FusionJournal

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Fusion Journal is an international, online scholarly journal for the communication, creative industries and media arts disciplines. Co-founded by the Faculty of Arts and Education, Charles Sturt University (Australia) and the College of Arts, University of Lincoln (United Kingdom), ***Fusion Journal*** publishes refereed articles, creative works and other practice-led forms of output.

Issue 16
Engaging Technologies in Practices

Editor

Eleanor Gates-Stuart (Charles Sturt University)

Contents

Editorial: Underlining technologies in research practice utilising digital entrepreneurship in creating visual narratives/storytelling

Eleanor Gates-Stuart[1]

This 016 issue of *Fusion Journal* marks a successful seventh year of the journal since its first issue in February 2013. As the new Managing Editor of *Fusion Journal*, I would like to acknowledge the founding editors, Jane Mills[2] and Craig Bremner,[3] as being inspirational in steering the aspiration of the original journal. In her article in Issue 01, Jane set the background to *Fusion Journal*, outlining the rhetorical context to its history within a merger of two schools, to form the current School of Communication and Creative Industries at Charles Sturt University, thus creating a positive move of collegiality and innovation for research and establishing the online *Fusion Journal*. The journal's name evolved, explained:

> *In all, the term 'fusion' not only fitted the aspirations of the journal but opened up new ideas and provoked exciting collisions and creative frictions in preliminary discussions among the founding editors and all others involved in the early days of developing fusion. (Mills)*

Fusion Journal's mission and aims remain strong, fostering the interdisciplinary and creative practice in its scholarly critical awareness and openness of dialogue, flourishing mentorship and collaboration.[4] As we welcome our new Editorial Board, representative of interdisciplinary expertise and diverse research fields, Jane continues the journey with *Fusion Journal*, as does Kim Woodland (our Production Editor) and Patrick McKenzie (web maintenance). Given this brief introduction and moving forward, reminiscent of the beginnings of *Fusion Journal*, the reimagining process and visioning for future issues is an exciting development of our next stages. Although we have some journal issues committed for next year (2020), *Fusion Journal* Issue 16 provides us with a momentary space to pause, reflect on good practice, absorb our contributed wealth of knowledge and set the pace for publishing new ideas and, as always, remaining true to our aims as a scholarly journal for the communication, creative industries and media arts disciplines.

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[4] *Fusion Journal* Mission Statement, Aims and Scope. Faculty of Arts & Education, Charles Sturt University

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This 016 issue of *Fusion Journal* focuses on how researchers engage with technologies in their practices, utilising digital entrepreneurship, technology transfer and data information in shifting ways, redefining traditional creative perspectives, visualisation and activities in creating visual narratives/storytelling. The call for content was driven from a question asked in relation to the wider visibility of the creative industries, particularly in and amongst a range of university disciplines as far reaching as science, engineering and agriculture – an interesting question given that collaborative research practices exist in many cross-disciplinary areas and much of our practice is an intersection of cross-references. However, it is a timely question, as engaging technologies fuse creative innovation, and its visibility can be extremely effective but can also seem hidden.

The use of technologies in research is not necessarily a new direction; however, as these technologies widen our capabilities in the communication and understanding of models of practice, the complexities are enriched, increasing our knowledge and impact, connectivity and conceptual development. This special issue of *Fusion Journal* aims to increase our understanding of these new practices from differing perspectives and to support interdisciplinary research; for instance, this issue brings together four very different articles, addressing the creative application of technology in cross-disciplinary practice as well as being embedded, processed and enriched as an artistic outcome. The authors may seem similar, addressing personal perspectives in their unique systems of artistic knowledge that is the integrity and the challenge of visualising and communicating complex information – yet the underlining technologies in their practice present monumental perspectives and achievement evident through these works.

Andrew Hagan's article, *Painting with Pixels: The Art of Communication Using Animation and Visual Effects,* takes us on a personal journey and explains his experience of the early introduction of computers in days when applying creativity to a formalistic system was a calculated vista of imagination, certainly in achieving a vision by any means successfully. Mindful of his enterprise and the challenge of new technology, in this editorial overview I am reminded of these means, arguably, as a process of production, ideally summarised in 'Reframing Art': *the artist shapes the end product according to imaginative constructs that are realised through the possibilities provided by the computer software* (Carter and Geczy). It is through the reframing of *Painting with Pixels* that Andrew begins his personal perspective from manipulating code in applying technology for making art, sharing his influences and creative perspectives that shape his imagination, being experimental in approach to establishing new ground and expertise. His experience and track of transcending knowledge for effective communication via new modes of storytelling challenge the limitations of technology, pushing the boundaries beyond *Painting with Pixels* to actively manipulating the technology for best practice and use of visual effects.

As for many artists, the use of technology is as much part of a toolkit as are the concepts, whilst complex ideas unfold and creative play entwines with intelligent decision making and experimental investigation; these factors are often understated as the result, the artwork, evolves as an entity in its own right, to invite curiosity, and be

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experiential and enjoyed by an audience. These creative assets, the thinking process and application of spatial awareness, sense of materials (physical and digitally constructed), spoken and unspoken words, ability to convey meaning and message, perform and express emotions are of crucial influence and expertise when multidisciplinary research is applied. Science and art collaborations enable people to think in ways that they have not always entertained (Gates-Stuart et al.); therefore, the opportunity to form a multidisciplinary team and develop a proof of concept project as outlined in the article, *Evoking Memories: Displacing the Fear of Technology*, provides an overview of the concept and challenges involved in determining and displacing the fear of technology for a person with dementia. The article describes the development involved in addressing the complexities for the person with dementia, when technology provides a means to enable virtual reality (VR) experiences – and yet the technology itself (the VR headset) is also an obstacle when the wearing of the device creates emotional uncertainty for the user. How other people can play a part in supporting this experience is a key element, as well as constructing the story in asking the person with dementia, "*Where would you like to visit?*". The article addresses the problems that can be encountered for people unfamiliar with technology, yet finding a way to explore solutions for Health and Arts research as end users of technology, whilst being creative in the application of arts and technology within the multidisciplinary team.

Continuing on the theme of health and innovative technologies, it is exciting to see the benefit of long-term research commitment and personal development result in advanced educational research for VR immersive learning. In Zeynep Taçgın's article, *From Storyboard to Practice: My Virtual Operating Room*, she shares her journey of approximately 10 years in streamlining her practical experience, gaining medical knowledge learned as a non-medical specialist, building technological tools and developing augmented and virtual reality environments. Her ambitious research project eventuates as *My Virtual Operating Room (VOR)* with Zeynap sharing her research story with details relating to production, operation systems and co-design, particularly for immersive environments for instructional educational needs. She certainly defines the integrity and the challenge of visualising and communicating complex information as in 016 *Fusion Journal's* call for papers invitation; her article will interest instructional designers posed with improving learning outcomes whilst successfully implementing innovative design and VR immersive environments as an education model.

The complexity of landscape and its many dimensions is a fascinating article, *Night and Day – 7 Months*, by Bärbel Ullrich, as our attention is drawn to her time-lapsed photography as visual moments in time, focused on one site revealing multiple layers of the ecosystem and its density, spectacular and exposed. Given the infrastructure of technical planning and the creative compositional framework of the site, her collaboration with the environment is a partnership of story, the landscape giving its unspoilt natural honesty shared with animal and insect alike, revealed and experienced to us through lens and image capture. Her article includes photographs taken *night and day*, and what might appear on first view in the images as a construct of simple elements, is in fact worthy of lengthy gaze as intricate details are poetic and

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memorising, the technology to assist is forgotten and the aesthetic of a natural habitat is pure. Bärbel answers *Fusion Journal's* call, showing underlining technologies in her practice as presented in her own monumental perspectives.

This 016 issue of *Fusion Journal* is timely, as not only are we addressing how researchers engage with technologies in their practices within our School of Communication and Creative Industries but as a wider debate and conversations within our Charles Sturt University Faculties, other universities, local government and the related cultural arts and creative industries. As mentioned, the call for content related to the wider visibility of engaging technologies and creative innovation is reflected within the following articles in this journal – they are certainly diverse, distinctive and equitably innovative of technology. The expertise and strengths of multidisciplinary practice and value of research collaboration are noted as being highly prominent and instrumental, especially for engaging new research perspectives, knowledge and creative innovation. I would also like to reflect on one of the *Fusion Journal* aims, to encourage early career researchers by offering the opportunity to work alongside established researchers, and I congratulate the authors published in this issue. Finally, I would like to thank our journal reviewers for their considerable efforts and valued contribution, helping to bring this 016 issue to publication.

Professor Eleanor Gates-Stuart
Managing Editor, *Fusion Journal*

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About the author

Professor Eleanor Gates-Stuart is an international artist, specialising in interdisciplinary research, whose focus is primarily on scientific exploration and technology. She has held a number of educational leadership roles, internationally and nationally, particularly in research relating to the sciences, technology and art, working with major research organisations, museums, education, business and government. She is the Research and Post-Graduate Convenor for the School of Communication and Creative Industries, Managing Editor of *Fusion Journal*, affiliate member of the Graham Centre for Agricultural Innovation, and leads the development of the eXtended Reality Centre (XRC). Her research includes numerous professional associations, collaborating, publishing and presenting papers: in the UK, USA, Taiwan and Australia.

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Painting with pixels: The art of communication using animation and visual effects

Andrew Hagan[1]

Abstract

Animation and visual effects are leading disciplines for creating high-fidelity imagery that would otherwise be impossible to film or physically replicate in motion. A continually evolving art form founded upon a rich history of pre-digital traditions, it is theoretically possible to visually represent any concept with a capacity to enrich communication, increase focus, knowledge, empathy, impact, conceptual development and connectivity in ways not yet imagined. This article presents a personal account of how visual effects theory is interdependent with practical application and explores how the art and technology can be applied to interdisciplinary fields that have non-traditional creative perspectives on visualisation and activities in visual narratives/storytelling.

Keywords

Animation; Visual Effects; VFX; Virtual Reality; Augmented Reality; 3D

Introduction

Living in a small country town pre-internet with only two television channels made accessing information about computer-generated imagery (CGI) challenging in the early 1980s. There was a new computer room at my school and speculation about what the machines might do once people learnt how to use them. In place of training, Usborne published a series of influential computer books such as *Introduction to Machine Code for Beginners* (Watts and Wharton) that demystified digital technology with colourful illustrations and put theory into practice. The teaching strategy proved effective for learning how computers work and I was able to code variants of the BASIC programming language across multiple platforms with relative ease. Mature concepts can be taught to children if the information is well presented, embraces passion, respects intellect, addresses curiosity and rewards effort. I discovered that digital technology is basically zeroes and ones. The bits are precise and replicable and if one applies imaginative uses to code, it can result in astonishing creative outcomes.

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My first computer in 1986 was a $99 (AUD) Dick Smith VZ300 featuring 16 kilobytes of memory, four colours and a maximum resolution of 128x64 pixels. To create a bitmap image, I started with an original sketch (Figure 1a) and drew a grid representing 128x64 pixels using a black pen and yellow, red, green, blue markers to paint the graphic (Figure 1b). I converted the colours into hand-written code that was typed precisely into the computer (Figure 1c), or the program would fail. There was no drive to save the program so the reward was seeing the image display until resetting (Figure 1d). The same task can easily be achieved today with any graphics program, even Microsoft Excel (Figure 1e).

Mastering the simplest elements (bits) was the key to unlock the mysteries of the digital world. Except for quantum computing, understanding this classical model of computation is critical for a technologist. The consequences of switching a single bit contain the power to negate all.

Conversely, the exponential power of combining trusted code to build more complex systems demonstrates unlimited potential. It was evident to me at an early age that computers could fit any purpose if the data input/processing/output were appropriate for the given task. With this fundamental knowledge, I was acutely aware that with an increased spatial resolution (detail) and greater bit-depth (colour), it may one day be possible to present any vision imaginable via digital means.

Cinema tells the story

Exposure to computers in my childhood was limited, but the sheer invention of seminal films like *Star Wars* (Lucas, Star Wars), *Raiders of the Lost Ark* (Spielberg) and *E.T. the Extra-Terrestrial* (Spielberg), impacted me and I recall the influence of George Lucas and Steven Spielberg at the time. In terms of cinematography, motion pictures hold the gold standard for epic visual storytelling over the past century (Box Office Mojo). Only three films listed in the Top 200 Lifetime Grosses rely purely on traditional practical/optical special effects (Figure 2). They are *Star Wars* (1977), *Star Wars: Episode V - The Empire Strikes Back* (1980) (Kershner, Star Wars: Episode V - The Empire Strikes Back) and *E.T. the Extra-Terrestrial* (1982). Technically, it might be only two, as Larry Cuba's work on the Death Star briefing scene in the original *Star Wars* qualifies as CGI (Sito 157). By 2019, 150 live-action films depended upon digital visual effects as an essential storytelling device and the other 47 films were entirely animated. Every film in the 200 Top Lifetime Grosses has used special effects, visual effects or animation to tell their story.

