Three decades, three examples: creative interdisciplinary research

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Abstract

This paper will present three examples of creative interdisciplinary research the artist has been involved in. The projects discussed cover a period of 25 years, demonstrating how the character of such interdisciplinary practice and research has evolved. The presentation will be supported by software, digital video and still image documentation.

The first example presents research undertaken at the Commonwealth Scientific and Industrial Research Organisation (Sydney, Australia). This research engaged state of the art (in 1984) remote computer vision systems and sought to develop a working prototype visual sensing system for application in interactive installations and environments. This work involved physicists and computer science researchers and outcomes included interactive installations and a series of large scale computer generated images.

The second example evidences collaborative research undertaken by the artist whilst AHRC Fellow at the University of Cambridge (2002-2004). This involved working with a core team of researchers composed of a physicist, chemist, informatician and anthropologist. The research sought to explore potential applications for novel memory materials in the human environment. Materials were researched and a novel prototype assembly developed that demonstrated the potential for application in architectural and similar environments. Outcomes included a prototype assembly, journal articles, a book and interactive installations.

The third example presents current collaborative research by the artist with colleagues at the University of Edinburgh and Edinburgh College of Art. Collaborators include researchers and practitioners from the computer sciences, biomechanics, architecture, geography and the creative arts (visual art, performance, music and dance). A recently completed research laboratory intensive, inquiring into how inter-actors are affected by and effect various interactive and biomechanical sensing systems, will be presented and discussed.

A key insight drawn from these three distinct but connected examples of interdisciplinary research notes how work across disciplines and between specialists can lead to unexpected outcomes and how these can iteratively inform the development of the researcher's and practitioner's work in their respective disciplines.

There is this idea that creativity is the domain and function of the individual artist. We are brought up to hold in esteem the evidence of individual 'creative genius', as expressed in artefacts, music, dance or a bridge, spaceship or meal. However, how many of these things are actually produced by a single person – and when a single author can be identified is it possible to consider the creative processes employed in the production of the work in isolation to the efforts of others. As Newton famously stated, "If I have seen a little further it is by standing on the shoulders of Giants". The point here is that Newton's perceived genius was more a product of the work of others than of his own capacity. Newton recognised that creativity is not something that emerges as a pure ideal from some secret font within the mind of the individual but, rather, that it is a process of exchange. Not a thing but an activity, an activity that exists in the social realm.

I am going to argue that creativity is not a property or capacity of the individual person, somehow related to the intelligence, personal experience or dementia of a single human being. I propose that creativity is a process of exchange, a sort of social plasma that binds us to one another. Creativity is not a state of mind but a state of society – or perhaps we can conflate these concepts and propose the mind as an instance or individuated phenomena that is actually simply a facet of a more complex organism – society. I am entertaining the idea that societies cannot exist without creativity. That creativity is the 'stuff' of which communities are made.

Creative communities can be regarded as microcosms of larger communities. One type of community, the communities of artists, develop as cultural paradigms crystallise or dissipate. Such creative communities have historically tended to be international and yet reflective of cultural specificity, acting as a lens through which social change can be observed. Such communities exist as both local and global phenomena, in 'creative cities' and 'global networks', and appear to draw value from this conjunction of opposites. An important insight is that whilst creativity is often perceived as the product of the individual artist, or creative ensemble, it can also be considered an emergent phenomenon of communities, driving change and facilitating individual or ensemble creativity. The key understanding here is that creativity can be a performative activity (Latour 2005) released when engaged through and by a community.

The model of the solitary artist, producing artefacts that embody creativity, is contested as the ideal method to achieve creative outcomes. I propose creativity as an activity of exchange that enables (creates) people and communities (Leach 2003). Understanding creativity as emergent from and innate to the interactions of people facilitates a non-instrumentalist analysis. Creativity is not valued as arising from a perceived need, a solution or product, nor from a supply-side "blue skies" ideal, but as an emergent property of communities. Marika Luders (Luders 2009) observes creativity 'is now commonly understood as part of what constitutes human beings. Moreover, creativity is not necessarily (or even ever) an isolated phenomenon'. Rob Pope (Pope 2005) states 'being creative is, at least potentially, the natural and normal state of anyone healthy in a sane and stimulating community … realising that potential is as much a matter of collaboration and 'co-creation' as of splendid or miserable isolation'. All communities are thus potentially creative.

We can ask what "creativity" is, situating it as an activity defined by and defining of communities, seeking to transcend the debate on the instrumentality of creativity and knowledge, situating innovation as an ontological factor in the formation of communities, nationally and transnationally.

How can we seek a less reductive understanding of creativity, deconstructing established perceptions of these activities and developing a more nuanced understanding of creativity and its value? How does creativity inform the formation of communities? How do such communities form?

Can we explore these questions by approaching creative practice within an expanded field of what can constitute practice, working across disciplines and their conceptions of what represents creativity and novelty? Here I will reflect on a number of collaborative projects I have been involved in over the years, observing how they can be perceived and understood as examples (good or bad) of creativity in social action.

I will present three examples of creative interdisciplinary research that I have been involved in. The projects discussed cover a period of 25 years and may demonstrate how the character of such interdisciplinary practice and research has evolved. I will present documentation, including software, digital video and still image documentation.

The three examples I have chosen are research undertaken at the Commonwealth Scientific and Industrial Research Organisation (1984, Sydney, Australia), collaborative research undertaken whilst AHRC Fellow at the University of Cambridge (2002-2004) and current collaborative research with colleagues at the University of Edinburgh and Edinburgh College of Art.

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In 1984 I curated the Adelaide Festival’s/Artists’ Week exhibition ‘Interface: A Survey of Art and Technology’ with Claudio Pompili (responsible for the music and live arts programme) and assisted by Francesca Da Rimini. This exhibition was the first such event in Australia, seeking to present a wide range of artists’ practices employing or addressing new technologies. The exhibition also included the work of significant international artists, such as Alvin Lucier and Felix Hess. I suspect that for many younger Australian artists this was their first opportunity to see such a range of works. Certainly, this was the case for me. Through curating this event I was able to deepen my nascent knowledge of technological arts practices in Australia and internationally and this had a significant effect on my work, allowing me to broaden my awareness of the context within which I was working.

