Imaginary Loci: Augmented Reality as one to one topography

Simon Biggs, Professor of Art, University of South Australia

Introduction

Context aware technologies (Augmented Reality) allow for novel forms of interaction with physical environments, including performance environments. These technologies feature properties that allow information to be situated in the environment in a context aware manner.

There are diverse ways in which information can be integrated into the environment by such means. Augmented reality technologies allow the placement of virtual information in locations that are congruent with physically tangible objects and environmental elements. However, the main concepts behind the technology have been around for a long time. The Greek pre-Socratic rhetoricians of Classical antiquity developed the discipline of mnemonics, employing a system correlating real places (loci) and imagined images (imagines) (Yates 1966, pp.18) as an aid to the public presentation of their theories.

Where conventional augmented reality devices, such as AR apps on mobile phones, allow you to co-locate information with real world objects, head-up displays, such as the Microsoft Hololens, allow this as an immersive experience, so the user (interactor) is fully engaged with the AR merged environment. Interactors can place virtual images or other elements (imagines) onto physical walls or objects (loci). This can include altering visual aspects of the physical environment around them, such as creating virtual portals through actual walls or floors to reveal other virtual spaces, or placing a virtual ball on a physical table so that when the physical table is tilted the ball rolls along its surface and drops onto the physical floor, bouncing on impact. The virtual object and the physically tangible space the virtual object has been placed within are, within the logic of the system, of the same ilk. The imaginary and the tangible are merged in a novel manner.

Psychogeography and Dérive

Artists have been developing context specific creative interventions for some time, where the imaginary is sited in particular places. Such works often draw on the theories of French Situationist Guy Debord, who proposed

> ...the dérive, a technique of rapid passage through varied ambiences. Dérives involve playful-constructive behaviour and awareness of psychogeographical effects, and are thus quite different from the classic notions of journey or stroll. (Debord 1956)

Psychogeographic works tend to be site responsive, the artist developing an acute close reading of a site that they can employ in the construction of their intervention in that place. For this reason few such works are developed for the blank space of the art gallery or museum, except where that institution might have characteristics of interest to the artist.

Janet Cardiff's work employing recorded spoken narrative for pre-determined walks (psychogeographies) are an exemplar. Cardiff carefully crafts the recording of her voice to create a sense of co-location not only with the physical and visual environment the walker encounters, as they listen on headphones to the narrative, but also the aural characteristics of the location; Cardiff states,

> On the CD you hear my voice giving directions, like 'turn left here' or 'go through this gateway,' layered on a background of sounds: the sound of my footsteps, traffic, birds and miscellaneous sound effects that have been pre-recorded on the same site as where they are being heard. (in: Gibbons 2007)

In more recent collaborative work, such as Alter Bahnhof Video Walk (Cardiff and Miller 2012), the artists have extended their use of technology to create augmented psychogeographic experiences to include video and mobile technologies, in the form of mobile phones and their capacity to exploit geolocating technology along with audio-visual media.

Janet Cardiff & George Bures Miller, 'Alter Bahnof Video Walk', 2012. 26 minute walk produced for dOCUMENTA 13, Kassel, Germany.

Similar to wearing the Hololens, an interactor in a Cardiff psychogeography experience uses technology to mediate their experience of place, wearing an audio headset or using a mobile technology device. By these means information is co-located with real world objects and experiences. Although this work does not employ technology as immersive and total as augmented or virtual reality headsets the merging of real and virtual is compelling, due in large part to the great care Cardiff takes in designing the audio-visual environment and correlating it to the actual environment the interactor is within.

The Art of Memory

The merging of now and then, here and there, the constructed and the experiential, in works such as those by Janet Cardiff, allows the creation of hybrid places that exist in the physical now and the artistic imaginary. Whilst characterised as a psychogeography this could also be considered a form of memory theatre. In the Art of Memory the art history scholar Frances Yates recounts how early Greek rhetoricians developed the art of the memory theatre; where memories, as images (imagines), could be associated with places (loci) in order to create a mnemonic system that could be used to create an 'artificial memory' - a system of mnemonics that exists not in the mind (what is described as 'natural memory') but in loci. Thus the rhetorician could recount their memorised narrative simply by revisiting the loci in the correct order and reconstruct their argument from the associated 'imagines'. Such an approach offers a model for how augmented reality might be used to create 1:1 mappings as a memory theatre.