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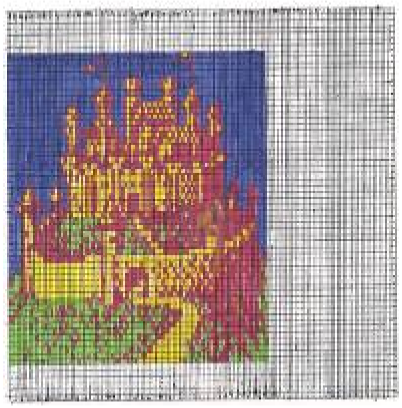
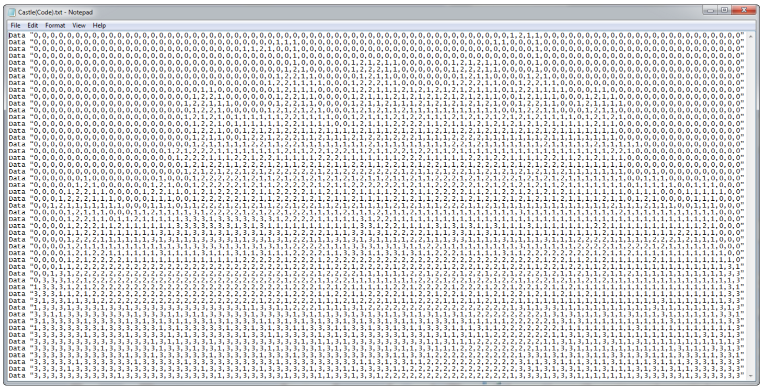
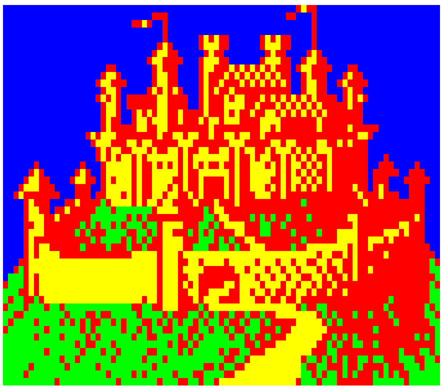
(a) The original pencilled sketch



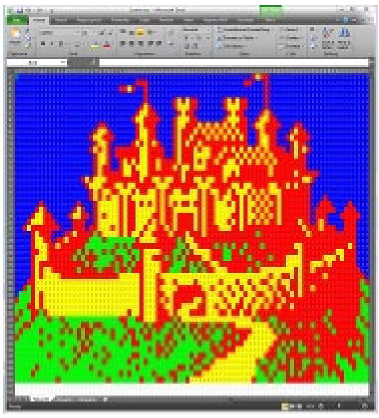
(b) Manually drawing with coloured textas



(c) Source code (was originally hand-written)



(d) Recreated computer image (via emulation)



(e) Comparison with Microsoft Excel

Figure 1. Creating a bitmap image.

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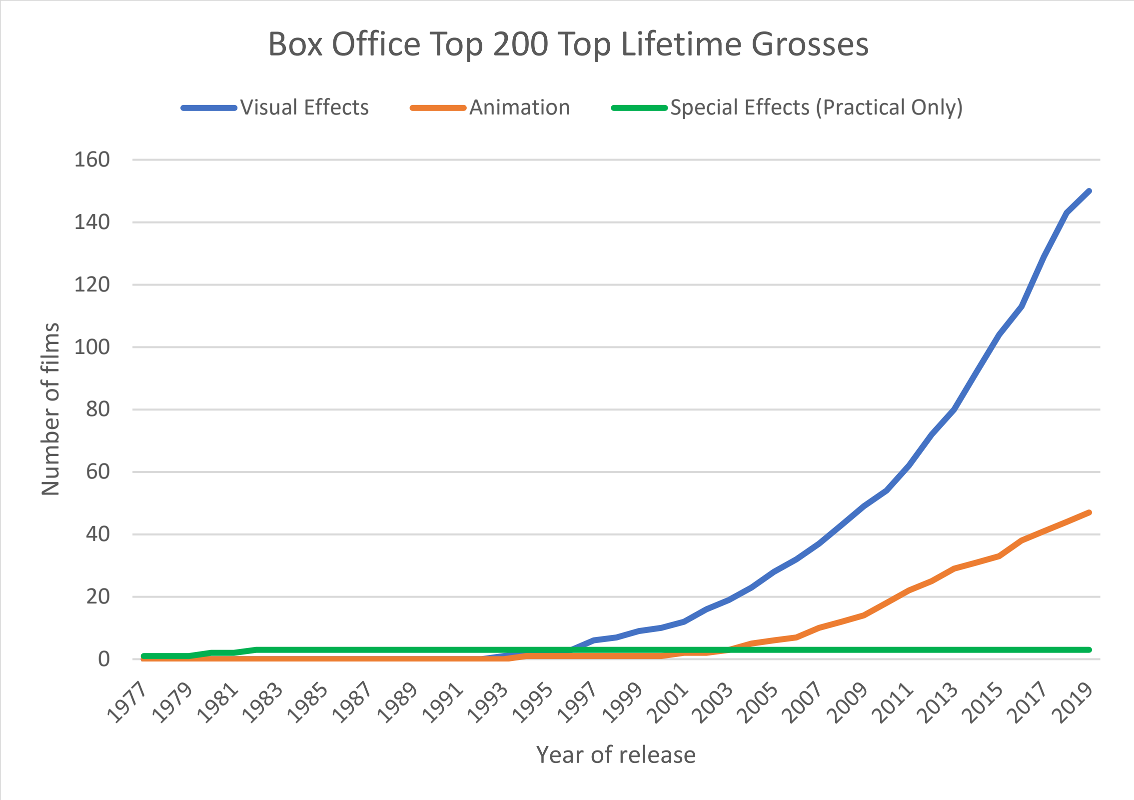

Figure 2. Box Office Top 200 Top Lifetime Grosses as of 1 November 2019 (Box Office Mojo).

Taking a more conservative view and adjusting grosses to estimate inflation over the past century, the dominance of fantastical films is more balanced with classical character-driven storylines. This approximation of financial parity over time demonstrates 82 films depended on visual effects and another 33 films were animated (Figure 3). Even when ignoring all the films using nuanced, practical/optical special effects, there are at least 152 films in the 200 Top Lifetime Adjusted Grosses that used special effects, visual effects or animation as an indispensable storytelling device (Box Office Mojo).

It is important to note that Visual Effects (VFX) does not replace Special Effects (SFX) and these disciplines work in tandem in live-action productions. The above chart only identifies pre-digital SFX, but the total number of SFX is cumulative with VFX in live-action films. The rule-of-thumb is to film minimal VFX and shoot everything possible in-camera. Scenes that are too dangerous or impractical to film with real elements employ special effects on-set to create a plausible photographic deception. Visual effects go further and visualise what is too dangerous, impractical or impossible to film with a camera. Masters of the craft mix these skill sets to maintain the audiences' suspension of disbelief and leave people wondering how the illusions were achieved, if they noticed the effects at all.

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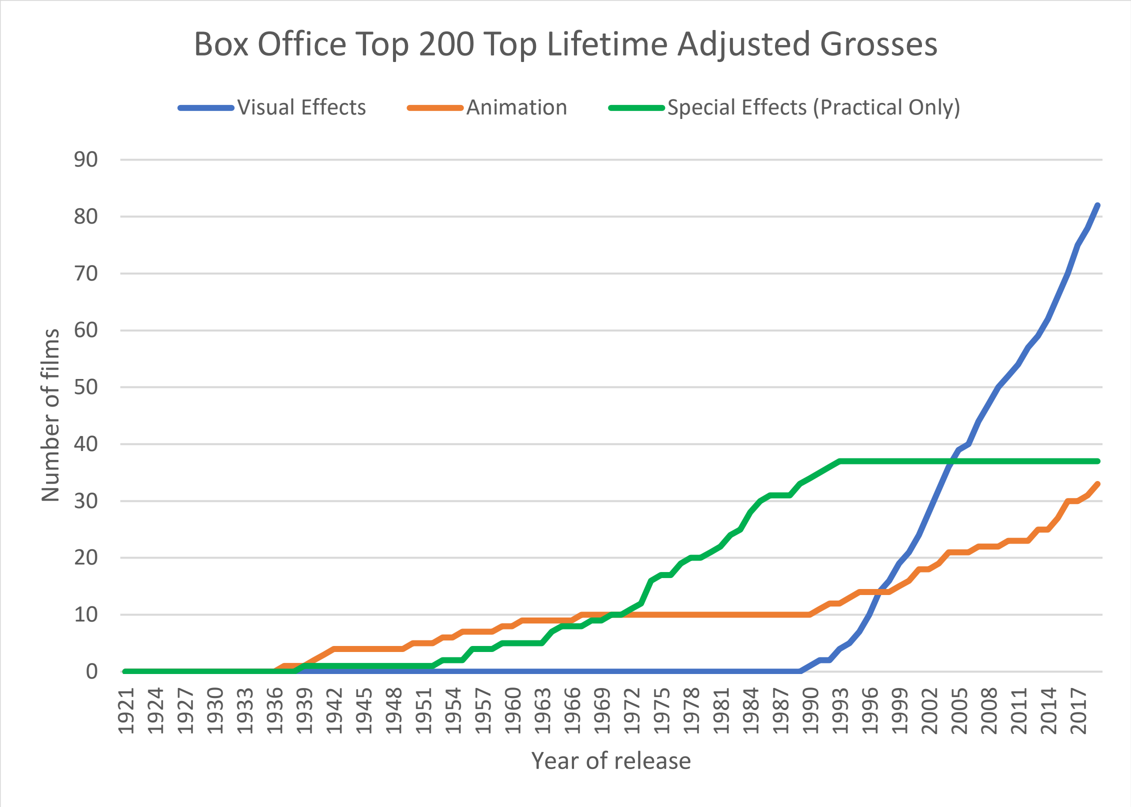

Figure 3. Box Office Top 200 Top Lifetime Adjusted Grosses as of 1 November 2019 (Box Office Mojo).

Artistry plays a critical role in the successful communication of visual ideas. James Cameron expresses his view on what skillset a computer artist requires (Kenneally);

> *When I was the CEO of Digital Domain, I always felt like I should get all my computer artists in a room and teach them, you know, Art History 101. Basic composition, basic perspective, linear perspective, aerial perspective, composition with colour, lighting, all of those things. Just the real basics because those aesthetics, they thought everything could be solved by math. It can't be solved by math. It's still an art form. (James Cameron)*

The Pixar founders were once critical of the mechanical types of animation exhibited at ACM SIGGRAPH conferences. As Ralph Guggenheim, producer of *Toy Story* (Lasseter) recalls, "in those days, computer animation, computer graphics was in the domain of guys in white lab coats." John Lasseter, director of *Toy Story* agreed, "all of the images in the animation were being created by the same people who wrote the software" (Kaplan and Milsom). The consensus was beautifully rendered 3D images pushed the boundaries of technical excellence but soulless animation lacked emotional connection. Compounding this was a widespread misconception, still applicable today, that computers generate the artistry. As John Lasseter lamented when asked, "what software did you use to animate Andre and Wally?" His answer, "it was just a key-frame

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animation system pretty much like other systems I've seen", left him bemused by the questionnaire insisting, "no, no. It was so funny. What software did you use?" (Kaplan and Milsom).

One of the most regrettable snubs in VFX history was the industry itself failing to recognise *TRON* (1982) (Lisberger) at the 55th Academy Awards when not a single question was asked about the computer graphics at the Best Visual Effects "Bake Off" or any nomination for Scientific or Technical achievement; the result of a false assumption that computers did all the work (Kallay 215-218).

I was fortunate to have some aptitude with drawing, illustration, painting, sculpting, model building, woodwork, metalwork, and electronics when applying skills to the computer. I endorse the professional opinion that the tactile experience of creating artworks in the real-world greatly assists what an artist can achieve in the virtual world. A personal weakness that would become a strength was naivety. I operated in an environment where insufficient knowledge about the challenges faced by the pioneers of early computer graphics resulted in a positive mindset that fully committed me to a venture that might otherwise not been attempted.

State of Art

I proposed making a short live-action visual effects film for my final year in high school despite not owning a video camera, 3D/animation/editing software or capable computer at the time. This educated risk was the culmination of extensive research, an 8-minute animation created in two years earlier, a stringent saving and trade-in regime where I sold each computer in order to advance from the VZ300 to a Commodore 64, Amiga 500 and Amiga 1200, and the generosity of friends to participate. I sought permission to be the first student to have a personal computer at my boarding school desk, against the wishes of well-meaning mentors who cautioned that "computers are just a fad". I mapped out a 10-month schedule and rapidly learned about video, photography, 3D, animation, digital compositing, graphics programming and sound. I created *State of the Art*, a fully digital 4-minute film that was selected for the national ArtExpress '93 tour (Board of Studies). The work coincided with the first-year video-based artworks were accepted into the exhibition.