Immediately after Interface was over, in June 1984, I took up an Artists Fellowship at the Commonwealth Scientific and Industrial Research Organisation’s National Measurement Laboratory in Sydney’s northern suburbs. It was a quite a culture shock to go from the buzzy artistic intensity of an international arts festival to a quiet and very serious scientific research institute on the fringes of sprawling suburbs. However, after a short period of adjustment I was able to orient myself in this alien environment. I can’t say I ever felt comfortable there. I knew that I looked different, behaved differently to most of the scientists, technicians and support staff that worked at the NML. There I was, the rather dishevelled artist with long and typically un-kept hair and beard. There they were, in their suits, lab coats and horn rimmed glasses. However, once wearing a lab coat myself I could half pretend I fitted in. Certainly, I was made welcome, if approached with caution by some. Nevertheless, there were many who were more than welcoming and actively engaged in discussions regarding ideas and experiments I had to mind.

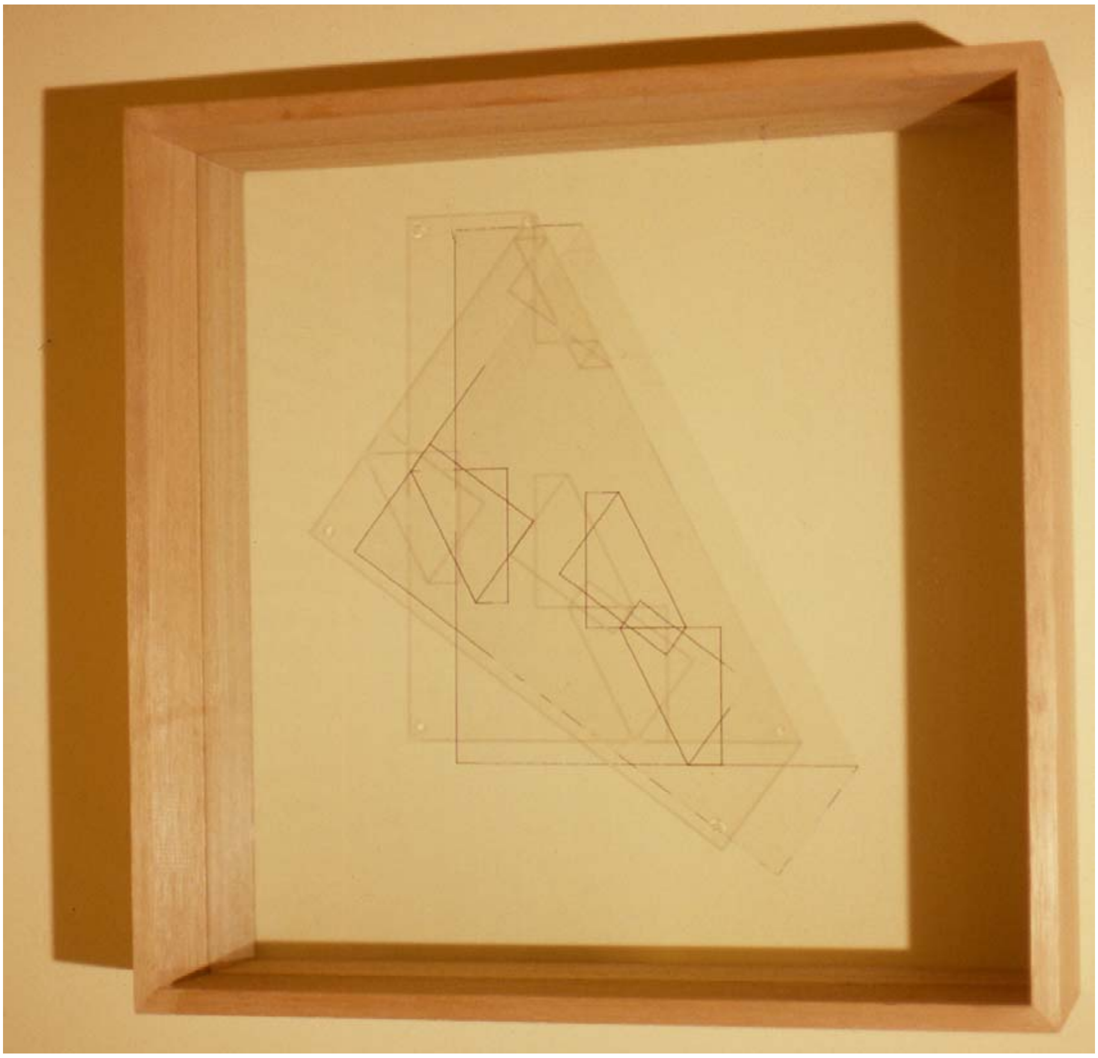


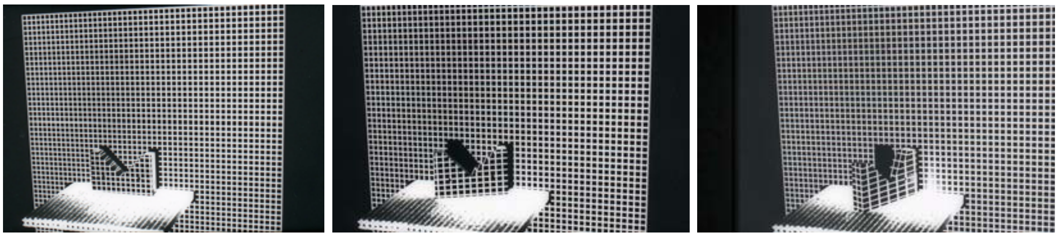
Diagram 5, ink on folded acetate sheet, glass sheets, wood, 1984

Whilst settling into this new environment I undertook some initial experiments with using a very large scale flat-bed pen plotter. This system, built around a DEC PDP11 computer, allowed large images to be plotted on a variety of materials employing a wide range of inscribing tools. I produced two series of works using this system. The first was a series of fine ink plots called 'Diagrams'. Just prior to departing Adelaide I had been producing some works that involved designing objects that could be made by folding their diagrammatic instructions into various forms, a little like origami. In the CSIRO 'Diagrams' series I produced a series of object diagrams designed to be folded into flat shapes. These designs were plotted onto transparent sheets of acetate which were folded accordingly and mounted between sheets of glass, presented as wall sculptures where the lighting caused the diagrams on the folded surfaces to cast their shadows on the wall behind, creating geometric shapes and patterns derived from the original diagrammatic inscriptions. These works were not experimental as they simply transferred an idea and technique I had already developed into a new medial context. Nevertheless, it was an opportunity to gain knowledge of the systems I was working with and gain familiarity with the people and working conditions I found myself in.

