relaxed way. It can be customized so that a patient is rewarded for practicing a movement over and over again and getting it correct, thereby turning previously monotonous exercises into an engaging interaction. The program is also able to track progress, so that a physiotherapist needn’t always be present to monitor improvement during daily exercises.

Still Life leapt from the world of physiotherapy into the performing arts in early September as part of the Féileacán project, a performance that had its debut at the closing ceremonies of the 2003 conference for the Association for the Advancement of Assistive Technology in Europe (AAATE).

The performers are supported by a variety of innovative technologies, including Still Life that facilitates new forms of expression. Still Life is presented on a wall-sized screen behind the performers, effectively turning that wall into a “magic mirror” in which the performers are

reflected. The program tracks their movements and responds in a variety of ways – for example, by causing dancers to glow, orbs to radiate energy, and elements of the new world to be revealed as though they were being painted by the movement of the performers.

In December of 2003, the Féileacán team re-united for a performance at the United Nations in Geneva, for the World Summit on the Information Society. The performance, called Anima Obscura, dealt with themes of control, and the interplay between the real and virtual worlds. The entire interactive component of the show's tech was provided by Still Life.

Figure 2: Live and animated dance with the SYMPHONY engine by Rob Burke et al. Audrey Murphy dances from the wheelchair as Trust, Lizbeth Goodman as the Transformatives, and Jen Fleenor as Hope, in the Geneva and Dublin shows mixed on screen (co-directed by Goodman an Cathy O'Kennedy, choreographer for FluxusDance).

For Anima Obscura (v1.0) we added several new features to Still Life, including the ability for 3D characters in the magic mirror to interact with elements of the real world. As one example, dozens of butterflies can now chase around the motion glitter and land on the performers when they stand still.

TECHNOLOGY PART 3: AUGMENTED PERFORMANCE INTEGRATION WITH THE ROBOTIC CHARACTER – JOSEPHINE THE ROBOT

There is the age-old paradox of technologists predicting bleak futures for mankind because of their research directions but nevertheless hurtling full steam ahead in pursuing them. Strong humanoid research could be one such example. The holy grail of robotics and artificial intelligence research is regularly perceived as aiming to understand mankind by artificially creating a similar degree of functionality and form. But why build an artificial human?

Man and machine have been merging for a considerable time. As early as the mid 1700s, Vaucanson's flute and tabor players provided mechanically driven functionality to human-like forms. Wolfgang von Kempelen's chess player, the "Turk", famously illustrated the power of perceived intelligence in machines through people's willingness to accept what effectively was an illusion (see Wood, 2002 [4] for a discussion). But why build a humanoid robot? What if we freed the machine of the chains of mankind? What capabilities would it, should it have? It is easy to follow the thesis that given higher resolution in robot function and form, current humanoid projects such as Honda's Asimo [5] and Sony's SDR-4X [6] would incorporate such facial functionality as achieved through silicon skinned robot heads. Fine-tuning the animatronics, the sensor modalities, the actuators and the aesthetics could all ultimately lead to the "replicant" problem. But, the question should never be "is it a man or a machine?" This perspective often forgets the constraints of the function. If it performed beyond our capability set, there could be a serious issue of Masahiro Mori's Uncanny Valley [7] in its public acceptance. An artificial "person" with a lens zooming out their eyeball would be simply freaky and break the artificial human paradigm. If the robot is perceived as being human, then effectively it should be human and not a robot in form and function. But, if one succeeded and

could build a perfect robot reproduction of man or woman, what would it do? It could in fact only do what we can do, no more, and no less. The addition (or subtraction) of any attribute not pertaining to our human form and function results in a deviation from the original holy grail. Consequently, such a robot could "only" replace us and the fear of robots taking over the world becomes real.

Figure 3: Media Lab Europe's "JoeRobot" in 'her' first transformation to Josephine, in the Flutterfugue performance with SmartLab and NYU CATLab: London, July 2002 (Photo courtesy of Brent Jones)

Figure 4: Josie with Jen Fleenor as HOPE, performing live at Media Lab Europe Feb. 2004 (in front of a projection of Jorgen Calleson and Lizbeth Goodman with Josie in the Flutterfugueperformance of 2002)