The concept for *State of Art* was that exponentially-evolving technology, represented as an artificially intelligent machine communicating with uncanny personas, had the potential to radically alter our reality for the better but might also pose a threat to humanity if left to its own devices. The short film applied every visual effect technique I could employ on a consumer desktop computer in 1993 (Figure 4a). The entire film was rendered in 3D, except for a rotoscoped performance achieved with stop-motion photography (Figure 4b). The final renders do not show the high amount of detail in the models and textures as the technical challenges were immense, such as not enough memory to calculate shadows (Figure 4c). Video of the actor's performances was composited with 2D animation (Figure 4d) and morphing (Figure 4e). Animated geometry, materials and exploding/reforming particle effects featured in the storytelling (Figure 4f). The television and video transformed into the upper-body of a

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rigged robot with articulated fingers/hands (Figure 4g). In one shot, the geometry, textures and shaders of the entire raytraced scene morphed from simple to complex structures along with the animated character (Figure 4h).

There were no known digital artist career pathways at that time, let alone courses or textbooks to follow. The production process was an amalgamation of the best practices I could extract from reputable media at the time. I memorised behind-the-scenes film featurettes from televised 'Making of' specials and *Walt Disney's Wonderful World of Color* series, noted rare photos/interviews across various mediums, and trawled for niche articles in disposed magazines when volunteering at the recycling shed. I gravitated towards opportunities that generated luck and increased chances to learn the craft (Wiseman), though I did not conscientiously realise this at the time, I was also applying "production sense" in administering the project.

"This resulted in a production schedule that detailed overall progress with a realistic timeframe and measurable milestones (time management), along with a production pipeline that describes the workflow processes (efficiency), and develop the skills necessary to critically analyse and creatively solve priority matters resulting in the highest payoff for the final animation (production sense)." (Hagan, Illusion & Delusion: Living In Reality When Inventing Imaginary Worlds)

I made a digital film on a $1,000 computer because I could not afford a $2,000 VHS camera. As Tony Walters half-jokingly advises potential guerrilla filmmakers in *How to make Double the Fist* (Anderson and Moses), "there are many different kinds of camera available but any camera you can get your hands on for free, is the camera for you." The smart use of available resources determines production quality. Studio budgets allow for a higher degree of financial stability but not necessarily creative freedom. The democratisation of technology has allowed independent artists to engage with a more competitive media landscape in every passing year. A great story on a poor budget beats a poor story with a great budget.

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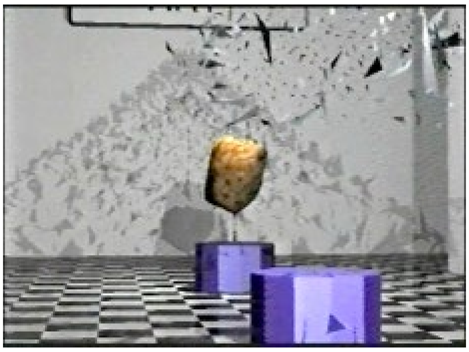
(a) Opening Title Sequence

(b) 3D render with rotoscoped composite

(c) Technical limits of rendering

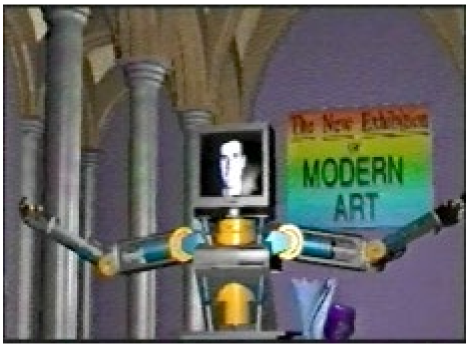
(d) Post-production video techniques

(e) Morphing between actors



(f) Exploding/reforming particle effects

(g) Fully rigged arms/fingers/hands



(h) A raytraced scene with all elements

Figure 4. *State of Art* (1993).

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Visual quality

As a general rule, a visual artist should always strive for the highest quality workflow as it is easier to reduce elements downstream than be compromised by substandard source material during production. Technology has an aesthetic; inherently bound by the unique digitisation processes of individual electronic systems transcribing the analogue world into finite bits of data for the digital realm. Knowing when to break the rules and use low-tech devices to achieve the desired outcome was demonstrated in *WATCHES* (Hagan, WATCHES), a public artwork for the Wagga Wagga City Council NIGHTLIGHTS initiative. *WATCHES* tested community reactions with a large-scale surveillance panel that monitored CCTV footage of the city at night. The artwork engaged with the passionate public debate about an increased surveillance culture within the community. The project required multiple camera setups in prominent locations at the most unsociable hours in order to provide an authentic experience of relaying live surveillance video at night (Figure 5). Privacy and respect for the law were paramount in filming. Five hours of timecoded high-definition surveillance panels was projected onto the council building wall (actually a four-minute loop) and the initial reactions thought the CCTV was real; until a title sequence revealed otherwise. Despite the political tension surrounding the topic, there were no complaints and only favourable feedback from the council, community and social media.

Figure 5. *WATCHES* (2015).

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Procedural animation

I was commissioned by Wagga Wagga City Council to create an original artwork for Charles Sturt University's Foundation Day with a brief that the animation must be red and envision an "annual celebration to recognise our past, acknowledge our beginnings and create awareness of who we are, what we value and where we are going." The timeframe was only a few days but with math, fractals and a clear conceptual vision, I was able to produce a 5-minute loop of high-resolution hypnotic procedural animation that successfully encapsulated the brand and message (Figure 6).

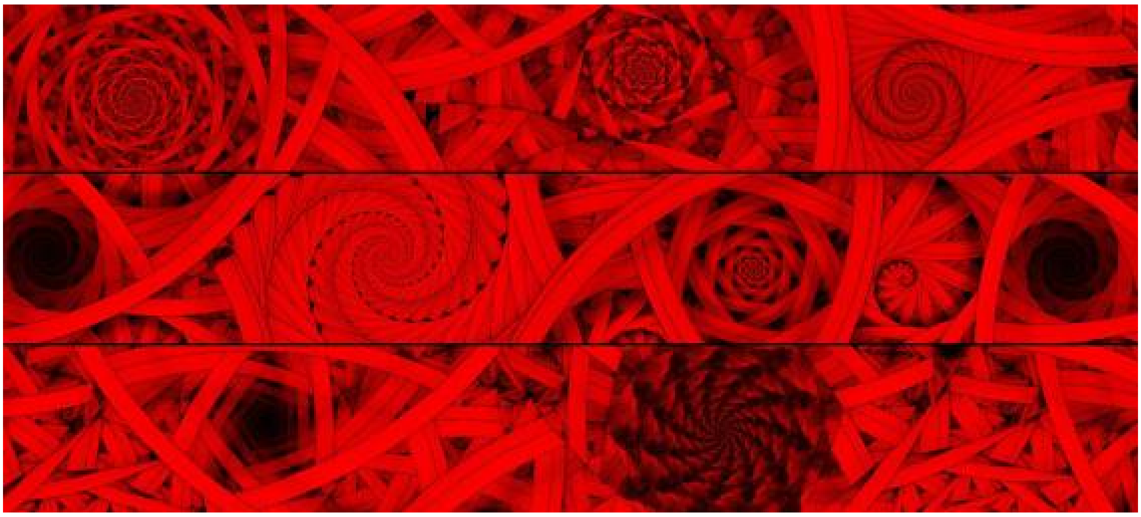

Figure 6. *Foundation Day* (2015) – 3 panels.

Film production

I was Visual Effects Supervisor on *Kapyong*, written and directed by Dennis K. Smith and produced by John Lewis of Arcimedia (Smith). I visualised 58 high-definition photorealistic shots to recreate the historical battle from 24th April 1951 using industry-standard VFX techniques (Figure 7). The documentary was launched by Prime Minister Julia Gillard who went to South Korea on ANZAC Day to lead the commemoration of the 60th anniversary of the Battle of Kapyong. Industry peers complimented the documentary for the cinema-grade digital compositing and the film contributed to a new wave of digital SLR cinematography and production for independent filmmakers.

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Figure 7. *Kapyong* (2011).

Public exhibitions

Their Light Still Shines commemorated the Centenary of ANZAC in collaboration with the Wagga Wagga City Council and the Museum of the Riverina – Botanic Gardens Site. The 15-minutes projection was commissioned to highlight stories from the region and respectfully document the human sacrifice in a sombre large-scale exhibit fit for public viewing (Figure 8). Akin to making a documentary, there was a clear objective but the narrative adapted as discoveries were made in response to the delicate filming / photographing / scanning of precious artefacts, digital restoration of historical portraits/photographs, and expert knowledge from the museum curator Michelle Maddison. In support of mutual community goals, the museum was given a hard drive with of all the archival-quality digital files created when researching the exhibition.

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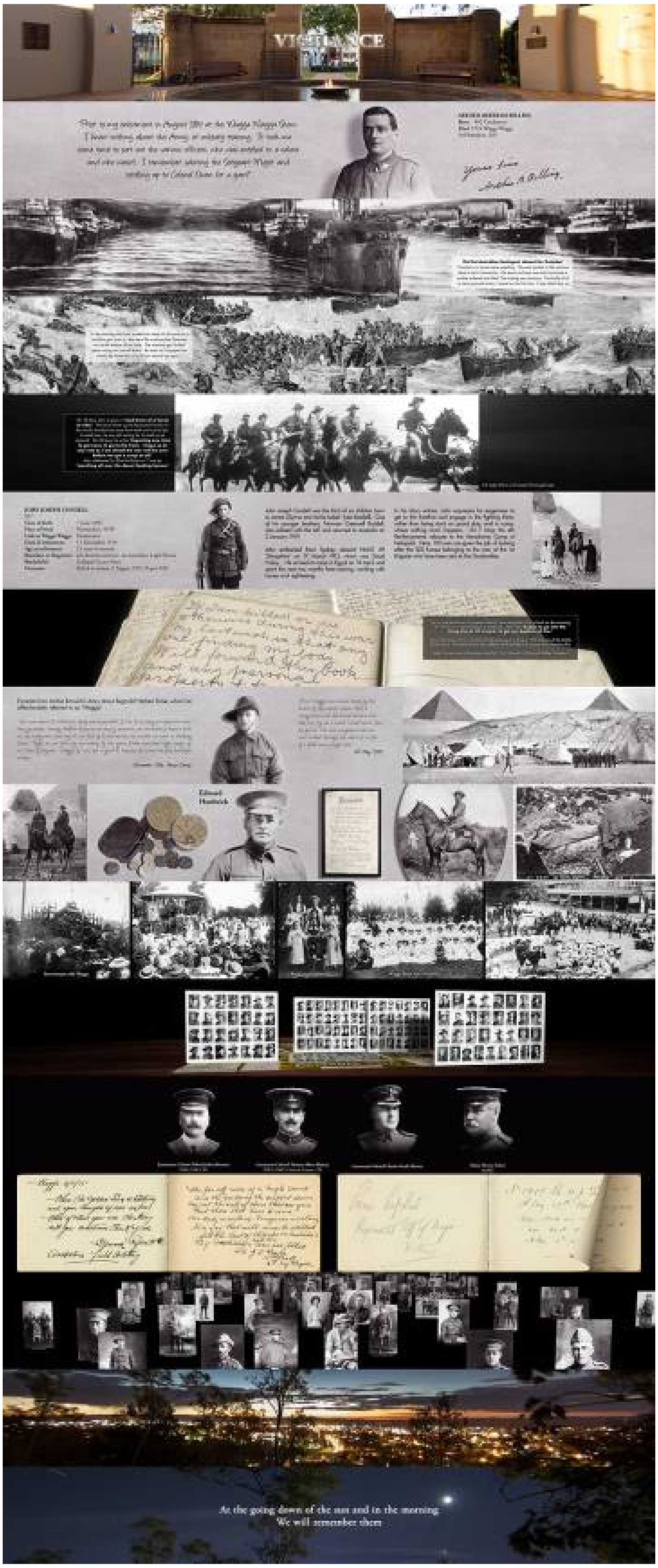

Figure 8. *Their Light Still Shines* (2015).

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Aerial perspectives

Enlighten was a collaboration with photographer Dr James Farley to produce a large-scale 18-min public art projection for the Wagga Wagga City Council to explore how principles of landscape photography/cinematography could be applied to showcase the city and surrounding regions (Figure 9). Familiar places from unseen perspectives offered new insights about our place within the ecosystem and invited viewers to appreciate the planet we live in through a completely new lens.

Figure 9. *Enlighten* playing on the Wagga Wagga City Council's 50 x 8m screen.

Maintaining curiosity and a willingness to experiment helps to test whether theoretical ideas work in practice. In this example, I successfully generated a detailed 360° 3D scene using photogrammetry on a short drone flight. The image shows the original footage above, and the fully textured model below (Figure 10). The result opens new pathways of research and applications to the real-world.