My initial plans when coming to the CSIRO had been to research and develop remote visual sensing systems for application in interactive installations. The principle idea was to use video cameras to track people in a defined installation space and to use the acquired data to control computer generated elements in the artwork. To begin with, working at the CSIRO, I was quite unclear as to how I might go about doing this. After talking to various scientists it became clear that the person to talk to was research scientist Dr. Zoltan Hegedus. He had been undertaking research, supported by the Australian National Railways, developing automated systems to monitor wear and tear of railway tracks. His solution was to use structured light and a camera. A small unit was fitted, to the carriage of a train, that projected a band of light onto the rail track. A camera was mounted at an angle such that when it photographed the rail its contour would be very clearly revealed by the band of light. The library of images would then be post-processed by a computer employing shape recognition software developed by Hegedus.

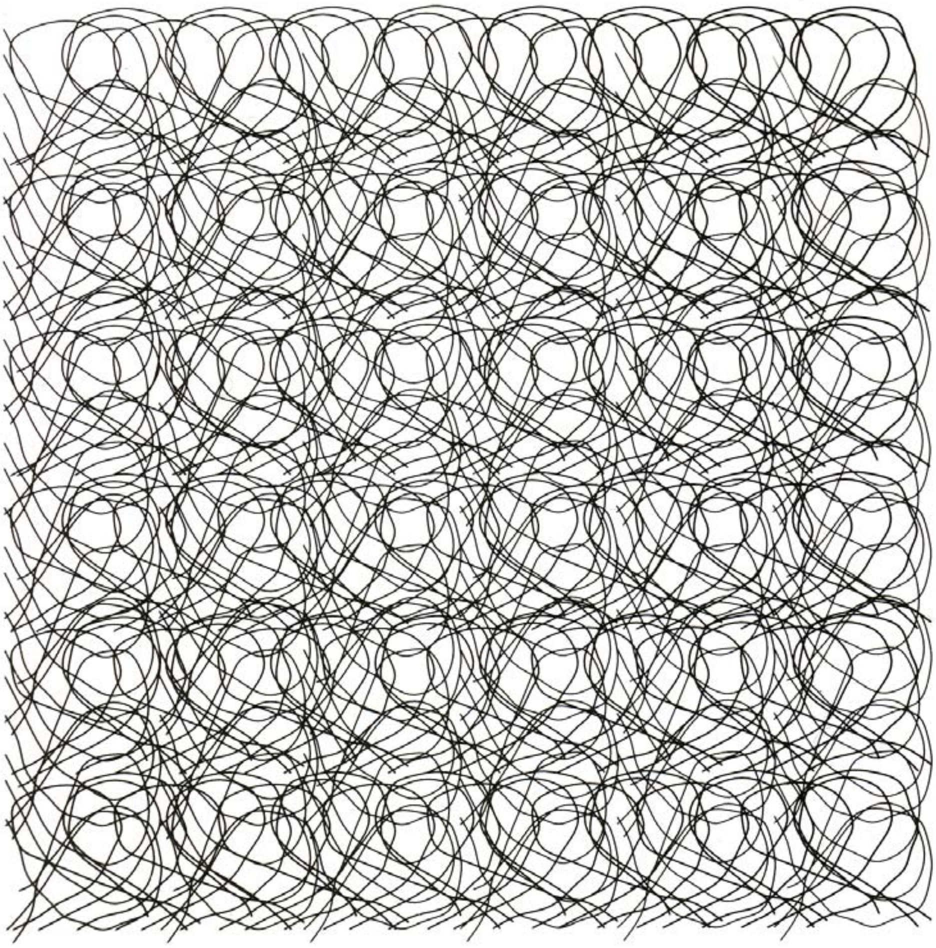
Taking this principle as a start, and after reading numerous scientific articles that Zoltan had referred me to, I decided to use structured light in my own experiments. Perhaps typically, for an artist, or perhaps just exhibiting youthful arrogance, I immediately jumped in the deep end, designing and producing a 50 by 50 grid of lines rendered onto Kodalithographic transparency. This was then mounted in a precision projector and the light oriented onto a variety of objects in a very dark laboratory. The objective was, by employing a mesh of structured light, to produce a replica in real space of the sort of 3D wire-frame graphics that at the time typified commercial computer graphics. I had the half-baked idea that if I could make real objects look like they had been rendered by a computer then a computer equipped with vision capability would be able to acquire some sort of meaningful data from such objects. Not being scientifically trained it did not occur to me to plan my experiment. I had no question or objectives, no defined methods as to how I would realise my ideas nor a description of a likely outcome. If I was to apply for funding from any of the relevant funding councils today, such as the Arts and Humanities Research Council, the application would have been rejected at the very first stage, even before it could get to peer review, as not being a piece of recognisable research.

But this is what I did. I designed and installed a rig consisting of the projector and structured light, a reference background plane and small table in front of that on which I could place three dimensional objects to be illuminated. I scrounged a couple of computers from other researchers consisting of a Hewlett Packard mini computer and an Apple IIe desktop micro-computer. I managed to get hold of a black and white analogue surveillance camera, which I pointed at the scene I had created, and the necessary cables, and connected everything up. The Apple IIe was hardly the thing a scientist dreams of when they are contemplating the sort of computer power they need to crack whichever nut they are seeking to crack. However, in 1984 it had an almost novel capability, which was that you could plug a camera into it and get video on your computer screen. Due to the video being routed through the computer's memory it was also possible to write software that could monitor the signal, process the image and output it in other forms. Knowing that the Apple would be far too slow to achieve anything approaching real-time 25 frame per second analysis of a video signal I hooked up the HP mini-computer and wrote and ran the analysis software on that platform. After some months of coding and experimenting I managed to get the system working; not to the ambitious levels I had originally hoped but to a point where the system could determine where in space an object was, how far away it was, whether it was moving and, if so, in which direction and how fast, and to gain a degree of data about the volume of the object. What the system output was reams of numbers which, as I developed it, became graphs that could more readily be employed for evaluating system performance. Over the next couple of months I produced a large volume of such documentation, knowing that whilst it was clear I was not going to create a fully functional system during the period of the residency I would be able to do so within a reasonable time span within my own studio environment, so long as I was suitably equipped with such data.