There is little doubt regarding the power of anthropomorphism in design as researched by the Anthropos Project at Media Lab Europe. As our interaction with robots becomes inevitable, our need to facilitate this interaction comes to the fore. Judicious anthropomorphism is the key to facilitating social interaction while maintaining those useful features that are fundamentally mechanistic. However, when machines can be such valuable tools, why would we want a robot to be anything other than a tool? From a technological standpoint, can building a mechanistic digital synthetic version of man be anything less than a cheat when man is not mechanistic, digital nor synthetic? The optimal solution is a balance between function and form. It's a case of delving into the design pool and only using those features that constructively contributes to the solution. A robot being a machine is its advantage, not a flaw to be hidden. In order to design such a sophisticated robot, it is

arguable whether the roboticist needs to have a design that is necessarily as complex as its perceived behaviour. If played right, the social capabilities and sophistication (and therefore perceived intelligence) of the social robot can be achieved through an illusion. It is open to debate whether a system can maintain such an illusion of intelligence developed through social interaction. The panel of NIST's 2000 Performance Metrics Workshop agreed that "social behaviour is fundamental: it compensates for the lack of perfection of the individual intelligent system". Exploring the mechanisms underlying our tendencies to anthropomorphise could provide key insights into the development of the "illusion of life" and the "illusion of intelligence" through projective intelligence in embodied robotic systems. If a robot looks and acts "intelligently", then the particular computational mechanisms underlying the realisation of that behaviour are arbitrary. The real issue arises in how to maintain such an illusion over time. Does this inherently require that the robot be "intelligent" at a more fundamental level? Do we need to go beyond "pageantry" towards the "truth" if the result is the same? Can pageantry intelligence endure over time? Social robotics provides a powerful framework to finally build a system that will pass the Turing Test [8]. While anthropomorphism is clearly a very complex notion, it intuitively provides us with very powerful physical and social features that are being implemented to a greater extent in social robotics research.

The social robot is the next important stage in robotics and will fuel controversy over existing approaches to realising artificial intelligence and artificial consciousness. Invariably, researchers will not be happy building anything less than a fully functional humanoid robot. It's just not in their nature.

The robot, Josephine, embodied these fundamental tenets in the Anima Obscura performance through the tangible creation of an animatronic character. It was the audience who created and maintained the powerful illusion that the machine became alive and displayed powerful emotions.

TECHNOLOGY PART 4: ANIMA IN THE ONMIGLOBE

The latest production of Anima Obscura v 3.0 was remixed and scaled for installation on the OmniGlobe system.

In the words of Tom Ligon, creator of the OmniGlobe (a President of ARC Science Simulations, working with Jon Lang - Content production manager):

> *The OmniGlobe is a large (60") spherical internally projected screen with a highintensity digital projector housed in its supporting base. Basically a "spherical monitor," the OmniGlobe can be used as an interactive display for presenting global data in its natural format, or any content that lends itself to presentation on a big ball.*

The OmniGlobe offers, in practice, a spherical computer screen, ideal for telling stories 'in the round'. The A.I.R. Gallery show Daria Dorosh: Plays Well with Others of 2004 showed a new version of the Anima Story on the globe, and also included split screen projection of the live dance and responsive screen feedback from earlier versions, with improvised live dance on site with an integrated olfactory sculpture made by Gayil Nalls.

Figure 5: The OmniGlobe installation at A.I.R. Gallery playing animation by artist Camille Utterback

Figure 6: Artist and curator of Plays Well with Others installation, Daria Dorosh (FIT) & artist Galen Brandt move the world that is the globe

Figure 7: ANIMA plays on the Globe: the performance is divided into character sets, each character's story being told from one side panel, with the avatars and morphing creatures swirling around the top of the sphere

SUMMARY AND NEXT STEPS

We plan to include a range of extended bio-affective feedback triggers to empower disabled dancers to control their avatars in future iterations of the showcase system. James Condron at Media Lab has devised an Accelerometer System which was tested but not yet stable enough to trial off site in live performance. Brian Duffy has created a responsive chair which will allow future dancers with cerebral palsy to interact with and control 3d versions of the screenic showcase in response to their own involuntary movements. The SMARTlab and Media Lab teams are currently planning the next stagings of the showcase and a number of bespoke screen systems for installation in hospitals, rehabilitation centres, science museums and theatres.

In summary, it is important to re-iterate the strengths of a flexible and portable showcase system for integrated live and media performance by and for people of different abilities: with each iterative software and hardware development of this project, we also layered versions of video and animation from previous shows, and the characters as well as the archive of images and sounds has grown and enriched the interpretative, creative layers of the system in this process.

We work with communities with real social needs and with real, time-based physical issues to grapple with. For instance, the photos below show Homer Avila dancing the Conductor, using his one leg and a crutch to create a haunting visual parallel to the unique arm and conductor's baton used by Bobby Byrne in the same role, in previous versions of the show. Lizbeth Goodman dances the Puppet creature. In this, the opening scene, Avila and Goodman do a duet on the floor to mirror the circular motions of the 'Touch Duet for Arms, Legs and Wheels' as choreographed in the screenic presence of the Hope and Trust avatars dancing and rolling on the wall projections. The layering of two sets of performers (Byrne, Fleenor, Goodman & Murphy in versions 1 and 2; and Avila, Dib, Goodman, and Smith in version 3) created a sense of multiple presence, especially as a number of simple props (the wand, the golden scarf, the marionettes) seem to move through the screen and into the physical space inhabited and literally touched by the audience.