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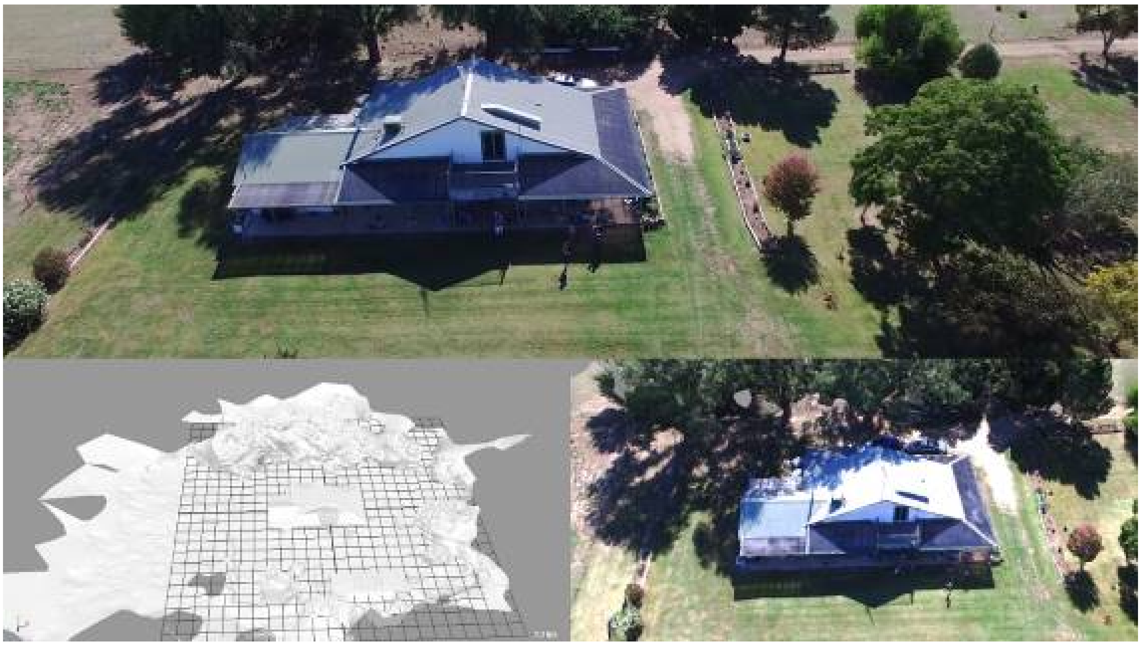

Figure 10. Successful photogrammetry result from basic drone footage.

Game engines

The Poet's Exchange was a public art projection showcasing three original poems as part of the *FUSION 2017* multi-cultural street festival (Hagan, The Poet's Exchange). For each poem, there was an English translation and the native language text. Red Room Poetry developed the three works, *Untitled* by Anwar, Aymen and Qasim (Figure 11a), *Khudi* by Zohab Zee Khan (Figure 11b) & *Africa* by Jackline Okot (Figure 11c). The projection featured a photorealistic room with each poem rendered in various virtual landscapes. I used game-engine technology to create four hyper-realistic scenes at 7232 x 1080 pixels with unprecedented speed of up to 60 frames rendered per-minute. The game engine employed, Unreal Engine 4, demonstrated that digital artists could overcome previously impossible deadlines without compromising on creative control. The video contained 4 x 1-minute sequences that were the first project to play 50 frames-per-second animations on the city's projector - double the standard framerate for smoother motion.

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(a) *Untitled* by Anwar, Aymen and Qasim

(b) *Khudi* by Zohab Zee Khan

(c) *Africa* by Jackline Okot

Figure 11. Three poems from *The Poet's Exchange*.

Real-time visualisation

Dr Waseem Afzal linked his work in Information Studies with my VFX interests, to develop a digital prototype of an immersive 3D-environment, based on research concerning informational and affective properties of extremists' content, to educate youth against extremism. *Using virtual reality to counter extremism* consisted of concept/script development with actors (Figure 12a), full-body motion and facial performance capture (Figure 12b), translation of motion onto digital characters (Figure 12c), live and post-production animation work on virtual performances (Figure 12d), rendered animation in sync with original audio (Figure 12e), and playback to multiple formats (Figure 12f) (Afzal and Hagan). The virtual production workflow was then embedded in the Animation & Visual Effects coursework at CSU and there is a high demand for creative partnerships related to STEAM (Science, Technology, Engineering, Arts and Mathematics).

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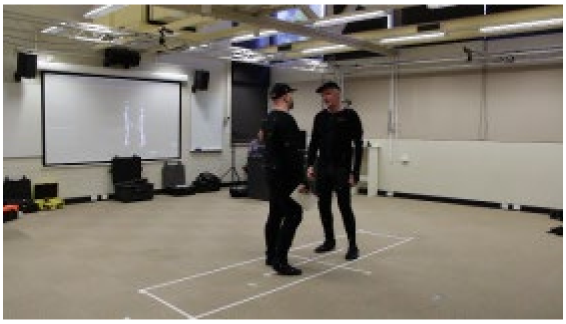

(a) Concept/script development

(b) Translation of motion onto characters

(c) Performance capture

(d) Live and post-production animation

d

(e) Rendered animation with audio

(f) Playback to multiple formats

Figure 12. Virtual production workflow.

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360° immersion

The *360° Immersive Biodiversity Project* is a partnership between CSU Green and the School of Communications and Creative Industries at Charles Sturt University to monitor the effectiveness of management strategies in maximising biodiversity values using comparative analysis of 360° recordings over three years (Figure 13a). The research also investigates other methods of data capture, such as reconstructing a 3D mesh from LIDAR point cloud information (Figure 13b). This proof of concept model demonstrates the ability to visualise outdoor environments with the capacity to walk through them using real-time with game engine technology.

(a) 360° Video Capture

(a) 3D mesh from LIDAR scan

Figure 13. 360° Immersive Biodiversity Project (work in progress).

Conclusion

Digital visual artists can transcend the limitations of the physical camera and apply their creative skillsets to non-linear open-ended environments to discover effective new modes of communication. Animation and visual effects artists are ideal candidates for interdisciplinary careers that require 360° workflows, stereoscopy, interactivity, immersion, performance capture, game engines, virtual productions, hybrid production techniques and pioneering work in the evolving fields of Virtual / Augmented / Mixed/ Extended Reality (VR/AR/MR/XR) (Edwards). Beyond pre-conceived notions that visual narratives/storytelling is bound to the entertainment sector, digital artists are ready to work across primary, secondary, tertiary and quaternary industries. The exponential growth across interdisciplinary fields to communicate using the skills of digital artists mirrors the impact of the visual effects revolution at the box office. As academia, industry, communities and government work collectively to improve society; creative artists are ready to help with the best practices in visual communication. There is no need to redraw a grid every time an idea is sparked.

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About the author

Andrew Hagan has over 20 years' experience as an academic and practitioner in industry. He is a Visual Effects Producer & Supervisor, co-director of the Australian International Animation Festival, Adobe Certified Expert, Autodesk Certified Maya Instructor, international judge, and with relevant degrees in BA (Fine Arts) (Honours) and BA (Television Production), he established Australia's first undergraduate university degree dedicated to the art and science of Animation and Visual Effects. His latest work is in real-time visualisation that combines the art and science from diverse fields spanning primary, secondary, tertiary and quaternary industries.

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Evoking memories: Displacing the fear of technology

Eleanor Gates-Stuart, Marguerite Bramble, Rafael de Lima, Bernard Higgins, Coralie McKenzie, Samantha Dowdeswell, Robert Lewis and Sarah Redshaw[1]

Abstract

In a scenario where a person has limited ability to be independent and lacks the means to travel, other than with the help of others, the desire to go somewhere nevertheless remains. The question, *"Where would you like to go?"*, centred our thinking when designing a proof of concept, virtual reality (VR) artwork. People with dementia often express the desire to go home and VR can help them to 'go there' but they may be afraid of the technology. The key aspect to this work relates to a particular focus on people with dementia in residential care, addressing the uncertainty for people with dementia in wearing VR headsets. The project is centred on the relationship between family, the care in wanting to help someone and the persuasiveness of a younger family member in the challenge of approaching new technology. The work to a proof of concept stage has required collaboration to bring many elements together, including technical production, acting, voice, animation, etc. This is a first stage that can be developed to assist the health sector in harnessing VR technology. This article provides an overview of the factors involved in creating such a work, developing a proof of concept prior to extended study.

Keywords

Collaboration; Storytelling; Art and Science; Dementia

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Determining the brief and addressing the focus relating to creating a proof of concept

As a team of independent researchers involved in the creative application of digital technologies, particularly the use of virtual reality (VR) aligned with new methods of storytelling and positioning the human centrally as active participant, our research focus is collaboratively united. The project direction was to address the challenge of evoking memories for people with dementia in residential care, whether distant memory or momentarily forgotten thoughts. The possibility of using VR in the stimulation of past memories converted to story, replicated through a series of what might be familiar spaces to the person with dementia i.e., personal objects, artefact, workplace, home and other types of resonated environments including sounds, became a distinctive objective in our brief.

Displacing the fear of technology for the person with dementia had to be addressed, especially when the need to wear an unfamiliar piece of equipment, the headset, is required as well as the operation and navigation of the technology. The relationship of family and carers being an important factor in this situation, our brief centred on the valuable aspects of care and trust within personal relationships. This became a feature in the proof of concept, with a central focus on someone, a young child in this case, encouraging the use of the headset.

Emerging forms of interplay between academia and external stakeholders, creative industries and scientific organisations, including government can help to bring about an experience of 'going home'. The key aspect to this work relates to a particular focus

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on people with dementia in residential care, who often are in the mid to late stages of the condition and have a desire to go home.

The context

Dementia encompasses a number of conditions associated with neurological decline, with impairment ranging from memory loss to changes in behaviour and personality, difficulty recognising objects and understanding or expressing language, difficulties with speech and impaired judgement and visual and auditory hallucinations (Moyle et al. 2014). The picture for each person with dementia is complex and multidimensional, and drives a multidisciplinary health professional focus on person centred care, which redirects attention from the biomedical aspects of the condition to the subjective experience of the person with dementia (Moyle et al.2014). The framework for person centred care is a therapeutic response to both the neurological and social-psychological factors associated with dementia (Kitwood 1997). The concept of personhood leads us into each person's unique therapeutic space, 'into a way of being in which emotion and feeling are given a much larger place' (Kitwood 1997, 5).

For technologies to have therapeutic benefits for people with dementia this multidisciplinary, person centred approach is crucial. Whilst there has been some success with technologies, such as pet robots, or simulated presence therapy there is still a great deal of uncertainty around the wearing of VR headsets. The evidence suggests that involving families and friends would increase the likelihood of developing and 'bringing to life' an individual person with dementia's experience when using virtual reality (VR) (Moyle et al. 2017). All staff, including personal care attendants, registered nurses, enrolled nurses, allied health clinicians, and domestic staff must be involved and receive education so that they are confident in their ability to use VR devices with residents (Goh et al. 2017). This approach can enhance staff knowledge and confidence, thereby enhancing the use of technology in residential aged care facilities in order to improve care standards in people with dementia.

First challenges

Focusing a virtual reality (VR) piece for an individual person with dementia, their carers or relatives all bring their different technical and conceptual hurdles. It is perhaps because of these obstacles that research in the area of immersive-interactive virtual environments is up to this date somewhat lacking, drawing from relatively small sample sizes and critically needed (Flynn et al.2003).

Introducing a new piece of technology to a user-person with cognitive impairment could make for a very uncomfortable experience for the user – especially an interactive technology that is widely known for causing nausea and headaches, among other side effects (Cherniack 2011). Design flaws in the hardware could potentially encumber the interactive experience for any user as well, i.e., individual head and face shapes, having the user stand or sit down, donning wired or wireless head-mounted display (HMD),

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and higher or lower resolutions and frame rates all have implications for how or whether each person will benefit from a VR experience (Cherniack 2011).

Accessibility to the technology and the effectiveness of immersive and non-immersive VR for people with Alzheimer's and other neurodegenerative conditions was identified to be a priority for our research. Interactive VR is a medium that has evolved mostly from research in human-computer interaction (HCI) (Sutherland 1963) and, subsequently, game design and development. As such, the graphic interface inherently appeals to an *immediacy* between user and computer, in this case the HMD and controllers (Bolter and Grusin 2009). An initial difficulty in creating a comfortable experience was addressed in the design stage of our project.

Figure 1. Headset handed from child to person with dementia (the person with dementia as the viewer).

In our piece, the user is gently inserted into a new world and given time to habituate with the surroundings. A two-dimensional window *(looking through the headset)* within a 360-degree immersive environment begins the narrative – a motion captured child character (see Figure 1) takes the viewer to a rather peaceful and pastoral farm landscape (Figures 2 & 3). By not immediately enabling interactive features while at the same time positioning the user at the beginning of a narrative, our aim is to ease the levels of comfort for people with dementia in a HMD.