Documentation of a 3D object against reference plane illuminated with structured light, 1984

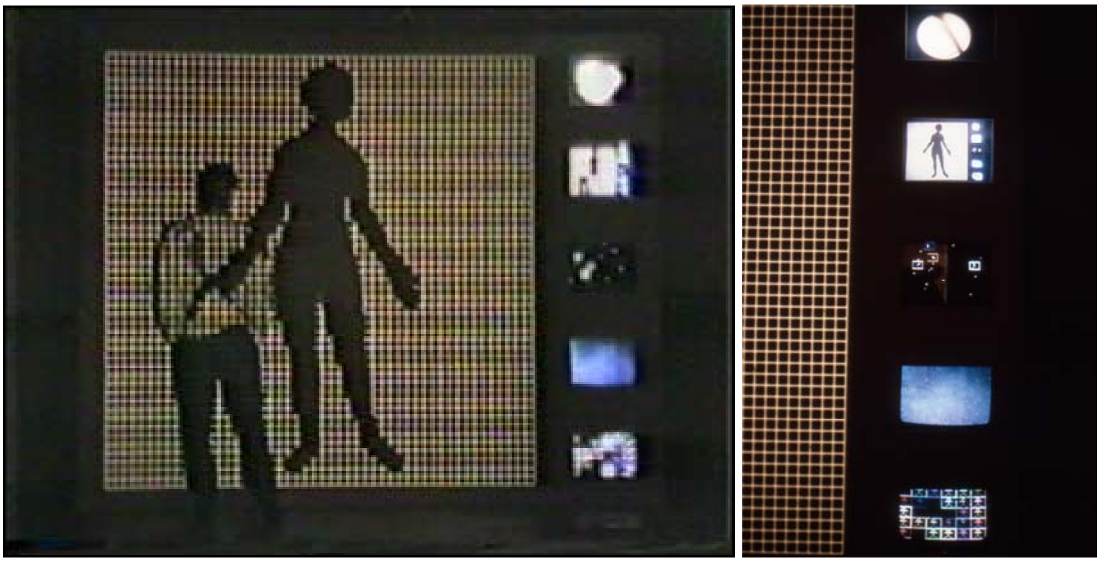
At the end of the residency I found that my outcomes consisted of a series of wall mounted drawing-sculptures and a substantial pile of paperwork documenting the software experiments I had undertaken. Whilst I recognised that the documentation was significant in terms of medium to longer term work it did seem rather a small quantity of physical artwork. I decided to employ aspects of what I had learned in developing the sensing experiments to produce a second series of larger ink pen plots, using large permanent markers and heavy grade 300 GSM Fabiano artists' paper. Neither of these media were meant to be used with the large-bed plotter and this minor subversion of materials and tools involved a lack of caution. To produce the drawings I used the vision system I had developed to create a series of b-spline curves, having the system track my hand as I mimicked the sort of hand movements I intuitively associated with abstract expressionist and Tachist artists expressive painting styles. This numerical data was then manually input into the PDP11 and a series of images were plotted employing it. The principle idea was to take the movement of the artists hand, Clement Greenberg's concept of the 'artist's mark' as the identifier of originality and value, and to replicate it in a machine-like manner, seeking to subvert how value might be perceived in the final artefact. A number of quite large images were thus produced and I was able to leave the CSIRO feeling that it had been a productive few months.



Computer Graphic produced at CSIRO, 1984. 180 x 180 cms. Ink on paper

I also left with a couple of lessons. The first was that to arrange and manage successful collaborations required substantial planning and negotiation with those you are intending to collaborate with. For whatever reason this did not occur prior to this residency and it was only through the generosity, tolerance and patience of a few individuals that I was able to make any progress at all. In a word. I was lucky. However, I knew I wouldn't always be that lucky and resolved to be more organised if ever such an opportunity arose again. Secondly, I understood that what I had done did not in any manner at all challenge the conventions of artistic practice. Yes, I had produced some artworks that visibly parodied what were then perceived as conventional artistic value, such as that of the artist's signature style with pen or brush. However, in my working processes I had remained very conventional, replicating the working patterns familiar from the artist's studio. I knew I had missed an opportunity to do things differently, although I had gained insight into how things might otherwise be, as well as into my own limitations in acquiring new methods and paradigms, and comprehended that these issues would be more pressing as my work progressed.

The final outcome of the CSIRO residency was completely unexpected. This was an artwork titled 'Torso', exhibited at Roslyn Oxley's Sydney gallery in 1985. This consisted of five video monitors, two video players, one computer, two video cameras, a slide projector and a large screen assembled in a dark gallery space. A modified version of the 50 by 50 Kodalithographic transparency was projected onto the screen, with the shadow of a larger than life-size figure in it. Each monitor displayed a different image; one a video recording from inside the body, another a recording of a computer generated animation, two others displaying each of the closed-circuit video signals and the last central monitor displaying a live computer generated animation produced by an ‘a-life’ program I had written. This program also had, as input, the signal from one of the video cameras which acquired data from the local environment. The presence and movement of viewers was used to generate data that would then ‘seed’ the ‘a-life’ elements in the program and thus indirectly effect the behaviour of the various graphical elements on the display. This was effectively my first interactive installation – very crude, particularly at the conceptual level, but the beginning of a practice I have pursued ever since. I had foreseen none of this a year before, when I arrived in Sydney to begin work in what was, for me, a rather foreboding alien environment.


Installation photographs of Torso, Roslyn Oxley Gallery 1985

During the period 2002-2004 I had the fantastic opportunity to be a half-time Research Fellow at the University of Cambridge, working between the Computing and Cavendish Physics Laboratories. How this period of research was engaged and managed was profoundly different to my experiences at the CSIRO.

Unlike the CSIRO, where I was more or less left alone to get on with my work, at Cambridge I had a mentor and research project director, Dr. Alan Blackwell from the Computing Laboratory, who worked closely with me through out the period. We also benefited from the embedded involvement of an anthropologist, Dr. James Leach, whose role was to monitor, document and analyse the process of research as well as feedback to the team in ways that would hopefully enhance the value of the work undertaken.

After an initial period of orientation, meeting with numerous researchers across various departments of the institution and visiting a number of laboratories and observing some very exciting research, it was determined that my work would focus on the research, development and application of a new family of ‘smart’ adaptive materials called Liquid Crystal Elastomers (LCE’s). These materials have some curious and unique properties.

> “These are polymer based materials which, like liquid crystal displays, have a molecular structure that changes when energy is applied. However, whereas an LCD changes its visual appearance when the molecules change shape (by

> polarising the light passing through the material), an LCE is able to change its shape by releasing the molecular bonds between stretched polymer chains. If embedded in a silicon sheet that has been stretched when it was cured, the sheet will contract in the stretch direction when those bonds are released. As with LCD's, the material returns to its original state when the stimulating energy is removed, so an LCE can exhibit repeated cycles of physical behavior." (Blackwell 2006).

Whilst there are a number of smart materials which have the capacity to remember their state and return to it under certain conditions (NiTinol is the best known example, a nickel titanium alloy, often used in the manufacture of spectacles, which after being bent can return to its original shape when heated) there are few, if any other, materials that have the capacity to switch back and forth between states and effectively be two-way switches. Our intention was to examine this material and develop the means by which we could use it to produce interactive objects and surfaces, our ultimate ambition being to construct room sized surfaces and spaces that would be highly reactive to activities within their space.