As will be outlined later in this essay, the pre-Socratic memory theatre described by Yates has functioned as the inspiration for a new project, by the author, titled Mnemo. Yates' recounting of various examples of memory theatres, sometimes known as memory palaces, is a well known and outstanding example of historical research, drawn from numerous texts, many archaic. Yates identifies three classical sources for the art of memory, the first being a story associated with Simonides of Ceos. To quote:

> persons desiring to train this faculty [of memory] must select places and form mental images of the things they wish to remember and store those images in the places, so that the order of places will preserve the order of things, and the images of things will denote the things themselves, and we shall employ the places and images respectively as a wax writing-tablet and the letters written on it[1] (Yates 1966, pp. 17)

Yates provides a further source for the invention of the memory theatre, a classical text on rhetorical technique by an unknown author, the Ad Herennium[2] (circa 86-82 BCE) where it is written:

> "Now let us turn to the treasure-house of inventions, the custodian of all the parts of rhetoric, memory." There are two kinds of memory, he continues, one natural and one artificial. The natural memory is that which is engrafted in our minds, born simultaneously with thought. The artificial memory is that which is a memory strengthened or confirmed by training. (ibid. pp. 20)

Continuing:

> The artificial memory is established from places and images... a locus is a place easily grasped by the memory, such as a house, an intercolumnar space, a corner, an arch, or the like. Images are forms, marks or simulacra of what we wish to remember... The art of memory is like an inner writing. (ibid. pp. 22)

These texts from antiquity suggest to us that rhetoricians and philosophers were well versed in the arts of memory they illustrate. However, as Yates identifies in Cicero, "Themistocles refused to learn the art of

memory 'which was then being introduced for the first time' saying that he preferred the science of forgetting to that of remembering. Cicero wrote (in Yates):

> Memory for words, which for us is essential, is given distinctness by a greater variety of images; for there are many words which serve as joints connecting the limbs of a sentence, and these cannot be formed by any use of similitudes - of these we have to model images for constant employment; but a memory for things is the special property of the orator - this we can imprint on our minds by skillful arrangement of several masks that represent them, so that we may grasp ideas by means of images and their order by means of places. ibid. pp. 33-34)

The reference to masks is noted by Yates, who (recognising the Latin terminology of Persona) suggests that the rhetoricians application of the art of memory was akin to an actor wearing a mask upon the stage, enabling a kind of theatrical experience.

ATOM-r and Stationhouse Opera

The concept of memory theatre can be observed deployed explicitly in recent work by the Anatomical Theatres of Mixed Realities (a Chicago based ensemble comprised of Mark Jeffery, Judd Morrissey and others, shortened to ATOM-r), including The Operature[3]. ATOM-r explore the dramaturgies of augmented reality in a manner directly evocative of the memory theatre described by Yates. The work of the ATOM-r collective merges digital, literary and performance practices employing augmented reality systems such as custom mobile AR apps, immersive digital projection and various sensing technologies.

ATOM-r, 'Kjell Theory', 2015. Performed in installation by Sarah FitzSimmons, for Chicago Architecture Biennial 2018, USA.

In the recent ATOM-r project Kjell Theory (ATOM-r 2015) the collective developed a narrative around the life of computing pioneer Alan Turing, employing eye tracking technology and high precision projection systems, to create, amongst other things, projected augmented reality tattoos upon the bodies of performers and interactors. The stated intent of such work is to investigate how technology can be queered through its blending with the human body. ATOM-r have performed Kjell Theory in the physical context of a schematic, but tangibly real, house-like architectural structure (by architect Sarah FitzSimmons) as part of the 2018 Chicago Architecture Biennial. In this version of the work the performers enact the work within an architectural schema directly reminiscent of that described in the Ad Herennium.

Such work evokes earlier projects by the London based performance group Stationhouse Opera, including Split Seconds of Paradise (1985), the Bastille Dances (1988) and Dedesnn nn rrr (Stationhouse Opera 1996).

In works such as these by ATOM-r and Stationhouse Opera, as well as that of Janet Cardiff and George Miller, we can see how co-located information in real world contexts (loci) can elicit a kind of intertextual folding between a physical experience and a recollected or imagined association (imagine). Narratives and stories become closely associated not only with place but with the objects within it, the structure of the information deployed throughout the environment via its association with specific objects, including human subjects, or sites within it.

Stationhouse Opera, 'Dedesnn nn rrr', 1996. Performance at the Frauenkirche, Dresden. Commissioned for Theater der Welt, Dresden, Germany.

Waiting Room and London Dig

The author has developed a number of previous works that employed augmented technological systems in site-specific contexts, in the form of interactive digital projections that employed full body motion tracking

