Mixing Realities for Heritage and Health:
L'inframince between the real and the virtual

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Abstract - As an artist and practice-led researcher my work concerns the space between art, technology and consciousness studies, this has developed to include algorithms facilitating behavioural change and I am now the lead partner coordinator for the EU funded *MinD* project, designing for people with dementia. This paper presents two projects where tangible interfaces to mixed-reality installations have been created to enable the visitor to bridge the space between the real world and virtual states in order to better understand a complex situation.

INTRODUCTION

The core of my thinking and practice concerns the similarities apparent within Conceptual Art and Hypermedia technology, where both enable the semantic associations between thoughts and ideas to interlink into an holistic complex concept or statement. My work takes the form of digital multi-media explorations, which have largely focused on unravelling the purposefully obtuse work of Marcel Duchamp, the instigator of Conceptual Art. I transposed his art work the *Large Glass* [1] across the internet as a web of websites, and collated this piece into one electronic system, but then began to focus on his ideas of the 4th dimension [2] and came to the conclusion that Duchamp's *L'inframince* his slippage between the 3rd and 4th dimensions could now be understood as our moving across into a virtual world – *L'inframince* is then, the liminal space between the real and the virtual where the imaginary can take us further than the rational. This is the space where the artist can create works to bridge facts with fictions and augment our understandings of the world and our place in it. In order to enter the transitional space and pass from the real to the virtual my work began to incorporate tangible interfaces and mixed-reality installation beginning with a piece commissioned by the heritage sector.

SHIFT-LIFE

I was invited by the Shrewsbury Museums Services (funded by Arts Council England) to create a work related to Charles Darwin for the bicentenary of his birth in his birthplace of Shrewsbury and was one of the 10 artists commissioned to make a work in response to the 'On the Origin of Species' for exhibition at the Shift-Time Festival of Ideas (3-12 July 2009). The *Shift-Life* installation created for this presented an understanding of Darwinian adaptation for survival where a virtual ecosystem was projected into a shallow wooden box of white beads. Visitors could use the playful tools around the box to directly affect the ecosystem and watch its creatures behave accordingly. Even though they knew the creatures were virtual they responded to them as though they were alive – this virtual-real slippage was an *inframince* moment.

This Mixed Reality piece was to facilitate a holistic grasp of the necessary adaptation of life-forms in their struggle for survival in a volatile environment. It required the viewers to be physically engaged in activating the virtual ecosystem and then working with each other to keep it in balance. The installation was later exhibited at The Wolverhampton Art Gallery and demonstrated at the Gadget Show Live (8-11 April 2010) at NEC Birmingham, UK.

Traditionally, digital media artists tend to engage with their viewers either through a computer screen/projection and keyboard/mouse, or through the physical triggering of sensors to activate their work. For *Shift-Life* I was concerned with a more direct 'relational' and participatory approach where viewers would both intuitively engage with the installation's everyday objects, and also with each other, to more fully experience the piece. In response to Darwin's idea, I aimed to create an 'alternate' biological life as a set of artificial or virtual organisms that possess similar biological processes to their 'real' counterparts – growth, reproduction, competition, and adaptation. The virtual life-form created exists in a trophic relationship of predator and prey and includes sessile (rooted) and vagile (free moving) organisms. Animal intelligence was programmed into the virtual organisms to allow them survival strategies. The system involved the construction of an enhanced Mixed-Reality based environment which was connected with wireless sensors with environmental manipulators for altering the 'climate' of the ecosystem. By bringing virtual 'living' creatures into the physical world where they would seemingly respond to audience activity, with the intent of creating a liminal space to blurr the perceived virtual and real states to the point where viewers might suspend the belief that these life forms were artificial, and thus engage with the work on a deeper level [3]. Working with two programmers and an animator we aimed to extend the concept of Mixed-Reality to another level – for what is true Mixed-Reality, if one of the worlds, which lie on one side of the interface, does not have life?