Over recent decades, since the work at the CSIRO, my artwork had settled on employing remote visual sensing systems allied with video projection to create large scale interactive environments. What excited me about LCE's was that they offered a means to create artworks where interaction would be more physical, far more immediate and less technologically mediated than visual remote sensing can permit, whilst also producing objects and spaces where the reaction to interaction was both physically more substantial than video projection can allow and where the processes of interaction were a function of the material itself, rather than, as with how sensing works in my work to date, the product of a mediating technology (the computer). Our ambition to create such an interactive environment was thus clearly directed towards developing the next generation technology that could provide the basis for my practice.

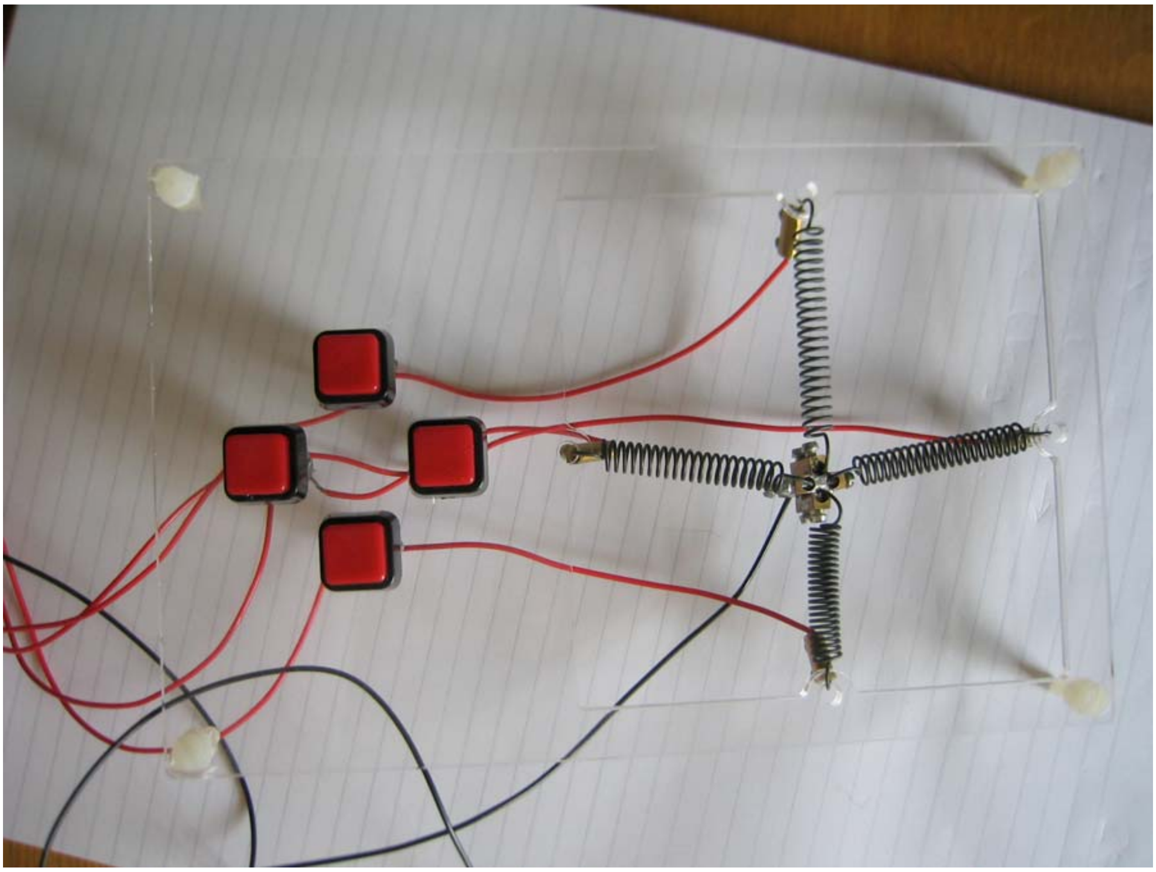
We spent a significant period of time, with numerous visits to Cambridge over a 12 month period, in the various laboratories within the Physics department. In particular we spent a substantial amount of time working in the 'wet-lab', a laboratory dedicated to undertaking chemistry experiments that were designed to test and evaluate theoretical work in physics with implications for materials at the atomic level.

The key scientist I worked with during this period was Dr. Eugene Terentjev, Reader in Physics. One of his research foci was the development of novel materials that can adopt unstable and bi-stable states. With him, Alan, James and the chemist Ali Tajbakhsh we produced and experimented with a range of variations of the LCE's that were reactive to different stimuli, such as heat, visible and infra-red light, electricity and physical stress (pressure). Our experiments also focused on developing varying LCE behaviours, so that the response of the material might be to change shape in a particular manner, or change colour, transparency or its refractive qualities. We also evaluated how the materials would behave when the envelopes of sensitivity and reaction were varied and the amount of material increased and decreased, in order that we had a wide enough sample of data that we could best determine what our prototype would be like and what it could do.

Working with Eugene Terentjev, Cambridge, 2003

During our experiments we had many successes but also a number of failures. One major problem we faced and, in the end were unable to surmount, was the intrinsic weakness of LCE's. Whilst they were surprisingly resilient in relation to a wide range of stimuli (heat, light, etc) they had little tensile strength. Also, due to their motile atomic nature, LCE's have very few affordances to bond with other materials, making it extremely difficult to adhere anything else to them. We experimented with a wide range of non-reactive fixatives and found that either they would not bond securely or, if they did, the LCE would then tear itself apart as it reacted to various stimuli. We thus sought to identify another material which would allow us to work with the LCE in a more constructive manner, potentially providing the tensile strength the LCE's fundamentally lacked. Collaborating with scientists at Cambridge's advanced engineering laboratory (Professor Sergio Pellegrino and Dr. Mathew Santer) led to us identifying NiTinol springs as the solution for this substrate material.

The prototype we produced was distinct to what had originally been envisaged. It had been my initial intention to produce a reactive surface that would interact with the presence of people. Costs ensured that the scale of that ambition was too great whilst the technological assembly of materials we had produced was less a surface and more an object – in fact, a slab of metal and polymer resembling the bio-assembly of bone and skin. We had effectively produced a slab of twitching cyborg 'meat', where an assembly of NiTinol springs (usually employed in robots) functioned like a network of muscles stretched over an acrylic skeleton, all this covered in a reactive skin of LCE. The NiTinol springs were stimulated by a small electric current, causing them to shrink and heat up. As the heat of the springs transferred to the LCE the 'skin' would buckle and change shape and, at the same time, shift from opaque to transparent. In doing this the NiTinol assembly beneath the skin was revealed, the cybernetic character of the assembly becoming apparent. As is so often the case with artistic experimentation we ended up in a place distinct from where we had set out to.