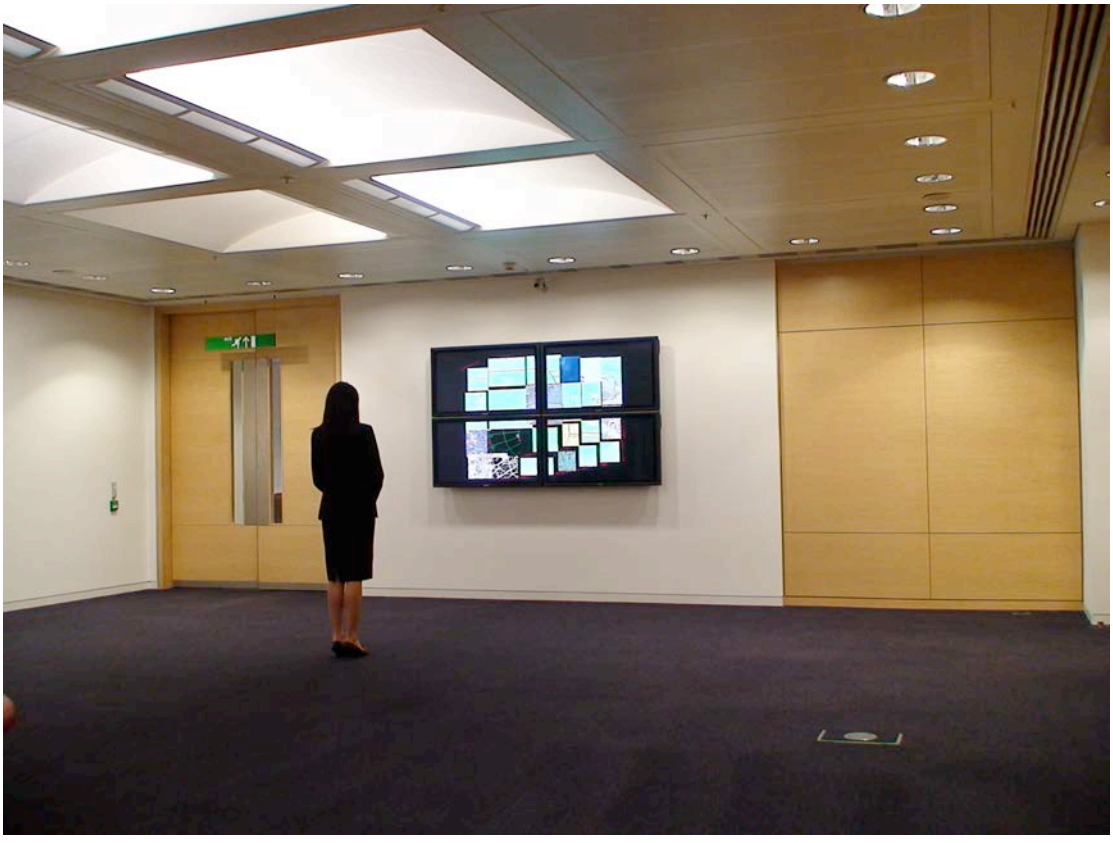
of visitors to envelop them in augmented environments integrated into sites of specific interest. An example of this is The Waiting Room (Biggs 1998), developed by the author and choreographed by Sue Hawksley, with sound by Stuart Jones, which was located in a railway station waiting room that was built to be used by Queen Victoria when she visited the city of Sheffield in 1897. The room, approximately 100 square metres in area and with high 5 metre ceilings, was notable for being entirely lined with cream coloured tiles, with relief details of lions' heads, and on each side of the room three full length mirrors, creating a space of unique quality and power.

Simon Biggs, 'Waiting Room', 1998. Installation view. Commissioned by Site Gallery, Sheffield, UK.

The author found this space in a semi-derelict state, unused for decades, and developed a work (commissioned by Sheffield's Site Gallery) for the site, transforming it into a virtual dance hall, where virtual and real people could mix in the same environment. The virtual figures, all dancers, were equally distributed female and male (three of each) and, surrounding the people who entered the space, waited to be engaged by the visitors (employing low-light video-based motion tracking sensors), upon which they would invite another virtual dancer to dance with them - a tango. The space was interactively zoned, with a relatively fine granularity, so that visitors to the space could interact with the virtual dancers in various ways but also contribute to the composition of a live generated interactive soundtrack played by a virtual, but not visible, tango ensemble (composed and programmed by Stuart Jones). The virtual dancers continue to use the room to wait - but rather than waiting for a train, as the British monarch once did, they wait to be invited to dance, either by a visitor to the space or by another of the virtual dancers. The work sought to function as a speculative archeological dig, an oneiric re-imagining, of the site, revealing aspects of the

waiting room that were both historically factual and an artistic re-imagining of place (not unlike Debord's dérive).

London Dig (Biggs 2006) is another work by the author that explores the specificity of a space through temporal re-imagining. This is an explicitly topographic work, comprised of numerous aerial images of the City of London, many of them in the form of maps, or fragments thereof. London Dig is composed of four 42 inch 16:9 plasma screens arranged in a rectangular array of two by two screens, creating a single image. The imagery displayed on the screens derives from numerous bird's eye views of the City of London, centred on the location of the building in which the work is located, Allen and Overy's (the commissioner's of the work) world headquarters in Spitalfields, City of London. The site of the building is an historically loaded one, located near to one of the original Roman gates of the City of London, and over the plague pits where those that died during the Great Plague were buried en masse. The location is also within the extent of the Great Fire of London, the previous buildings destroyed, and what ultimately became Spitalfields Market, much of which remains a vital trade and cultural site today. The building, designed by Norman Foster and Partners, is also located at the site of the birth place of Jeremy Bentham, Utilitarianist, philosopher and penal reformer. To state the site is loaded with historical associations is somewhat of an understatement.