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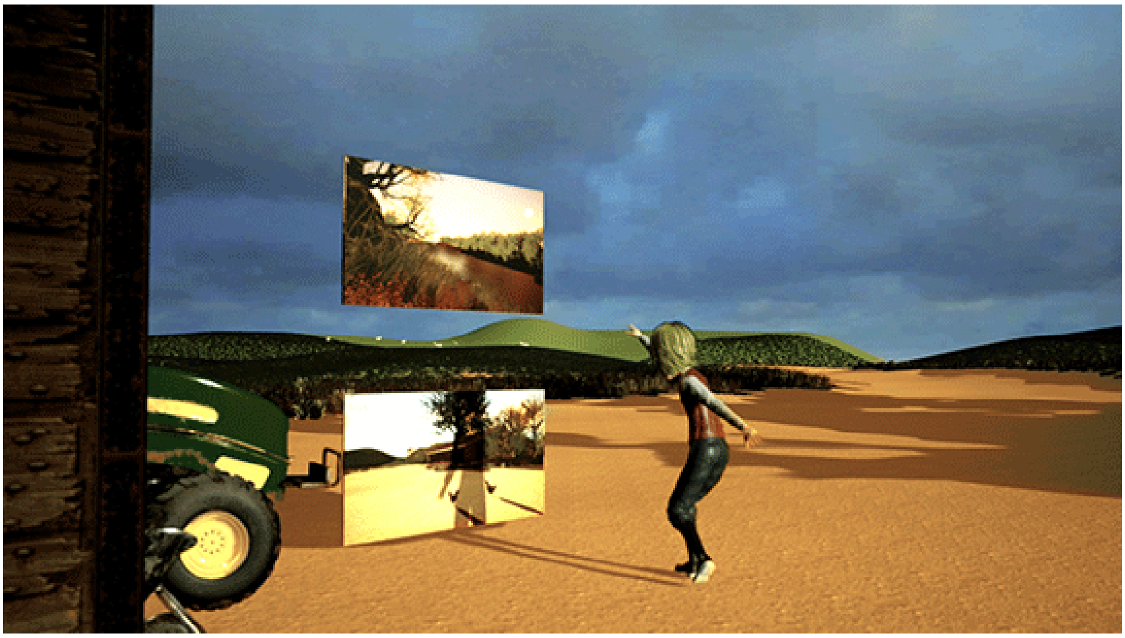

Figure 2. Menu screen: Authors.

We chose not to simply explain to a newcomer how to use VR, but made the 'how to' become a part of the narrative, at the same time inviting and facilitating immersion for the user. This is the approach that we propose for research in VR going forward. As a proof of concept we could pitch the story as a generic VR experience in this instance, allowing us time to build a case for future collaborative projects, led by the health practice brief in the application and use of VR. Haptics were discussed and would likely be implemented in future iterations of this project.

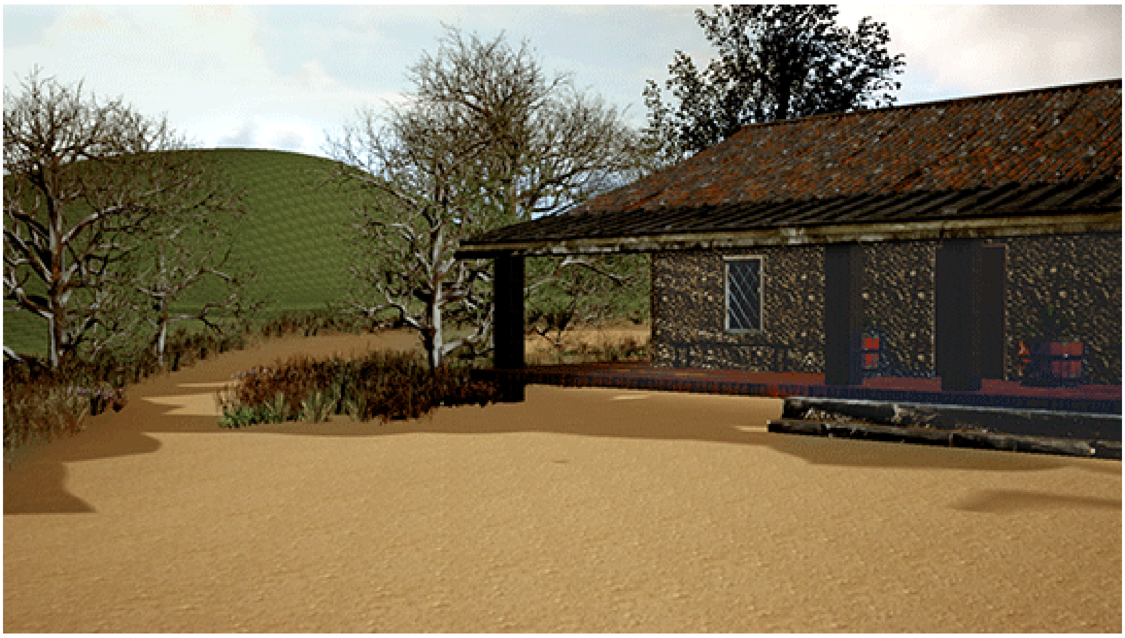

Figure 3. View of farm: Authors.

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As a multidisciplinary team of practitioners in health and arts, this co-produced proof of concept work drew on individual researcher's key discipline interests and expertise, thus creating a unique vision and knowledge to impart into the production. Narrative enquiry, performative ethnography and personal experiences were all taken into account as legitimate inputs to inform and build this piece (Haseman 2006).

A fundamental motivation for this research project was to address the complexities that remain unsolved in the VR in dementia treatment literature. While a more comprehensive study would be required in order to thoroughly assess the feasibility of this approach to ease the symptoms of dementia, this investigation is a first step to strengthen such efforts.

Development of the scenario

In order to create the experience for the user many dimensions within the VR environment need to be considered including how voice is used in the 'space' and the management of movement within the space as well as the 'story' to be told. In the following the exploration of these dimensions is described by the person creating the experience. In the first case this was two actors considering voice and movement to be captured and applied to a virtual character, a child.

How do you provide a voice for a body that isn't physical? This is the question the actor asked herself when approached to take part in the *Evoking Memories* research project. As an actor and voice and movement lecturer, finding the appropriate physical and vocal adjustments for a character always begins with the body and more specifically, your own body. You work with the canvas that you are familiar with and yet explore its vast landscapes of bumps and nooks and grooves to discover new pathways of expression. Rhythm of thought is integrated with voice and body allowing the internal life of the actor to be expressed externally. But again, we come back to the question, what happens if the body *isn't* physical? Or, more difficult still, isn't your own? What happens when you are provided with an image, an outline of a character with light brown hair, soft features and a thin structure? How do you begin to search for those qualities within yourself whilst looking at yourself i.e. the character on the screen? While simply imitating the thing itself might be an option there is a far more exciting way to explore this challenge. For deeper understanding there is a need to go back before going forward, meaning, you reverse the actor's process; you start externally to then find the internal, truthful responses.

Virtual reality and motion capture are new avenues for actors to serve as vehicles in creating various works of art such as films, video games, animations and even training videos for various fields of study. The actor needs to take the visual stimulus of the created character and storylines and apply them to their own bodies. What is it like to be a warrior with heavy armour? Wearing the armour, how does your body respond? If you are a tall thin creature with large horns on your head, where would the balance be placed in the body, try it, and let your imagination take the lead. How does the voice resonate in the body of a large, thick breasted character? Take the visual stimulus as inspiration and let your body and voice play. The more invested in physical and vocal

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explorations, the more imaginative life and internal life are allowed to respond to the environment around you.

Training for the Zero Wall: Motion Capture (MoCap), 360 Film and Virtual Spaces

In order to connect the actor to self and the environment for this project some Laban Movement System (LMS) exercises were used. The exercises began by focusing on the self in relation to the actors' own kinesphere, "the sphere around the body whose periphery can be reached by easily extended limbs without stepping away from that place which is the point of support when standing on one foot" (Laban 1966, p.10). Gradually awareness is then shifted to the wider space and volume.

Laban, one of the most influential choreographers and movement teachers, who 'came into the field of dance from the visual arts, where he had studied anatomy and proportion' (Moore 2009, 126) developed an interest in the relationships between the body and the surrounding space. The body and all its movements were viewed by Laban as a kind of "living architecture" (Laban 1974, 94). This architecture is depicted in several layers: firstly, the practical nature of the human body and how this relates to the concept and nature of architecture, meaning the human body must be balanced; secondly, the performer must acknowledge that the form and shape of their bodies follow a coherent pattern that is evident in architectural forms; lastly, the body must acknowledge that the architecture around them works as a continuum within (and from) their own bodies.

Two categories of the LMS were explored throughout the motion capture (MoCap) training process: Shape and Space. Shape is often an integrating factor for combining the categories into meaningful movement. There are several elements for Shape, however, for this investigation, Shape Forms (static shapes the actor makes in their immediate space) and Shape Qualities (describing the way the body changes in an active way, e.g., Opening, Closing, Advancing, Retreating and so on, which refer to specific dimensions of spatial orientations) were explored. Although not common, vocal exploration was also implemented throughout the training in order to increase vocal awareness and allow the subsequent sound to be affected by the physical shapes. This original way of incorporating body, space and shape was an integrative approach designed to connect imagination and the actors' physiovocal instrument. The Space category of the LMS is referred to as revealing the body's approach to kinesphere.

The Cube

When the actors are familiar with both the IPA and the various physiovocal sequences of the vowel chart, they explore Shape Form Qualities. Physiovocality progressed out into the immediate (MoCap studio) and internal (pharyngeal) space and created physical shapes within the body. The resultant sound was also shaped by the changing space of the mouth. The other form of inner space is the breath; the body shrinks and expands with each inhalation and exhalation and the voice.

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The baseline of Shape Qualities (see Figure 4), which is an indication of where the body is changing shape, is Opening/Closing (which in figure is not listed, but is practised by staying in the centre at the /ɜ/ and /ə/ and expanding arms and energies outwards to the sides of the external space while vocalising those vowels), Rising/Sinking, Advancing and retreating. These exercises were oriented towards process, a process of growing toward, as opposed to exploring space in the IPA chart which is destination oriented. This was practised in order to familiarise the actors with the volume they inhabited in the MoCap studio, for example, the corners of the room, the walls that surrounded them, and the space in between themselves at the parameters of the space itself.

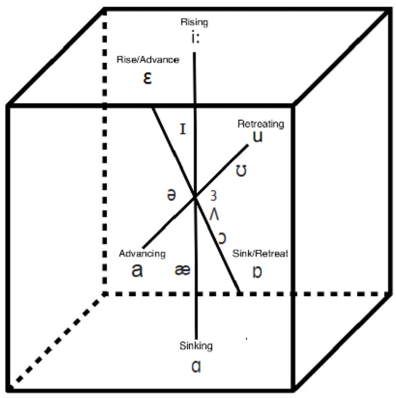

Figure 4. The Physiovocal Cube. (Source: Robert Lewis)

Figure 4 demonstrates these Shape Qualities and their relationship within the IPA chart, which are contained within a cube in order to give it context. The actors are asked to stand centred in the middle of a cube (physically established by the MoCap truss in the studio obtaining a cube shape in itself). The studio itself was the imagined cube and actors positioned themselves in the middle of the space (see Figure 5). As the actors moved through the sagittal and horizontal planes, they were asked to shift vowels based on the positioning of the vowels and corresponding plane.

In Figure 5, the actor, Samantha Dowdeswell, performs in the MoCap Truss after experiencing the cube exercise based on the LMS. As there were cameras around the truss, it was important for the performer to be aware of the 360 performance environment at all times, as well as connecting to the 'audience', which were, in this context, the director and technicians, as they were ultimately giving the actor advice, direction and feedback on the performance.