The 'Gameboy' like assembly of NiTinol springs, wiring, switches and acrylic chassis

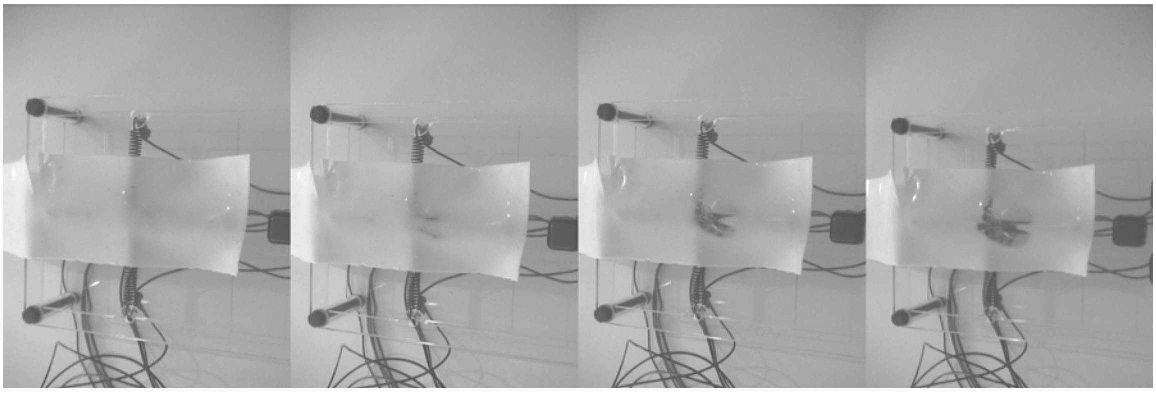
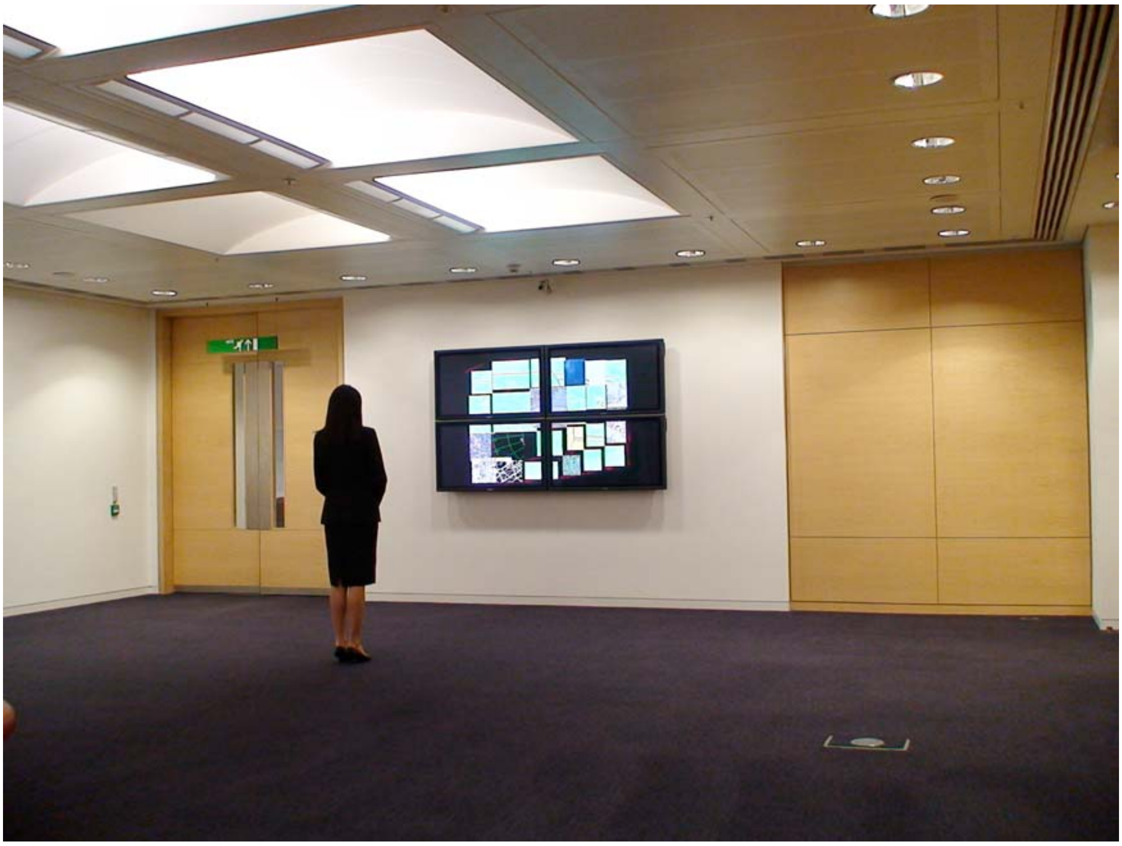
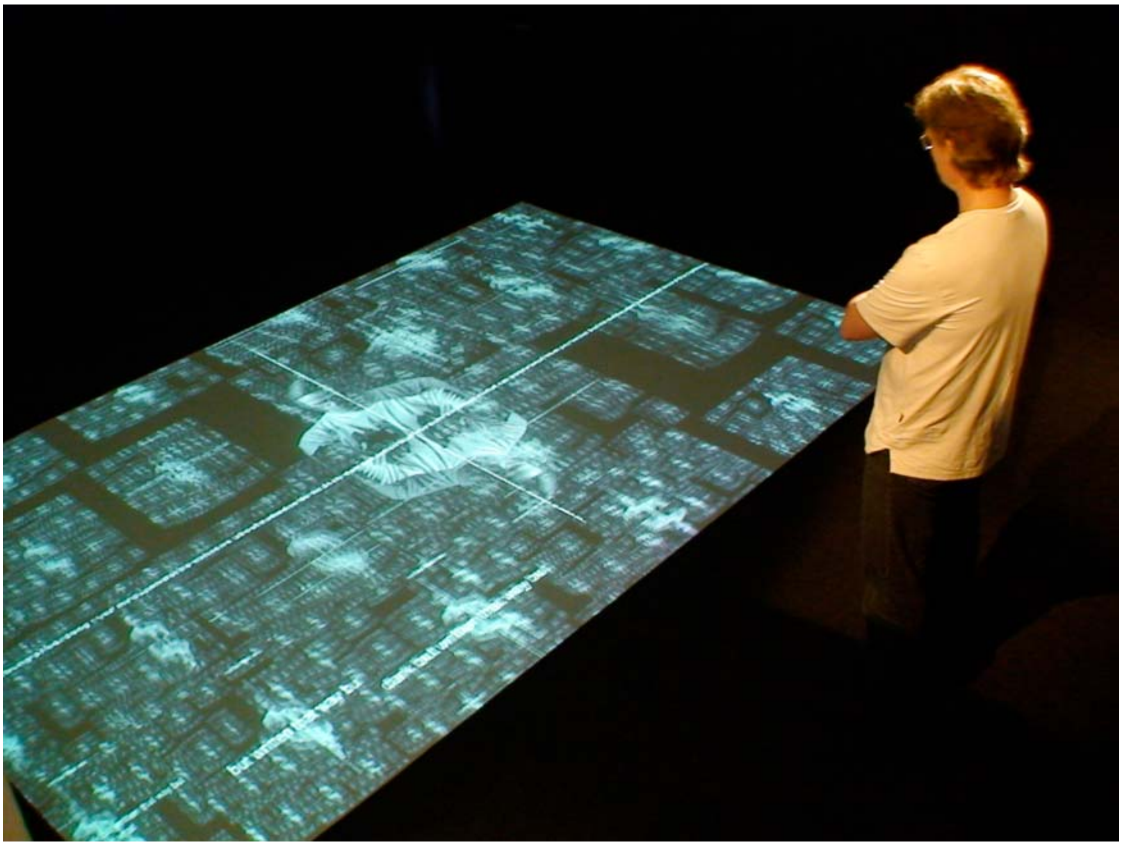