When a live performance of one of our augmented dance shows is over, the audience often describes feeling 'haunted' or 'ghosted' by the presence of the characters' stories following them into the 'real world' beyond the theatre space. This is particularly true of the story of ANIMA, which is a story about stories and their power to shape self-identify: a scenario of nonverbal communication and body language impacting on each audience member in an emotionally resonant way, as these themes tend to appeal differently but equally deeply to international audiences of a wide range of ages, cultural identities, languages, generations and physical abilities.

In future iterations of the ANIMA show, and in new shows to use some of the same technical systems and performance methods, we (SMARTlab and the SPIRITlevel consortium) intend to build new versions of the portable ANIMA system, to enhance functionality for low-bandwidth low tech use on the PORT (webcam-based simple tracking system) and on higher specification version of Symphony yet to be developed, with animation controls to extend beyond our current puppeteering and breath control interfaces to include sip'n'puff, accelerometer and other haptic triggers and interfaces as well. Dr Marc Price of BBC R&D has also been working with us to develop an interactive game engine to play the ANIMA content in the Virtual TV Lounge (this collaboration to be featured in the Omniglobe presentation of SPIRITlevel contents at the Siggraph Art Gallery, L.A. August 2004 (see: http://www.dariadorosh.com/siggraph).

In all this work, we aim to work with communities around the world to record, tell and retell their stories, in words and movement and music, in their own formats, in their own time, using whatever interfaces are most comfortable, appropriate and empowering for them. And we aim to record this work in a growing archive of stories, to be shared and replayed, and to stand

tribute in lasting form to the many talented and generous spirits who have contribute to making of ANIMA in all its forms.

Figure 8: Home Avila dances the Conductor in New York, April 2004, with a mix of the first two performances projected behind him, and with live input from the company

REFERENCES

[1] Goodman, L. 'SPIRITLEVEL: Making & Using 'SMART' tools integrating intelligent systems & performance technologies to connect and empower creative spirits in shared and distant spaces', in Assistive Technology: Shaping the Future, eds G. Craddock et (Amsterdam, IOS Press, 2003), pp. 89-97.

[2] Duffy, B., Goodman, L. and Perlin, K et al. 'The Butterfly Project: Expressive Animations for Performance and Assistive Technologies', in Animating Expressive Characters, eds. R. Aylett et al., (Shefifeld, U. of Sheffield Press, 2003).

ALSO see Goodman with Kozel and Milton, 'The SMARTshell: Connecting Performance Practice to Tools for Connected Learning' (on creation of the Extended Body Telematic Performance Methodology Toolkit', in A Guide to Good Practice in Collaborative Working Methods and New Media Tools Creation (by and for artists and the cultural sector), eds. Goodman and Milton. Online 2003/Oxford; Oxbow Press, 2004.

[3] Goodman, L. 'Virtual Interactive Puppetry', in Leonardo, (MIT Press), Autumn 2001. [4] Wood, G., (2002). Living Dolls: A Magical History of the Quest for Mechanical Life, Faber & Faber. [5] Honda Corporation ASIMO Website: http://www.honda.co.jp/ASIMO [6] Sony Corporation SDR4X Website: http://www.sony.com.au/aibo/ [7] Mori, M., (1997) The Buddha in the Robot. Charles E. Tuttle Co. [8] Turing, A. M. (1950). "Computing machinery and intelligence", Mind Vol.59, pp433-460 [9] SMARTlab Centre website: www.smartlabcentre.com (see clips of Anima in performances v 1, 2, 3 and AIR gallery remix on the site

[10] Details at the TRUST Project website: www.give-trust.org *SMARTlab wishes to credit LEGO Europe, the University of the Arts London, the MindGames Group at Media Lab Europe and Dr Gary McDarby, the Gulbenkian Trust, the Children's Health Fund (NY) and JP Morgan for support of the project to date. Information on how to bring the project to new sites can be found on the SMARTlab and TRUST project websites as above.

[11] http://www.dariadorosh.com/siggraph

[12] Media Lab Europe web site (Still Life pages): More information about Symphony and Still Life is available at http://www.mle.ie/~rob

* This paper is dedicated to the memory of Homer Avila, who danced the character of the Conductor in the New York Performance, only weeks before he died of cancer, aged 48. His role in the continuing showcase platform will help us to commemorate his work and inspire new audiences and communities to take part in future shows.