For this participatory artwork, we 'mixed' reality by simulating virtual life which can be interacted with via actual, physical human activity, converging the virtual and the physical in an innovative Mixed-Reality system which we had formalised. We accomplished a truly 'mixed' reality system by integrating real-time display, artificial life, ecological simulation, and real-time sensors, and physical props in a relational art installation. The Mixed-Reality system comprised of a $1.2m^2$ box filled with polystyrene beads held under a muslin sheet and surrounded by a set of manipulative tools. A projector fixed to the ceiling of the installation projects real-time rendering of the virtual agents and its environment onto the muslin sheet. The interactive tools were a foam-based hammer used for simulating earthquakes; two plastic watering cans were used for altering the humidity and *pH* level of the soil, and a desk-lamp as the light source for altering the luminance to affect both the temperature and the light/shade of the environment.

Our creatures, programmed with simple rules produced a multiplicity of behaviours during the exhibitions, some of which were surprising and unpredictable. I specifically chose the animator Sam Moore's work for this piece as I did not want the 'creatures' to resemble real-life animals or microbes in any way, instead, preferring them to be flat graphics and non-scientific in their look. The agents also needed to be simple, fun, and to reference Darwin's childhood in Shrewsbury where he first began his interest in the natural world putting small beetles in boxes for observation. Moore's animation style ticked all the boxes. As such, the agent representations were developed as 'bugs-in-a-box' 'sweet' creatures with a view to making them as approachable as possible to a diverse audience. The images moved away from a

computer-games visual aesthetic of hyper-reality and towards a deliberately non-digital, non-microbe, graphic and comic aesthetic. This positioned the animator's work in the realms of the overtly rather than covertly 'made' and referenced a clear fantasy world instead of attempting photo-realism. The creatures were based on pick and mix sweets; the carnivore was a liquorice all-sort, the herbivore was a jelly sweet and the foliage (for shade, sustenance etc.) was based around a selection of penny sweets. The creatures were limited to two dimensions as they were to be observed from above.
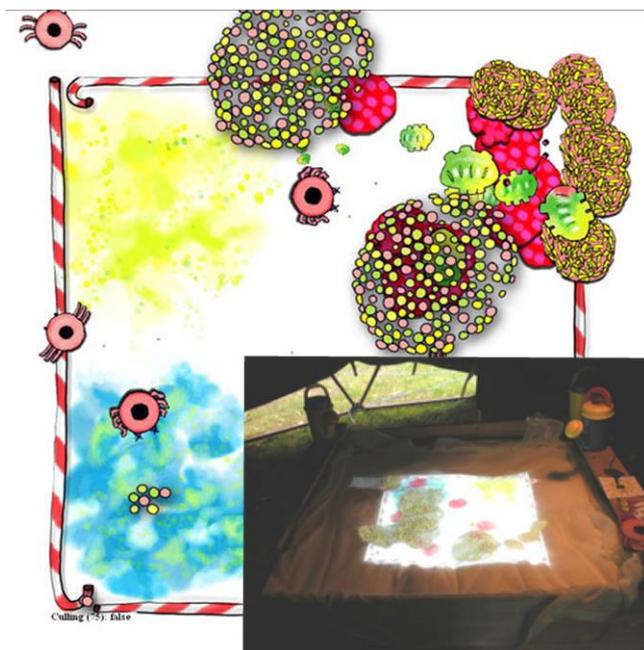

Figure 1: *Shift-Life* animation aesthetic, and installation

Participants often remained in a state of reflection by passively observing others' actions, watching as 'life' takes place in the virtual world. The algorithms implemented were self-sustaining and stable, without the need to intervene, as such it was visually mesmerising as noted by our participants. There was room for contemplation where the virtual world could be understood as an analogy for human activity and its effect on global climate change within our own world. This became evident through our conversations with participants during the session. From observing these members of the public engaging with the art installation it was pleasing to note that they needed no encouragement to do so, in that they found the implements playful and used them intuitively as intended. The aesthetics of the piece, the hand-made look and feel of it were important here where I was to elicit scientific principles to a non-science audience. The idea was to make hard science and complex technical details disappear for the participants, to allow for Ihdeian 'embodiment relations' [4] to take place where the perception of technology withdraws into the body and the human experience *through* technology is barely noticed.