Image showing, left to right, the effect of electrical stimulation of NiTinol springs upon LCE

This period of research led to a number of completely unexpected and surprising outcomes, including a jointly authored book by myself and James Leach (Biggs 2005) and a number of interactive computer based artworks which utilised the mathematical analysis of the behaviour of the LCE material to determine the behaviour of computer generated visuals. Artworks such as IDfone, Metropolis, London Dig and reWrite represented a new departure in my practice, employing algorithms, developed during the Cambridge research, in their software. A more recent piece, Blowup, is also informed by how the control of interactive elements can be mathematically mediated. Blowup's software also served in part to underpin the development of the work undertaken and produced during the last example of collaborative 'research in practice' discussed here.

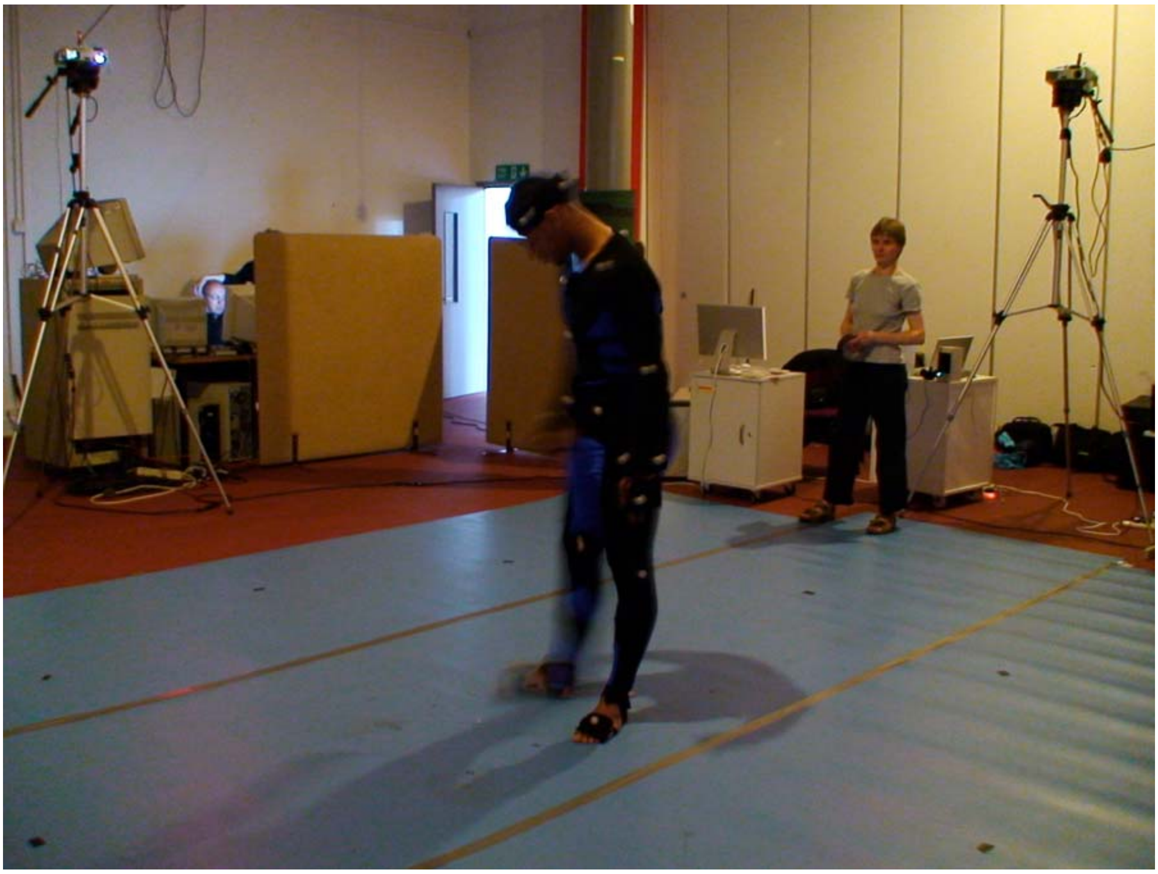


Documentation of London Dig installation, Allen & Overy LLB London Headquarters

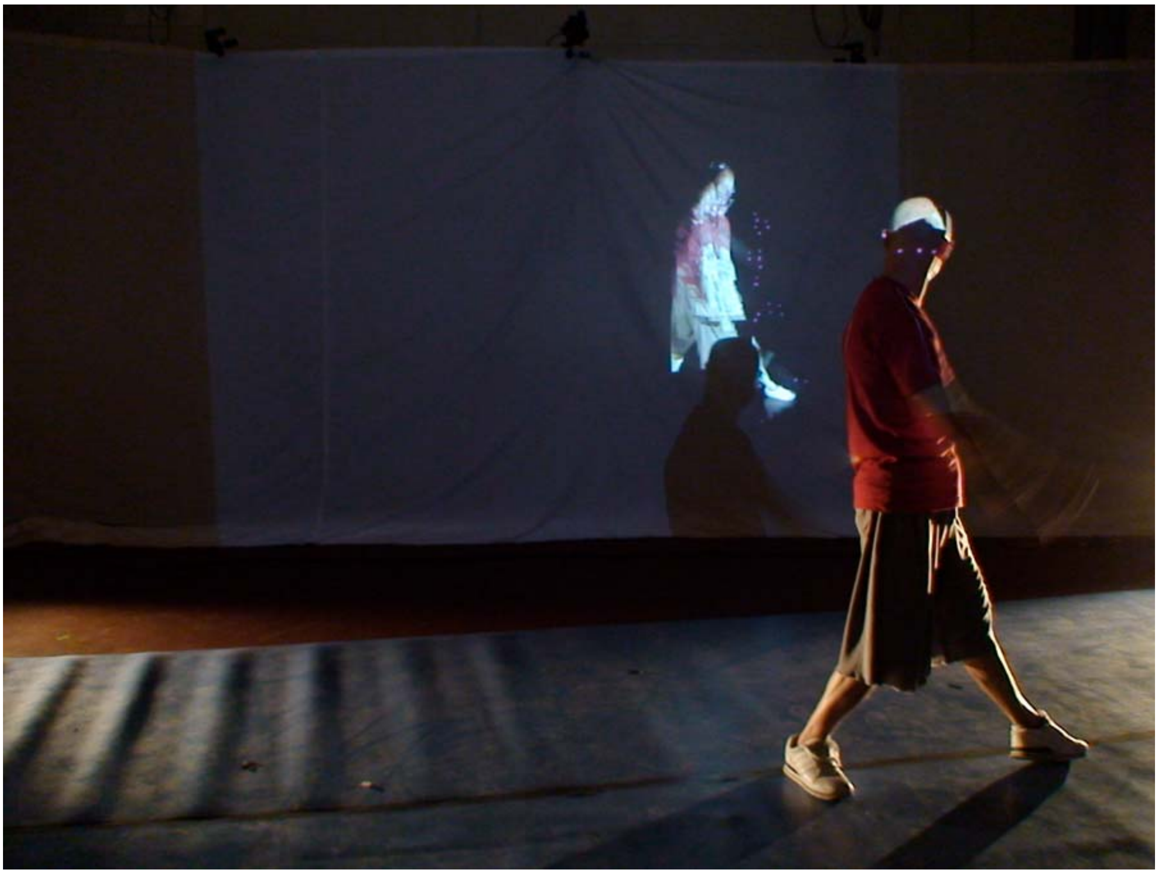

Documentation of reWrite, Museo OI, Rio De Janeiro 2007

Recently I have been involved in establishing a research group of practitioners and researchers, representing diverse subject areas, from Edinburgh College of Art and the University of Edinburgh. The group is called CIRCLE, an acronym for Creative Interdisciplinary Research into Collaborative Environments. Member's expertise covers the creative arts (visual, media, performing, music and architecture) and the physical and social sciences (informatics, geography, sociology, anthropology and biomechanics). Our focus is upon creative collaborative interdisciplinary research into interactive and mediating systems, such as surveillance technologies (CCTV, GPS, RFID, etc) and social media (Google Maps, Flickr, Second Life, etc). We are seeking to inquire into and unpack how these systems mediate our everyday lives and function to determine our collective and individual identities. Our expected outcomes include art works, scholarly outputs and public interventions.

In August 2008 we undertook our first significant collaborative research laboratory. This consisted of a two week intensive period. The first week involved rigging, experimenting with and tuning the systems we wished to work with (motion capture, visual tracking, auditory sensing and GPS tracking technologies were employed) with the objective being to use these diverse systems in various combinations. The second week involved the research team working with four professional dancers and a choreographer, exploring various questions concerning human interaction with technological systems and the manner in which such interaction can effect interactors.



Ira Siobhan and choreographer Sue Hawksley, Biomechanics lab Edinburgh University



Ross Cooper interacting with his own pre-recorded mo-cap data