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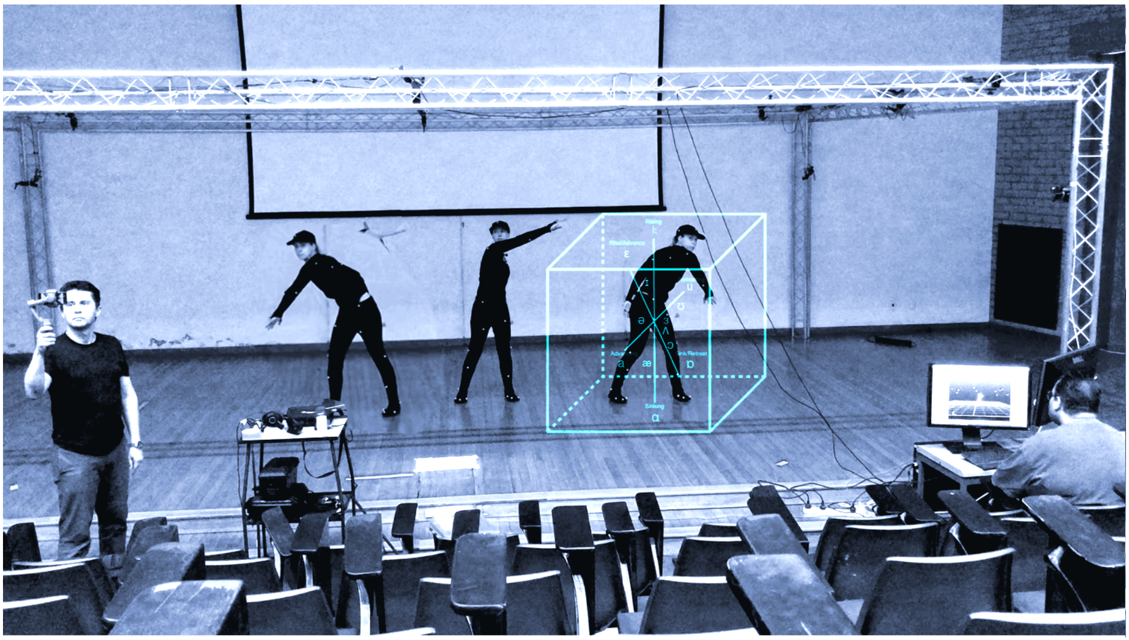

Figure 5. Samantha Dowdeswell performing in the MoCap Truss illustrated with the Physiovocal Cube overlay image, Swan Theatre, CSU Wagga Wagga.

Bring life to animated objects and scene – the challenges

There are many challenges to bringing an animated character to life and as animators we are trained to achieve this by using the 12 principles of animation developed by Walt Disney Studios in the 1930s (Thomas and Johnston 1981, 47-69). Building on this work from the 1930s, John Lasseter at Pixar applied these principles to 3D animation that speaks to giving life to a 3D model (Lasseter 1987, 35 – 44). The 3D object is considered as having appeal and personality – the two main aspects of the child character we were considering when tasked with creating this animation. Appeal, as Lasseter states, "means anything that a person likes to see: a quality of charm, pleasing design, simplicity, communication, or magnetism" (Lasseter 1987, 42).

We wanted to create a child character that would appeal to the intended audience and make them feel safe enough to try the VR headset. To achieve this we decided on giving the child character a playful personality. In character animation the goal is to create a character that seems to be thinking: if the character appears to be thinking and their movements seem to be determined by thought processes it helps create the illusion that the character is alive and not "just a series of unrelated motions" (Lasseter 1987, 43).

For this project to achieve a thinking, living character, we collaborated with an Acting lecturer, capturing her movements using motion capture technology (shown in Figure 6) and then retargeting that data onto the 3D model using Autodesk MotionBuilder. This animated character was then imported into Unreal Engine 4.23 environments that

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had been created using reference images of Australian farms and rivers. By building on the initial brief of ‘a young child helping their elderly family member feel comfortable using VR’ we were able to create a 3D model that appears to be thinking; ‘VR is exciting and fun and I want to share this with my elderly family member so they can hopefully evoke memories of their past’.

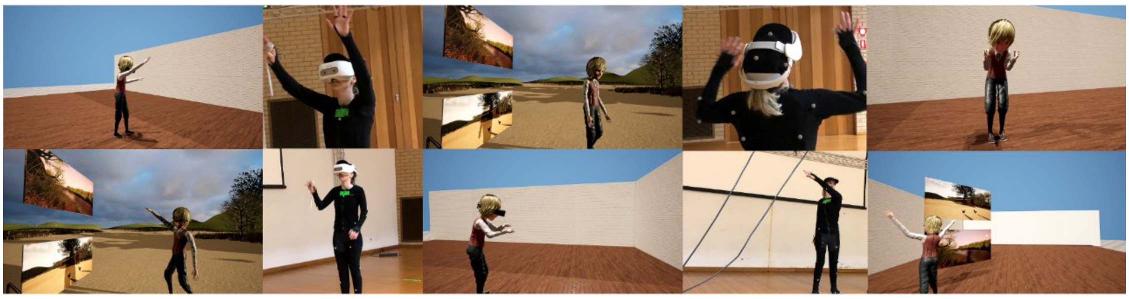

Figure 6. Movement to motion capture.

“CATCH MYSELF” – Storyboard to Scenes

A storyboard is a visual, physical presentation of a concept, be it a memory, futuristic vision, special effect or demonstration, allowing the viewer an opportunity to study the action, lighting, scene and make corrections until a suitable goal is achieved. Storyboarding remains one of the first steps in creating a cinematic animation, encompassing the brief, setting, lighting, character, audio, transitions, camera angles, dialogue (see Figure 7).

“Cinema added the elements of temporality, movement, and eventually sound to photography, allowing the photographic image to become a primary means of temporal narrative storytelling.” (Sturken & Cartwright 2009, 189).

Scientific evidence exists to support the direct correlation of images to memories. Storyboarding is the process of pencil drawing these photographs or memories (Brewer et al. 1998). Utilising this process allows the scenes and characters to come to life in the imagination of the viewer

When developing the storyboard for “Catch Myself” the brief from the artist influenced all imagery. As time was critical for this production, brainstorming generated input from the team under the direction of the artist: the character was to remain inviting and supportive at all times in order to overcome the obstacle of VR goggles whilst invoking participation from the user.

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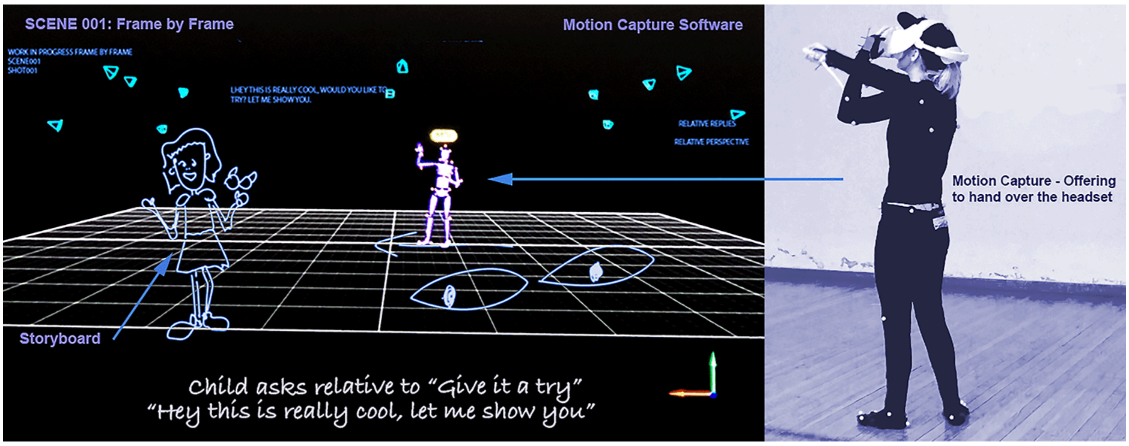

Figure 7. First sketches: Storyboard to motion capture.

The team's challenge was to create an environment that triggered memories in a potential participant. We addressed this challenge utilising visual triggers generic to each member of the team and potential participants. The Riverina locality was incorporated, using images of a farm to invoke memories which might have been experienced by any age group, perhaps holding sentimental memories of families, animals, sounds, textures, which are sensory stimuli.

Wagga Wagga contains a river central to the town, with most people travelling across the bridge, walking alongside the river banks, fishing, picnics, sunsets (represented in Figure 8). Both of these environments were addressed in "Catch Me" as whilst local, they remain timeless.

Figure 8. View of River: Authors.

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Each scene was developed in sequence with appropriate timing adjustments allowing the character to maintain integrity from a user perspective, dialogue driven for observation, response, combined with contribution from specialist team members.

Animation is considered to enable access to the mind of the viewer as well as to the inside of any object or subject it is covering, and this is particularly well suited for teaching (Thomas and Johnston 1981). Using visual options in conjunction with suggestions by the character, the approach involved responses to various stimuli. The nature of the work relies on verbal response to stimuli, questions, anthropometrics and ergonomics as part of the educational process. Sensory alternatives such as fabrics, flowers, scents and textures might also be incorporated in future versions. The potential remains to create new environments based on feedback

Conclusion

In determining this brief, part of the discussions in regards to VR often questioned the interaction of the participants in real time and that of the time being lived through the VR world, particularly as the potential for a self-narrative evolves (Gates-Stuart, 2019). This proof of concept proved to have many challenges due to its short timeframe for a point-in-time presentation, however, the collaborative aspect brought considerable value. Working as an interdisciplinary team including undergraduate and postgraduate students enabled a unique communication of knowledge across our individual disciplinary fields, thinking out of the box in the interpretation and structure of new narratives, placing ourselves in the 'place' of others, reframing challenges to simple enticement and 'have a go' invitation. 'Catch Myself: Frame by Frame' as a title is a self-check, keeping in the frame of technology as we map human movement, a frame of mind as we create virtual places of memories. This proof of concept is a starter project, first steps to applying creative industries research with health and nursing research, and a call for further collaborations.

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About the authors

The ‘Catch Myself’ team includes Professor Eleanor Gates-Stuart as creative director, Coralie McKenzie and Bernard Higgins, undergraduate students, and Rafael de Lima, postgraduate student, working on animations and editing, and contributions from acting academics, Samantha Dowdeswell and Dr Robert Lewis. Associate Professor Marguerite Bramble (Clinical Chair in Aged Care Practice Innovation| School of Nursing, Midwifery & Indigenous Health) has kindly been consulting with us on dementia for the project. Dr Sarah Redshaw has provided editing and streamlining of the article itself. This research builds on the opportunity to merge science-art-technology. The recreation of visual mindscapes (memory-idea-new thoughts-images) have potential positive benefits for our society in terms of working in areas of age-care population and health. This is an ideal outcome in extending the application of arts to applied research in the sciences and investigating our technologies: the scope of our VR capability and 3D image build content.

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From storyboard to practice: My Virtual Operating Room

Zeynep Taçgın[1]

Abstract

Innovative educational research integrates technological resources in a learning environment for finding the most appropriate method to increase the desired learning outcomes. This kind of research includes two fundamental stages. First, the learning material is designed and developed using suitable learning strategies and techniques. At the second stage, the developed product is applied to the target audience for the evaluation of the environment. The results of assessment direct the developer to redesign the material until the best version of the product is reached. Because of this interconnection the design reshapes and continues during development. This process explains why a well-designed learning environment is highly cumbersome and requires time, a qualified team and money. This article tells the development story of myVOR (my Virtual Operating Room) – from getting the idea off the ground to a finished product. myVOR is an immersive virtual reality (VR) learning environment, and the project has taken six years to make. Three different versions of myVOR have been developed over this time. The initial and latest versions were experientially tested on users. This study not only explains the distinguishing features of myVOR for each version but also summarises the findings of empirical studies to conduct the progress of learning with immersive VR.

Keywords

Virtual Reality; Learning Environment; Immersive; VR; Simulation

The nature of research depends on identifying a problem and offering solutions to solve the issue in practice. These problems and solutions are infinite under the umbrella of science, and each finding of the scientific studies only provides a drop of water to the knowledge of the ocean. Some of the areas have priority like defence, health and education. Structuring the research on these fields might provide some advantages like increased funding and greater impact.

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I am passionate about technology, and throughout my professional life, I work to integrate innovative technologies into learning environments. My journey in educational technologies started with distance education and material development. Approximately 10 years ago, the dazzling and vivid representation of the virtual and augmented reality environment started attracting my attention. I imagined creating a surgical simulator that doctors could use to define the individual data and specifications of their patients. Then, they can practise surgery on the virtual patient in order to reduce the risk and anticipate possible complications before the real operation.

I have a special interest in the medical field. Even though I am not a doctor, I know that gaining practical experience is extremely challenging because of the high-risk conditions (Ten Cate; Kneebone et al.; Kneebone; Law et al.; Windsor; Ota et al.; Jones et al.; Ward et al.). Using mixed reality systems might be an adequate option to make this dream real using intuitive learning (Huang). While I was thinking about this project, every day a new problem needed to be resolved such as the anatomy of a virtual patient, interaction types, speed and/or angle of the virtual objects, and registration of responses.

myVOR projects

I quickly discovered this kind of project was huge. Developing the environment not only requires use of emerging technologies, but it also needs a multidisciplinary team that includes doctors, coders, animators and designers, as well as significant funding. I decided to put strict parameters around the scope of the project. This project should overlap the requirements of learners and should be doable using fewer resources; it needed to be real. I simplified the scenario and determined an adequate method to offer a basic version of this dream.

Initially, I based my project on existing resources. I contacted a nurse to reinforce the theoretical background of this project (Taçgın). I interviewed her and some of her colleagues to discover the problematic topics for teaching. Then, I reviewed the nursing literature to specify the learning subjects. I wanted to use gesture control to teach the skills and procedures. After interviewing five surgical nurses, I noticed that they had consensus about a lack of practice during their training. After taking advice from an older surgical nurse academic, I decided to develop this VR simulation for teaching preoperative surgical procedures and concepts to nursing students.