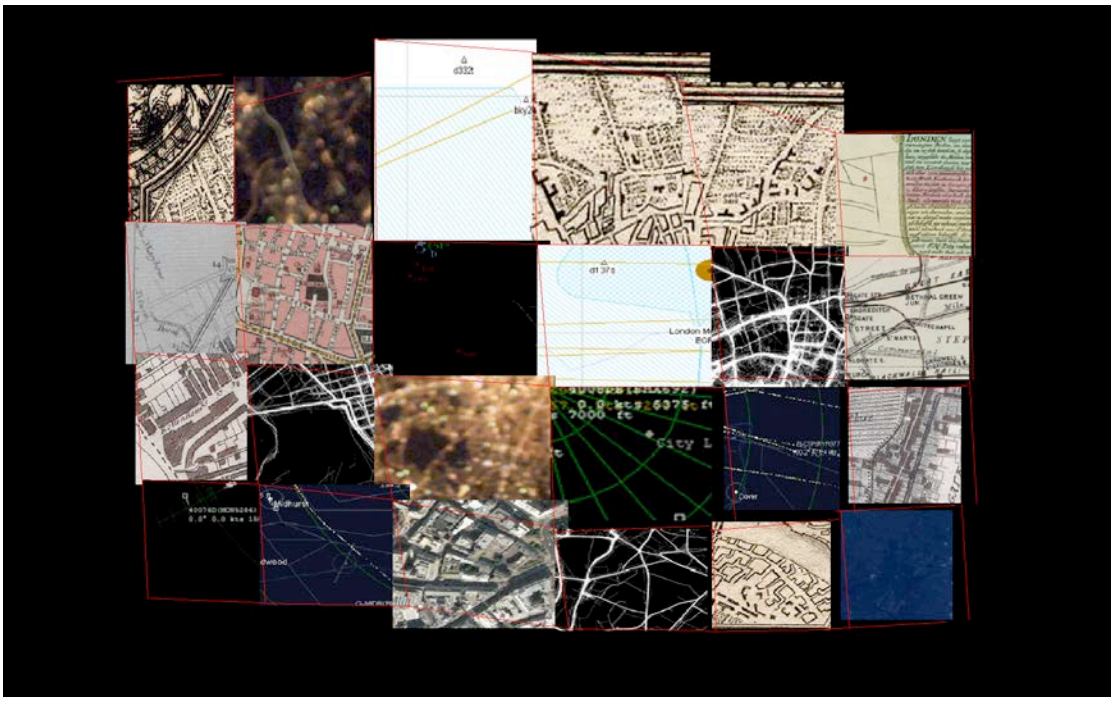


Simon Biggs, 'London Dig', 2006. Installation view. Commissioned by Allen & Overy LLB, London, UK.

In London Dig imagery documenting the 2000 year history of the site is presented on the plasma screen array, including maps from the Roman period through to contemporary images including data visualisations

of the City in various forms, flight data from local airports (including radar visualisations), and photographs from space. The work was the result of months of archival research, exploring both public and private image libraries, museum collections and other organisations (including the Bodleian Library, Museum of London, NASA, European Space Agency, Science and Society Picture Library, etc.).

Located in a rather featureless anteroom, leading to the main auditorium of the building, London Dig functions as an imaginary interactive portal revealing the history of the site. A video camera located above the plasma array tracks all physical activity in the room in which the work is installed. This acquired data is employed to manipulate the imagery displayed on the screens. People passing by or standing before the screens cause the surface of the imagery to ripple, buckle and distort, depending on their movement. The effect is akin to an earthquake disrupting an overhead scene, fragmenting the visualisations of the city. Most of the time the tessellated and disrupted view of the city is composed of a field of rectangular fragments of many different simultaneous visualisations, collaged together in response to interactor activity. Sometimes, due to a randomly assigned time-out, the imagery is prompted to evolve so as to converge on a single coherent target image, randomly selected from the image library, before this is again lost in the visual complexity of the ongoing temporal re-mix. In this work the body of the viewer acts as the excavator, 'digging' into the imagery of the site through disrupting the digital surface of the imagery. Viewers do not pass through the geographical space of the site but they do pass through a spatio-temporal simulation of place that would otherwise not be possible.