Mixed-Reality interfaces generally refer to systems which augment reality by overlaying real-world environments with computer-generated objects via headsets or digital displays. Our research experimented with an inverse of this concept by projecting computer generated agents and environment into the physical world and feeds environmental factors (temperature, sunlight, humidity, soil *pH*, and earthquake) back to the virtual environment. This allowed a mixed-mutual

relationship between the real and the virtual – virtual agents sensed our environment while human participants interacted with them. Our approach is particularly suited to relational artworks involving multiple participants in public spaces. The more complex task here is the development of an artificial life ecosystem the 'life' of our artwork [5]. We believe that the formalisation of our Mixed-Reality working practice will enable more creative approaches in the future when an ecology of 'living' objects becomes necessary. As creators of the system, we ourselves were occasionally surprised by the emergent behavior witnessed during the exhibition – simple rules can generate complex behaviours. In this context, I have since expanded my practice towards notions of creating 'living' virtual Duchampian art objects endowed with animal behaviours, which might inter-relate to allow new insights into this body of work.

SOCIAL ENGAGEMENT MAP

The implementation of intuitive tangibles through which to access the virtual world of the Shift-Life ecosystem, informed my work as the concept artist for the co-design activities of the Horizon 2020 RISE *MinD* project *Designing for People with Dementia.* The project required the creation of some form of social engagement map which could allow people with dementia to stay in touch with their loved ones and to remain physically active by taking the initiative in arranging joint activities. With my interest and experience in creating intuitive ways of moving between the real world and virtual platforms, the *Let's meet up* social engagement map was created as a hybrid board and electronic system with a simple, user-friendly tangible interface informed by a team of designers and a GEE group of people with early stage dementia (Group of Experts with Experience).

For this prototype the designers were informed by carers and the GEE group that it can be hard for people with dementia to keep relationships going, that friends and family may not always understand them that well, and that participating in group activities may become more difficult. They were also made aware of the importance of keeping a sense of continuation and familiarity, which could be attained through attending the same regular activity events, with the same people, or using familiar things. The project data collected from the carers and people with dementia revealed that although people with dementia might be happy to let go of activities if they found them difficult, they would not be so willing to give up activities that they found pleasurable and that gave them a sense of independence, purpose or achievement, even if this caused anxieties for the carer who perceived those activities as a risk. Therefore, the design needed to offer ways of encouraging motivation and confidence while offering new pastimes which might compensate for the necessary loss of some activities.

According to the *MinD* project theme of familiarity, the team noted that there is currently a large number of those living with dementia who are not 'digital natives' having been born into an analogue generation. They are less familiar with new technological devices and find their interfaces somewhat complex. Cognitive simplicity was therefore essential for this prototype. Although there are a number of mobile phones and tablets with helpful Apps available, they are not necessarily the means of first choice, and users with dementia as well as carers usually need training to use them, which is possible but can also be difficult. Feedback from the GEE groups indicated people's varied preferences for paper diaries, email or iPad use for Skype, but for the electronic devices this also brought them difficulties with

remembering, for example, passwords or the layered structure of Apps and Programmes. In bringing the two aspects of familiarity and cognitive simplicity together, the design developed an interactive format that offered a more simplistic interface than existing solutions, essentially in a 'hybrid' format integrating digital and analogue elements drawing on familiar concepts and processes.

For digital technologies, tangible counters for screen access can be easily manipulated without users having to learn or remember a new mechanism such as 'drag and drop' or tapping on a screen. Anyone who is able to physically manipulate those objects will perceive them as being graspable and moveable [6]. There is evidence that using physical affordances such as these can make interfaces more intuitive for people living with dementia [7]. In addition, they have longevity in people's memories – common physical affordances are learnt in childhood and reinforced throughout the lifespan. So they are much more familiar and potentially more robust in the face of dementia than other interface features, especially newer features and conventions that many people in their 70s and older have limited familiarity with compared to younger people [8].