A range of research methods were engaged including those familiar from computer science (monitored data collection and quantitative analysis, software versioning, extreme programming), ethnography (interactors and researchers were interviewed and their activities recorded for later analysis) and artistic methods of experimentation, creative reflection and applied iteration. The lab was carried out using what would be best described as a fast and dirty approach. We had limited resources and time and our primary goal was not rigorous and robust research outputs, whether workable artworks or data that could be employed in scholarly research, but rather to prototype how we could, as a diverse group of specialists, work together effectively, recognising that whilst we had diverse expectations and goals we could pursue these through a shared platform of activities.

Surprisingly we did manage to realise some reasonably concrete outcomes, some of them unexpected. A number of web-pages on the research group's website (CIRCLE 2008) document this work. A conference paper has been completed and will be presented in July 2009 (Biggs 2009). The project has also fulfilled another of its aims, functioning as a prototype laboratory which we could evaluate in order to inform taking the research forward as a more significant research council supported project. A research application has been submitted looking to take this work into new domains, focusing on technologically mediated public spaces and how such mediation effects human behaviour and interaction in public environments. The key focus of this research proposal engages territory and concerns that only a few months ago had not been on our conceptual horizon, evidencing how undertaking such forms of interdisciplinary research can lead to unexpected results.

Our key questions will include:

What are the effects of pervasive surveillance, remote sensing, communications and social network technologies upon people's self-perception, interactions, boundaries and navigation of public space? In what sense are 'social technologies' social?

Does current government policy on terrorism, seeking to appropriate the public 'eye' to the apparatus of surveillance, effect how people 'present' themselves in public space? Do some people assume the performative when occupying mediated public spaces, playing to what they perceive to be the voyeuristic gaze of 'Big Brother'?

Can employing scaleable surveillance, sensing and social technologies in public performances and artworks allow us to better articulate the character of peoples' activities within technologically mediated public spaces and facilitate insight into our questions?

Our research will investigate the creative implications of developments in surveillance and social technologies, focusing on how they are interacting with and influencing one another and the effect they have on the behaviour of people in public spaces. We will attempt the scaleable and adaptive integration of exemplar systems to create compelling interactions within and between public spaces in order to enable an enhanced sense, and improved comprehension, of the implications of these and similar technologies.

My own hope is that this further research will lead, within a couple of years, to being able to present outcomes and documentation of another example of how creative collaborative research can lead to outcomes as unexpected as those that have emerged as a result of the three examples of interdisciplinary research presented here.

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