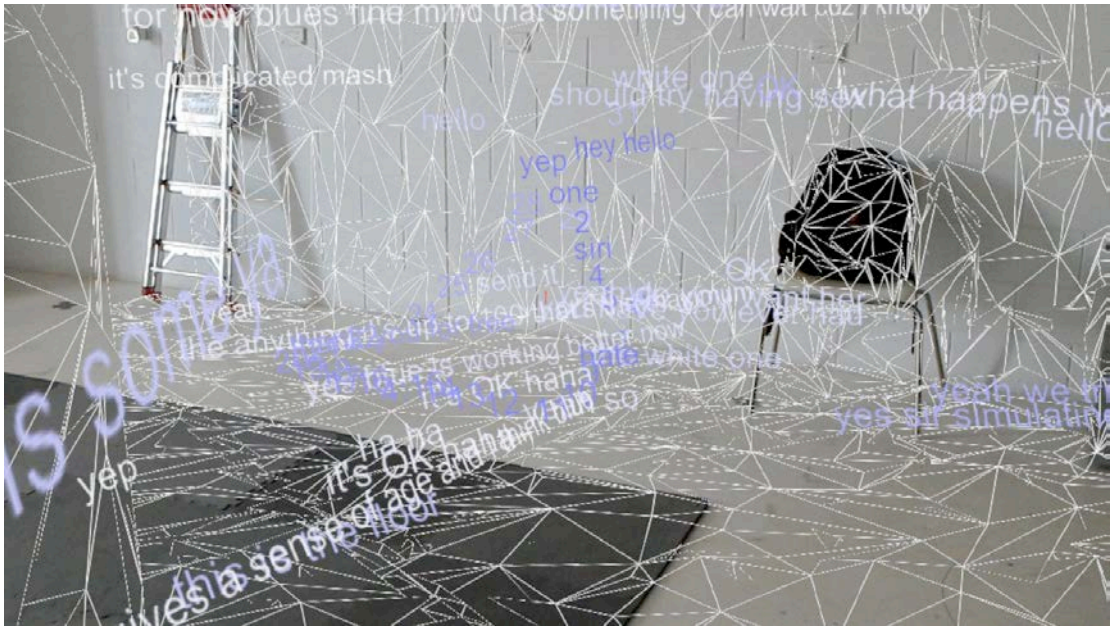


Simon Biggs, 'London Dig', 2006. Studio screenshot. Commissioned by Allen & Overy LLB, London, UK.

Mnemo

Partly informed by these earlier site specific interactive works, and developing out of more recent work by the author exploring the interactive and dynamic spatialisation and temporalisation of spoken language (in works such as Bodytext, Tower, Crosstalk and Dark Matter), current research by the author is exploring how people can encode textual information, similar to the imagines discussed by Yates, into the environment around them. The aim is to allow interactors, or others, to recover and read information at a later time from the loci where the imagines were placed. The research seeks insights into how place might be explored as an active mnemonic, a site of literary and artistic expression, or topopoetics (Cresswell 2017), in the form of subjective perception represented at a 1:1 scale in physical space.

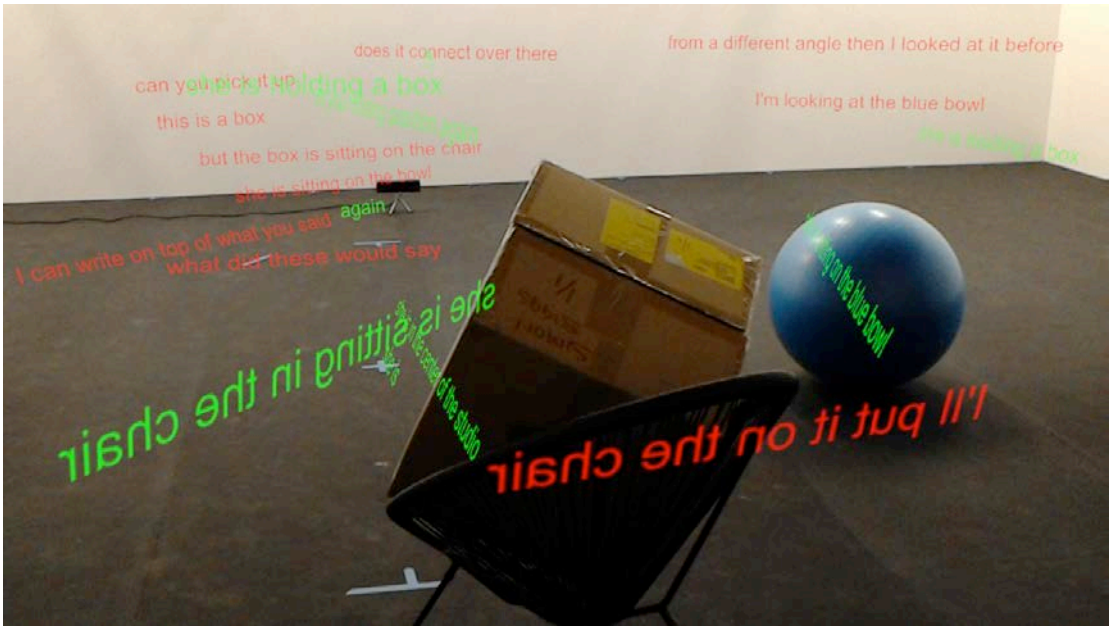
This research employs the Microsoft Hololens to co-locate information on objects and places in specific sites. The Hololens is a lightweight untethered wearable Augmented Reality headset. Physically it resembles a hybrid of a pair of wrap around sunglasses and the sort of head-up display you might expect a fighter-pilot to wear. The Hololens is effectively a stand-alone computer. It does not need to be connected to any other device, with or without wires, to be fully functional. The user simply puts it on, adjusts the headset for comfort and turns it on. The Hololens launches immediately into Microsoft Windows 10 and its familiar tiled interface, where various applications can be launched, including Mnemo. Application development was undertaken using the Unity 3D games engine, with software written in C# in Visual Studio by the author and Research Assistant Puzhi Yao, working within the Creative Computing Studio at the University of South Australia. The application was developed in Unity and exported to Visual Studio and subsequently to the Hololens. The process is similar to developing apps for an Android, Windows or iOS mobile device.