To meet these concerns the designers agreed on an electronic system in the form of an interactive map presented in the style of a board game with counters to move in order to play. The aim of the 'game' is to facilitate the person with dementia to connect, plan, support and visualize social participation. The social engagement electronic system *Let's meet up!* is not an App or a Tablet, a Planner or a Diary, it is a means of keeping a person with dementia in touch with their family and friends and for continuing with their leisure activities for as long as possible. It is aimed at elderly persons with early stages dementia who find new technologies unfamiliar and challenging, and prefer not to use smart-phones or tablets. *Let's meet up!* instead takes the form of a flat board game with tangible pieces to move around on a horizontal electronic screen while the sophisticated technology driving the system remains hidden beneath the surface, invisible to the person using it. The system is played in real-time, is bespoke to that person and incorporates machine-learning so that it can adjust to suit them as their dementia advances.

Figure 2: Trying out and evaluating the *Let's meet up!* experiential prototype with GEE participants

The final system design is the outcome of a co-design process (see Fig. 2.) It is intended to work from a single 40" screen placed on a (coffee) table where the person with dementia (player) will usually sit to rest and relax. Accompanying the screen is a round, transparent counter or 'puck' 8.5cm in diameter and an A4 sheet of instructions. The screen is activated by sensors which are triggered when the player sits down near the table, in a similar way to Shift-Life where the tangibles held the sensors around the wooden box. The screen then comes to life and shows a number of round images moving slowly around, some are large and clear seemingly at the screen's surface others are smaller and faded as if below the surface. The images are that of either the face of a friend or family member with their name and relationship printed at the top, or an image of them with the person with dementia enjoying an activity together with the activity's name at the bottom. The 'face' images keep to the left-hand side of the screen, and the 'activity' images to the right. The large, clear images indicate who and what is available at that time. The screen of labelled faces and activities is to remind people of who they know and what they do. They can then follow through a small set of actions ending with a call to make an arrangement to meet and undertake an activity.
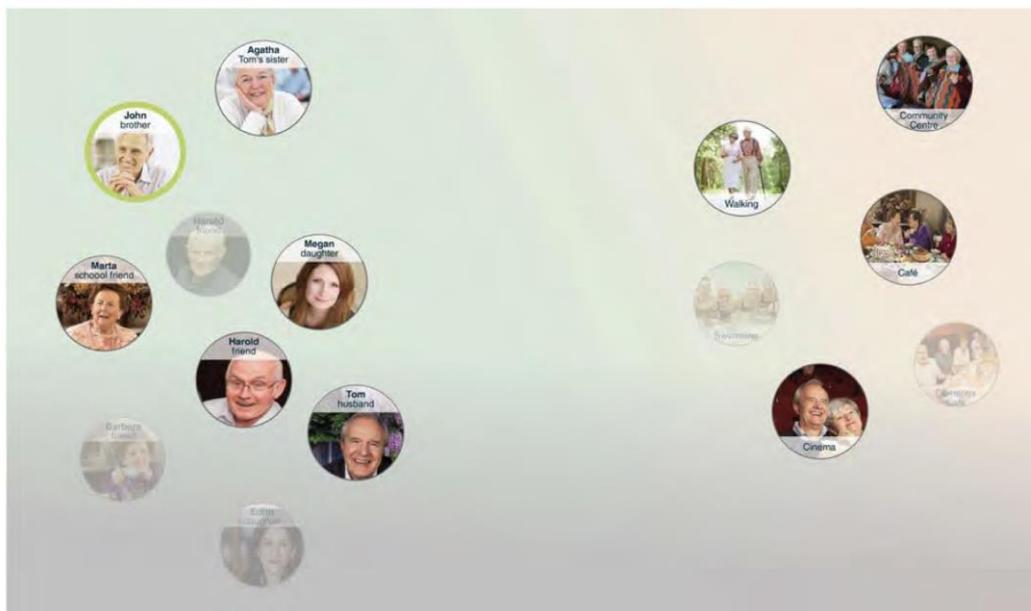