Nursing education uses an observation-based shadowing technique (Wyoming) to teach practical skills. This technique is not always enough to provide sufficient experience (Kneebone); for this reason, nurses have technical performance issues early in their professional lives (Undre et al.). They can lack knowledge with regard to the procedures as well (Pupkiewicz, Kitson and Perry). The nursing faculties and hospitals use manikins[2] in the skill labs (Herrmann-Werner et al.) to reinforce learners' practical skills. Learning scenarios (Kneebone et al.; Kneebone; Herrmann-Werner et al.; Ota et al.; Paige et al.; Ramnarayan Paragi Gururaja et al.), web-supported learning

[2] Manikins are the anatomical and interactive model of the human body.

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environments (Ramnarayan Paragi Gururaja et al.; Ward et al.; Whitson et al.; Kneebone) and problem scenarios (Sachdeva, Pellegrini and Johnson; Whitson et al.; Jones et al.; Ward et al.; Ramnarayan Paragi Gururaja et al.; Davis; Davis et al.) are used to overcome the limitations of traditional learning techniques. Each of these alternative methods has other restrictions such as instructor dependency, expensive devices and a lack of debriefing.

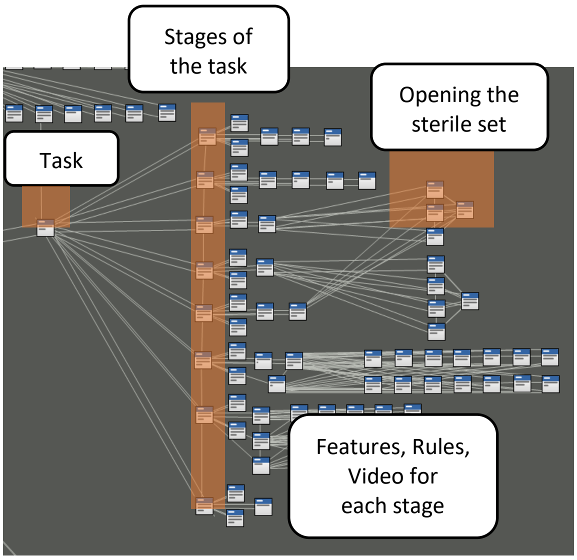
After analysing these requirements, I prepared a project form for funding and organised the research team for developing myVOR (my Virtual Operating Room). After the project was approved (EGT-C-DRP-200716-0392),[3] I gained insights about nursing terminology under the consultancy of an expert nurse who supported this project from the beginning until the end. Then, I prepared the storyboard[4] to represent the features of essential simulation over eight months. I used the catalogues of medical instruments for realistic design and learned a few procedures about preoperation. I used Twine[5] (Figure 1) for the main storyboard and added the specifications of the required instruments of the virtual operating room and learning scenarios. The storyboard (Figure 1a, Figure 1b) also included the relationship between the procedures. I designed two other storyboards to represent the interface of myVOR including menu and navigation components (Figure 1e, Figure 1f), and theoretical knowledge (Figure 1d) of the simulation.

After the storyboard was completed, I used the prepared 3D assets, but they were not enough to design a complete operating room experience to teach preoperative procedures to the nursing students. As seen in Figure 2, the team modelled more than 200 3D surgical instruments using Solidworks. We transferred and restructured these 3D models using the Unity game engine. The nurse checked the suitability of the environment, instruments and the learning scenario for each step. The initial version of myVOR (Figure 3) was developed in five months with collaborative teamwork.

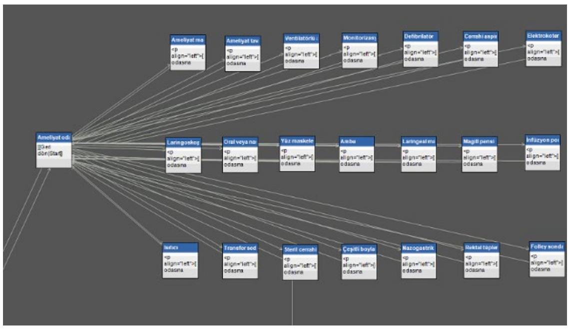
The project and material development had to be completed before I could start the data gathering phase of this research project. My research questions were:

- Was myVOR effective to teach the preoperative process to the nursing students?
- What experiences do the students learn using VR?

[3] The initial version of this project received ethics approval from Marmara University Medical Faculty (ID: 09.2015.242/70737436-050.06.04-). All participants signed consent forms.
[4] A storyboard is graphical representation of the product, which includes pictures, notes, dialogs or interactions.
[5] Twine is a web-based storyboard platform.

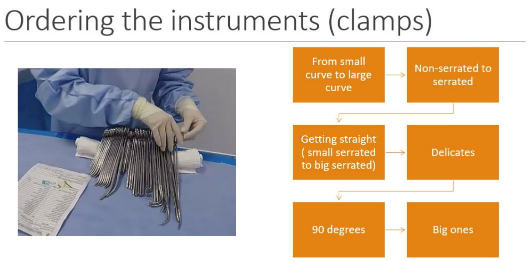


(a) Twine: procedures

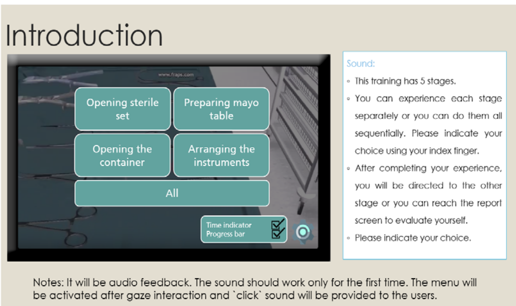


(b) Twine: instruments

(c) Twine output for a sample instrument



(d) Rules for ordering instruments



(e) Menu interface

(f) Interaction types and features

Figure 1. The sample storyboard screens.

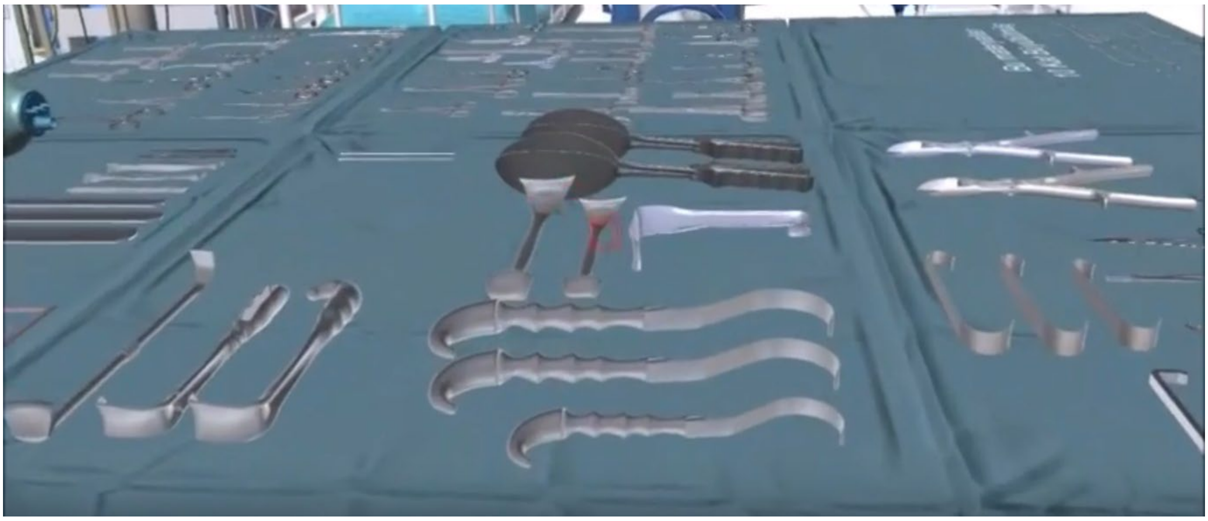


Figure 2. The designed instruments.

The learning scenario of myVOR started with the menu screen (Figure 3a). Using this interface, users could start the simulation, look at the sample real-life videos (Figure 3b), evaluate themselves via the report screen (Figure 3f) and activate/deactivate the time indicator or progress bar. After starting the simulation, they completed a total of 12 tasks of preoperative processes in the application area (Figure 3c). As seen in Figure 3d and Figure 3e, they interacted with the virtual objects using their physical hand movements.

I applied myVOR to the 14 third year nursing students who completed the internship and took related lectures about the preoperative process (Figure 4). In the first session, they struggled with the Head-mounted Display (HMD) cables and interaction methods. I understood that they did not have enough theoretical knowledge to complete the learning scenario of myVOR despite having taken lectures and an internship. Despite this, the students loved experiencing VR and were amazed by the technology. I added hints and instructions for the second session. In this session they were more confident using VR, and the added learning components worked well. In the third session, students were spending more time and trying to investigate the functionalities of myVOR. They were watching sample videos to see the correct implementation and using the report screen for self-evaluation. The majority of participants implemented the scenario correctly, and even they were shocked that they learned. After the last session, 11 of them achieved more than a 70-point score as a result of a paper-based exam. According to Bloom’s mastery learning model, 70/100 is the minimum score to be successful. Depending on this model, it is possible to say that the initial version of myVOR helped the learners to reach the desired learning outcomes.

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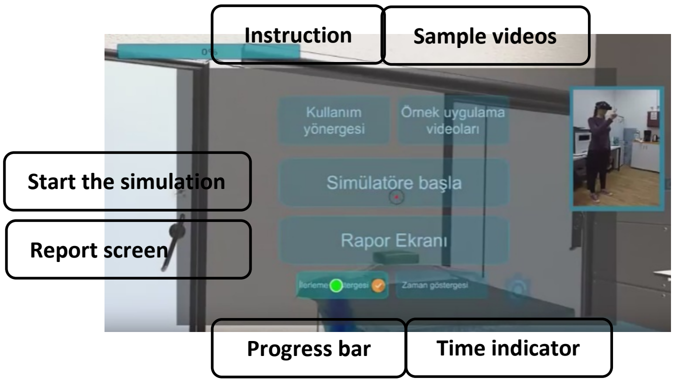
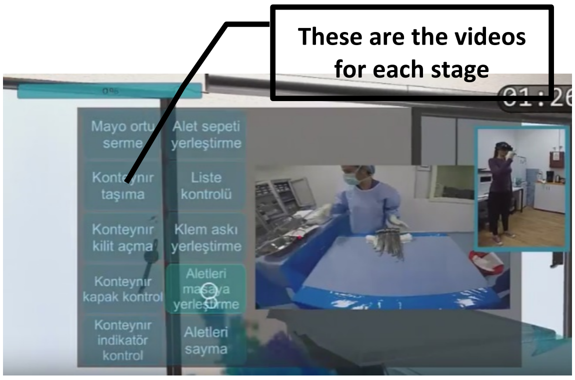
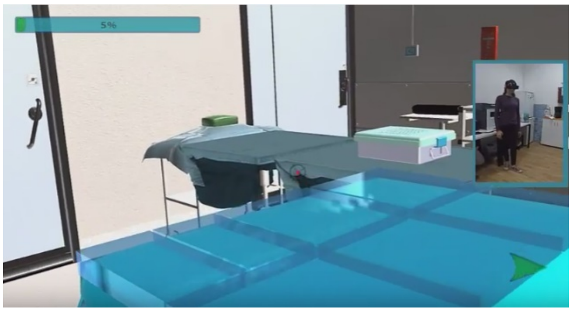


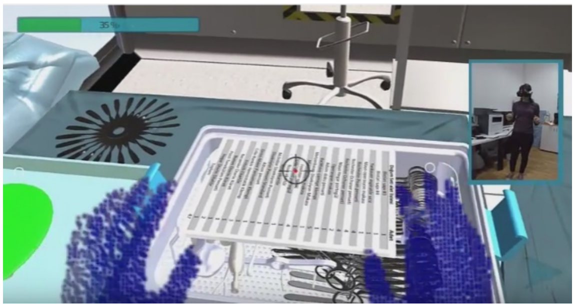
(a) Interface



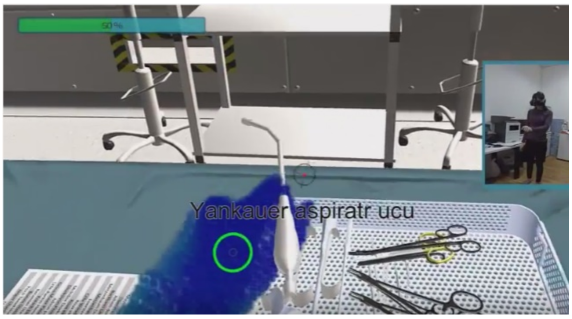
(b) Sample videos



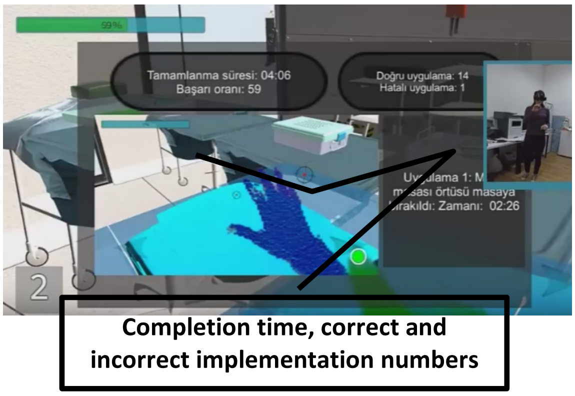
(c) Application screen



(d) Surgical container



(e) Interaction



(f) Report screen

Figure 3. The interfaces of myVOR.