Simon Biggs, 'Mnemo', 2018. Studio screenshot. Adelaide, Australia.

The Microsoft Hololens has a number of unique key interaction identifiers. These include hand gestures (Microsoft a). The snapping of the index finger down and then back up, called an 'air tap', allows the interactor to select a function; holding the index finger down to 'hold' or engage an object allows the interactor to hold or move a virtual element. Blooming' - a gesture involving the whole hand in a upward flowering-like gesture - evokes the system menu. Most of these gestures are reliant in part on another key interaction identifier, known as 'gaze' (Microsoft b). This is where the interactor fixes their gaze on a specific physical or virtual location or object and the system determines the direction and focus of the gaze (a process known as 'ray-casting'). Together these interaction identifiers allow a full range of interactions, as we are familiar with from 'point and click' operating systems, such as Windows or MacOS. The sensors embedded in the headset are able to determine the angle and depth of view of the wearers orientation and co-relate this with data from other sensors determining the position of real and virtual objects in the space around the interactor. This allows the headset to accurately identify physical objects and surfaces around the wearer.

The Mnemo software employs the gaze interaction and voice recognition capabilities of the Hololens to allow a wearer of the headset to directly inscribe, or 'write', texts upon objects in the real world around them by simply fixing their gaze upon an object and speaking. Once a text (an imagine) is attached to an object or place it will remain visibly co-located with the associated loci indefinitely. The interactor can remove the AR headset, leave the room for an hour, a day or a month, and on returning and donning the headset they will see their imagine remains where they placed it. In many ways this resembles the memory theatre, recounted by Yates and described in the Ad Herenium, and as practiced by the Pre-Socratic rhetoricians.

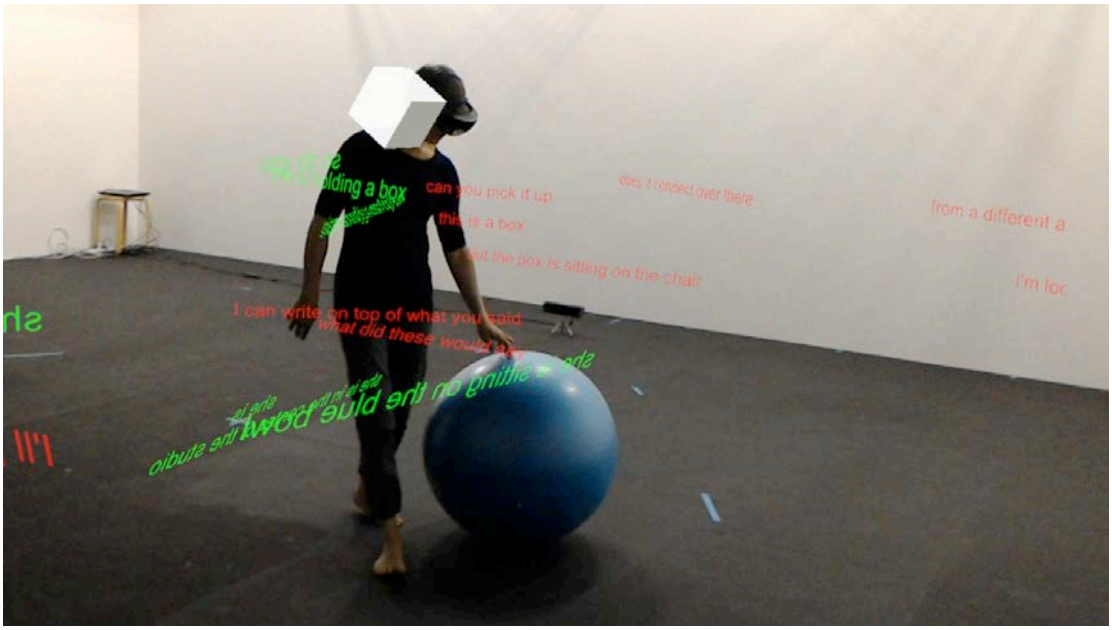


Simon Biggs, 'Mnemo', 2018. Studio screenshot. Cherryville, Australia.