Figure 3: *Let's meet up!* – first 'entrance' screen

Using *Let's meet up!* involves the following steps: First select one of the large clear face/activity images by placing the 'puck' on it. This action sets the image by 'stamping' a coloured ring around it (Figure 3), holding it still while most of the other images fade and shrink in size leaving the next set of selection choices available to stamp. A second stamped image causes the others to fade as before, but also generates up to three information circles as conversation prompts at the bottom of the screen. At this point one of the two stamped and colour-ringed images (face/ activity) will then be circled by an animated ring, encouraging the player to place the puck on it for a

second time. This action tells the system to call the chosen person directly and if it is a video call, the person phoned will appear in a central circle between the two face and activity images, with the three previously selected information circles visible below to act as conversation prompts. When a meeting arrangement has been agreed and therefore which information circle is to be selected, the player moves the puck on to the information circle. This, along with the face and activity circles, is now set in the system's memory so that all three will show again as a reminder to the player nearer the time. Once the last circle has been stamped, this completes the task and the puck is then moved off the screen and on to the table ending the call if the other person hasn't already ended it.

If the player has made an arrangement but forgotten about it and attempts to make another for the same time, the system will not offer any activity information circles which include that particular time. Instead it will offer alternative times available at the time of access. Should the player changes their mind at any of the three selection levels, they move the puck off the board and place it on the table, the system then reverts to the previous selection level so that the following choice can be re-taken. The only exception to this being where the final information circle is selected and may then need to be changed, in this instance the puck can be placed instantly on to another information circle taking the orange ring with it (without the need to move the puck off the screen and on to the table first). When all is finally selected, moving the puck off the screen and on to the table will then set the arrangement and end the call. There is also the potential for the system to enable members of the support team to call the person with dementia to invite them out. At present, this extra facility was not deemed necessary as the purpose of the electronic system is to empower the person with dementia by allowing them to take control and initiate the conversations to arrange their outings.

In technical terms, the system is activated by the person with dementia but runs on a database built on information supplied by their support team of friends and family who will have previously agreed to supply their data for this. The support team members will need to input personal details such as names, relation to the person with dementia, time-slots when they are available to be called, face and activity images etc. through a separate form. They will also be able to edit their data if, for example, they need to change their face image or their availability slots. The support team needs to ensure that between them there is always someone available in the daytime time-slots. It is likely that none of them will want to be available during the night so there would be no large clear images available to the player during those hours. The player simply moves the puck and selects the clear circular images, other than that the programmed system and database is invisible to them.

The system is designed to appear as being quite simplistic and easy to play in that there are only three levels to it and never more than three options for the player to choose from on each level. The aim is to enable the person with dementia to use the device on their own, as their carer may not always be at hand, and promotes maintaining autonomy for as long as possible. The prototype created exists in its most basic form of contact and engagement, and other affordances can be programmed in as required such as a means of recording the event for memory enhancement and savouring pleasant moments, or linking to a wearable tracking device. Each system is uniquely bespoke for its owner and may begin with a much wider social sphere than the one demonstrated in the prototype, however as the dementia progresses the machine-learning aspect of the system will reduce the scale of the user's social sphere accordingly.

SUMMARY

The tangibles involved in both of the projects outlined above, *Shift-Life* and *Let's meet up*, were introduced as a means of helping the participant in crossing over from the real world to that of the virtual held within the computer, either projected into a constructed space or seemingly existing below the screen. These two are very different projects with differing aims and intents but both consider an ease of passage for the visitor through hands-on means, both with the aim of making the complex simple through intuitive tangible interfaces without the need of buttons, swipes, clicks or prior knowledge of using computing machines and Apps. Within this, the sophisticated programming and computer technology is hidden from the visitor who can meet the creatures, or find their way through to contacting a friend, in a more human analogue and familiar way. Here the creative intervention of tangibles is bridging the liminal *L'inframince* between virtual and real states, and together with the use of bio-life algorithms and the affordances of machine-learning keep the systems alive and adapting to usage. These devices are now being brought into play within my Duchampian explorations where text strands are to be taken from his *Green* and *White* boxes, which accompany the *Large Glass*, and 'flocked' with others generated by algorithms to enable his ideas to advance (in unpredictable ways).

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