When the interactor first speaks they see the words they have spoken floating in the space immediately in front of where they are looking, through the Hololens lenses, written in red coloured type. The floating text moves with the interactors head movements and gaze. When the interactor fixes their gaze upon a specific location for a second or two the text becomes fixed, turning white and becoming an imagine, at the location of whatever object occupies the loci. This might be a wall, a floor, a piece of furniture - even another person in the space. The orientation of the text is also fixed at this time, with the text facing the interactor for ease of legibility.

Once the imagine is fixed at a loci it remains there indefinitely. When the interactor moves the position and orientation of the imagine remains fixed. Thus the interactor can walk around the imagine, viewing it from various angles, or turn away from it, to return their gaze and see the imagine still at its loci. If the interactor removes the Hololens headset and another person puts it on this second interactor will see the same imagines, at the same loci, as the first interactor. If they speak they will create a new imagine which will be located at the loci they gazed at at that time. This new imagine will be added to the virtual environment that is mapped, at a scale of one to one, onto the physical environment around the interactors.

Interactors can save spaces with their imagines and locis, giving them a name, by simple voice command[4]. Similarly, the interactor can load saved textual datasets, which then appear all around the interactor just as they were saved. There are also voice commands for clearing all the imagines, browsing and loading saved data-sets, displaying and hiding the command menu, enabling or disabling spatial mapping and for accessing information on the development of the project.



Simon Biggs, 'Mnemo', 2018. Studio screenshot. Cherryville, Australia.

Ultimately what an interactor or interactors might say, and thus inscribe into the environment around them, is arbitrary. The system will only work as a geo-located mnemonic system if it is consciously employed to do so. On its own the system is primarily of technical and conceptual interest, a platform of

potentials. For the interactor the question is what to do with it? The Mnemo project could be seen as an instrument to be used for creating imagines in specific loci or as a provocative system designed to enable Situationist-like Dérive.

Sharing

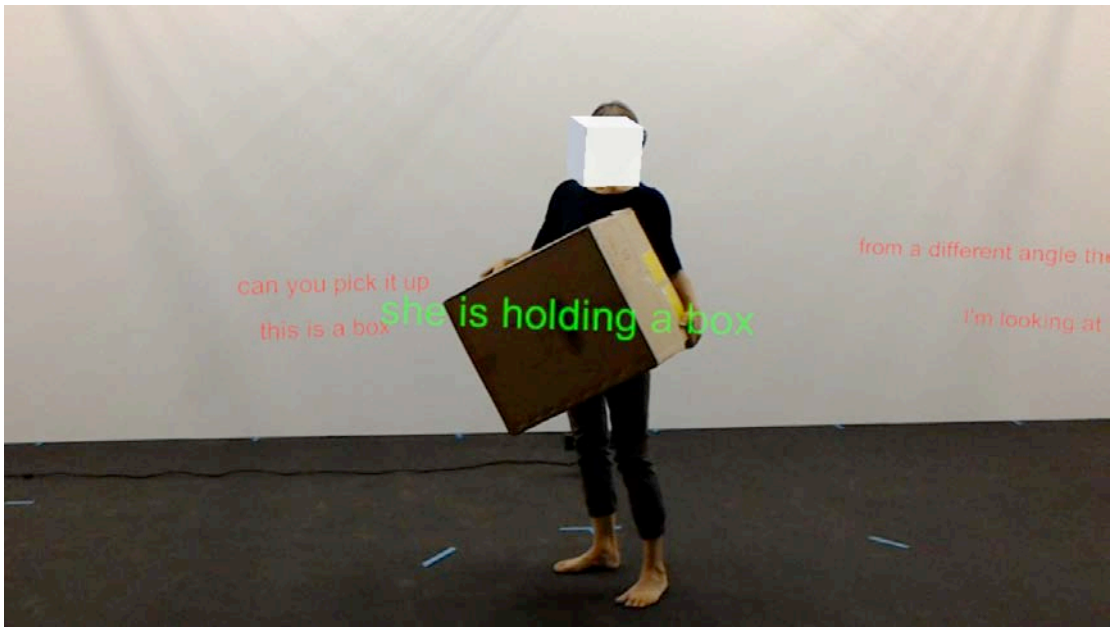
When proposing the concept of Dérive Guy Debord suggested that the activity was most effectively undertaken not by individuals but small groups of people, ideally of no more than two or three members. His view was that a small number of such participants would provoke one another in the exploration of place and their reaction to it, leading to the more likely occurrence of interesting situations. Responding to this, we (developer Puzhi Yao and myself) have developed Mnemo so that two (or more) wearers of separate Hololens headsets, who occupy the same space, can share the augmented reality environment together. Each interactor can write imagines at loci in the space and both can see these imagines, at the specific location, instantaneously. Together they can speak imagines into the space all around them, creating an externalised manifestation of their speech which can, if they choose, function as a dialogue - or not.

Simon Biggs, 'Mnemo', 2018. Studio screenshot. Cherryville, Australia.

Once an imagine is fixed at its loci it becomes shared between the wearers of the Hololens who are running the Mnemo software. Each interactor's texts are written in a different colour, so it is possible to differentiate between who said what. The intention here is to create a discursive environment that fosters conversation and engagement with place through speech.

The shared experience Mnemo provides is distinct from the memory theatre composed of personal memories, proposed in the Ad Herenium, as discussed by Yates. The Mnemo application, when in shared mode, is less a platform for the solo rhetorician and more an enabler of shared discourse, dialogue and

conversation between multiple users, inscribed upon place. The Mnemo software exploits the Hololens's built in capability for shared augmented reality to enable the co-creation and co-reading of information and can be used as the wearer of the device determines.



Simon Biggs, 'Mnemo', 2018. Studio screenshot. Cherryville, Australia.

Mnemo was developed using the Unity 3D platform. Puzhi Yao's contribution was instrumental in the technical realisation of the work. The application source code and assets are accessible to other developers under share-alike terms via Github on the Creative Computing Studio's repository at https://github.com/CreativeComputingStudio/Mnemo

Please feel free to download the source code and play with or further develop the system. Keep us in the loop.

Simon Biggs April 2018

Bibliography:

ATOM-r. (2015) http://atom-r.com/, Published October 25, 2015. Consulted October 20, 2017.

Biggs, Simon (2006) London Dig, 2006. http://littlepig.org.uk/installations/london/index.htm Consulted March 10, 2018.

Biggs, Simon (1998) The Waiting Room, 1998. http://littlepig.org.uk/installations/waiting/waiting.htm Consulted March 3, 2018.

Cardiff, Janet & Miller, George (2012) Alter Bahnhof Video Walk, commissioned for dOCUMENTA 13, Kassel, Germany. http://www.cardiffmiller.com/artworks/walks/bahnhof.html Consulted March 20, 2018

Cresswell, Tim (2017) "Towards *Topopoetics*: Space, Place and the Poem", In: Janz, Bruno (eds) Place, Space and Hermeneutics. Contributions to Hermeneutics, vol 5. Springer, Cham

Debord, Guy (1956) "Theory of the Dérive", in The Situationist International Anthology (trans. Ken Knabb), Berkeley: Bureau of Public Secrets 2006 (first published in Les Lèvres Nues #9, November 1956).

Engberg, Maria (2017) Augmented and Mixed Reality Design for contested and challenging histories. *MW17: MW 2017*. Published January 30, 2017. Consulted September 4, 2017. https://mw17.mwconf.org/paper/augmented-and-mixed-reality-design-for-contested-and-challenging-histories-postcolonial-approaches-to-site-specific-storytelling/

Gibbons, Joan (2007) Contemporary Art and Memory: Images of Recollection and Remembrance, London: I.B. Taurus.

Microsoft a. (2017) https://developer.microsoft.com/en-us/windows/mixed-reality/gestures#hand_recognition. Consulted November 2, 2017

Microsoft b. (2017) https://developer.microsoft.com/en-us/windows/mixed-reality/gestures#gaze-and-commit. Consulted November 2, 2017

Stationhouse Opera (1996) Dedesnn nn rrr, commissioned for Theater de Welt, Dresden, Germany. http://www.stationhouseopera.com/project/6042/ Consulted March 20, 2018

Yates, Frances (1966) The Art of Memory, London: Routledge & Kegan Paul 1966, Pimlico Edition, 1992.

---

[1] Originally in Cicero, De Oratore, II, lxxxvi, 351-4, 55 BCE, translated by E.W. Sutton and H. Rackham as De Oratore of Cicero (1942), Loeb Classical Library, London: Heinemann.

[2] Available in English as Rhetorica ad Herrenium, translated by Harry Kaplan (1954), Loeb Classical Library, London: Heinemann, available at https://archive.org/details/adcherenniumdera00capluoft (accessed 19 March 2018).

[3] For a discussion of this and related works see Engberg 2017.

[4] The Microsoft Hololens incorporates the speech recognition software Cortana that is available across much of the Windows 10 environment. In Mnemo Cortana functionality is used to acquire both the speech to be written into the space around the interactor and for voice command control of the software.