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(a) (b)

Figure 4. The implementation sessions.

The findings of the research proved the effectiveness of a well-designed VR simulation but also hinted at problems to solve in future research. For instance, the first version of myVOR used a Meta HMD to provide gesture interaction. This HMD was 3DoF;[6] therefore, moving into the VR had to be managed by someone else.

For this reason, I used the keyboard to direct learners after they told me where they wanted to go. The Meta[7] was bulky and heavy which caused neck ache for some users after the sessions. Meta was also sensitive to the sunlight because of the integrated depth camera. These factors negatively affected the quality of immersion.

I continue to develop and make myVOR better for learners. I organised another project which received funding (FEN-B-131216-0542), and the same core team continued on this project. This time we used a newer HMD as Meta 2. It was more comfortable, and the graphics were better. The goggle type was for augmented reality (AR)[8] instead of VR. We embedded only the intractable components and learning scenario to the AR version of myVOR (Figure 5). After learning that some of the procedures can change hospital by hospital and doctor by doctor, we used a machine-learning algorithm to provide constructed feedback to the learners. We used the correct implementations of 10 expert nurses to teach the surgical instrument arrangement to the AR system. This system worked well but then the company Meta closed (Robertson “Ar Headset Company Meta Shutting Down after Assets Sold to Unknown Company”), and the AR version of myVOR was not sustainable on the Meta anymore.

[6] 3DoF refers to track rotational motion for pitch, yaw, and roll.
[7] A Meta is a depth camera integrated augmented reality HMD.
[8] Augmented reality refers to enhancing perceived reality using digital components.

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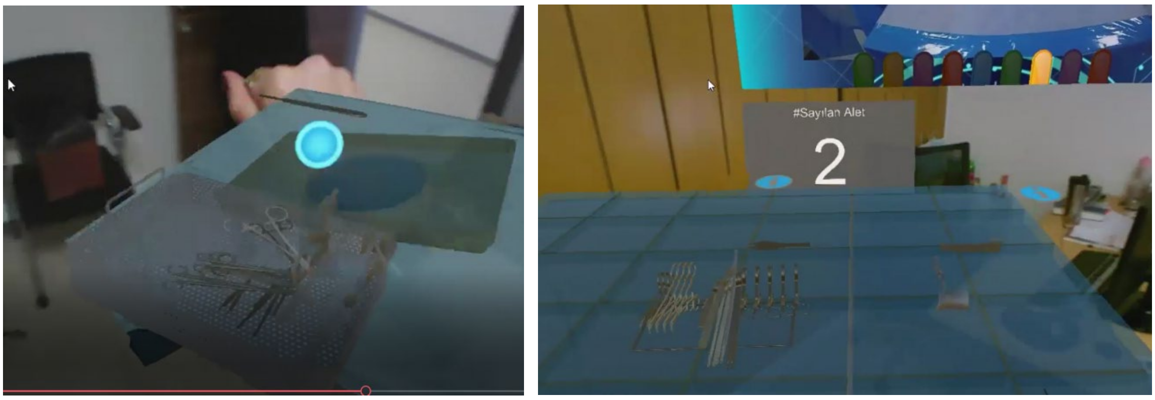

(a) (b)

Figure 5. The interfaces of the AR version.

These devices are expensive, and development is highly cumbersome. A year later, standalone HMDs were released to resolve the cable issues (Trivedi). They did not directly support the gesture recognition, but the controllers were more ergonomic.

Oculus Quest was released in 2019 (Robertson "Oculus Is Trying to Make the Quest the Only Home Headset That Matters") and I used the new version of Unity game engine (Unity) to increase the immersion using high-fidelity graphics. Oculus Quest is light, has 6DoF and a high-quality display (Oculus). It consists of two controllers that provide haptic feedback[9] as well. Oculus also released an easy to use application program interface (API) for developers.

I used the Oculus Quest to develop a second version of myVOR (Figure 6). I completed this project in three months. myVOR2 has no menu screen or particular learning scenario. I used transparent panels for presenting information because we do not see separate menus or buttons in our physical reality (Alger; Sherman and Craig). I added haptic and audio feedback for interaction. In this version, users were free to discover the operating room, learn the names of the instruments, watch the real-life videos and practise in it. They can also follow their status using the progress bar and see the learning outcomes and hints using the panel.

[9] Haptic feedback refers to providing feel of touch using vibration or other systems.

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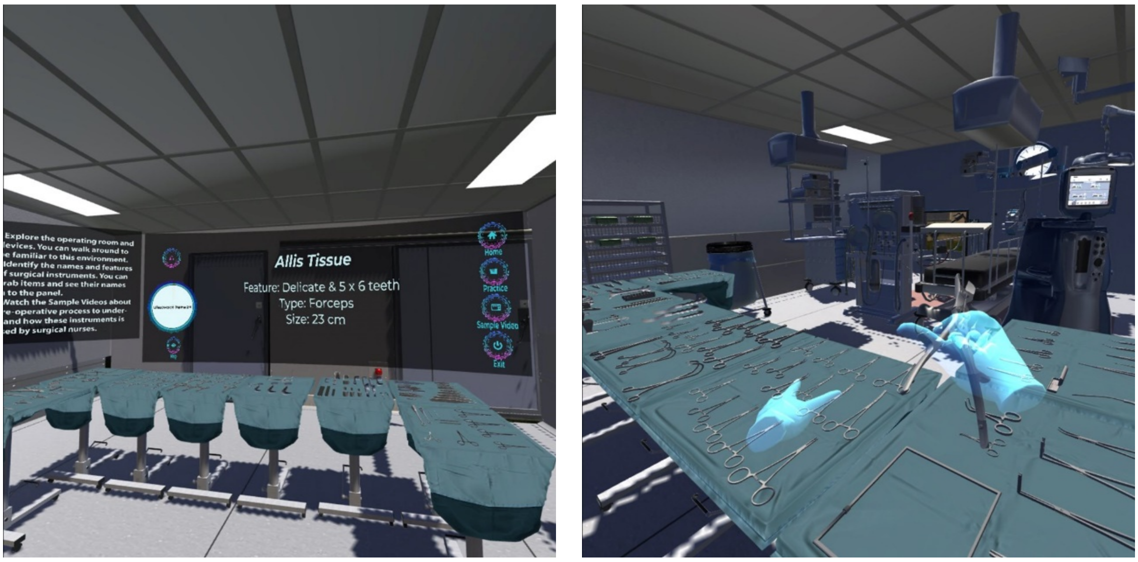
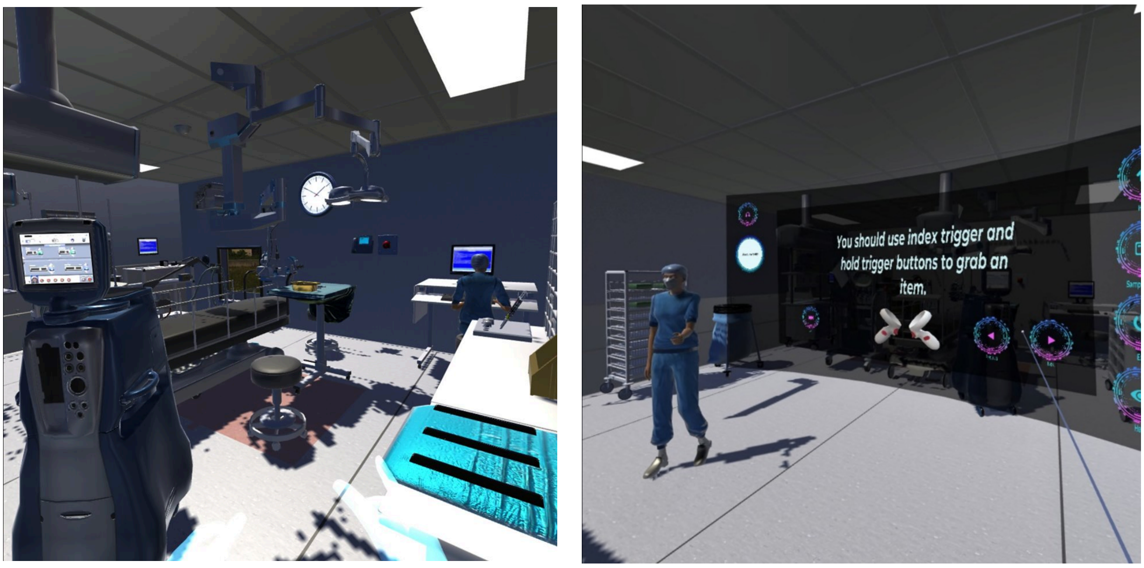


(a) Working place (b) Interaction



(c) The operating room (d) Instruction

Figure 6. The interfaces of myVOR2.

Three nursing academics and six instructional designers applied myVOR2 four times (Protocol number: H19221). They were amazed by the presence (Dede) of this version, and they claimed that they felt like they were in the operating room. Despite the comfortable and easy to use goggles, they required at least two or three repetitive applications to gain familiarity with this technology. They did not experience neck ache, and they were free to interact with every object in the virtual room. After providing tasks and hints in myVOR2, they spent more time in the application and tried to interact with all the objects, including shelves.

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Discussion

Learning tools and techniques have been transformed with technological developments. Virtual and augmented reality (AR/VR) learning environments are highly popular as a result of the represented authentic high-fidelity visuals and interaction opportunities (Buttussi and Chittaro; Heydarian et al.). These systems provide an opportunity to observe the structured virtual components beyond the perceived reality (Lee).

Constructivism in education is a paradigm that provides an opportunity to learners for structuring their individual knowledge (Wang and Hannafin; Macleod and Sinclair). Active participation (Martín-Gutiérrez et al.; Hussein and Nätterdal) is essential for this student-centred learning strategy which uses experiential, discovery, inquiry and situated learning for designing environments (Tacgin). Using AR/VR provides the advantages of using the simulation; thus, learners are able to experience high-risk conditions repetitively in a safe environment (Alqahtani, Daghestani and Ibrahim). They can see the mechanism and systems of intangible concepts (Alqahtani, Daghestani and Ibrahim; Aguinas, Henle and Beaty Jr). They can even be a mitochondrion to transfer energy in a cell in the virtual environment.

Experiencing a situation by learning in immersive VR (IVR) also facilitates learners' knowledge acquisition (Luo and Mojica Cabico) (Lu and Liu; Pérez-López and Contero). Encapsulating the perception of users via IVR environments provides a psychological presence which means "feeling like you're in there". Correspondingly, attention time (Tang et al.; Jetter, Eimecke and Rese; Di Serio, Ibáñez and Kloos) of learners increases when learning a particular subject.

The primary purpose of instructional design is to improve learning outcomes, and it is of paramount significance in creating useful educational materials (Taçgın & Arslan, 2016). The results of the experimental study presented in this article showed that the initial version of myVOR facilitated the learning of students and helped them to gain desired learning outcomes.

Applying traditional instructional design models does not usually overlap the features of IVR technologies. The principles of developing well-structured AR/VR learning environments is still evolving (Goodwin, Wiltshire and Fiore; Kirkley, Tomblin and Kirkley). For this reason, designing learning environments should be systematised using adequate learning theories, information technologies, systems analysis, and educational research and management (Morrison et al.). This process should be managed as a project using the epistemology of the scientific methods (Wang and Hannafin; Macleod and Sinclair). I suggest applying the design-based research methodology and designing the IVR environment during the development phase. The following design stages of myVOR present a pathway to plan immersive virtual reality learning environments (IVRLEs).

The development of myVOR was managed using design-based research methodology (Wang and Hannafin) that included iterative evaluation and development stages until

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the final version was reached (Cengizhan; Barab and Squire; Barab). This methodology is used to find new educational models as well (Hoadley).

Recommendations

The story of myVOR can be instructive in creating immersive VR environments and using them as a learning tool. Depending on the project, I would suggest applying these key elements:

- Applying the stages of project management helps to see the big picture and subsystems.
- Collaborative teamwork is a necessity, and you need at least a subject expert, an instructional designer and a coder for developing AR/VR environments.
- Designing learning environments requires adapting adequate learning strategies to enhance the environment using proper learning components. Use scientific methods to guide the selection of these components.
- Designing IVR should be an iterative process during the development phase.
- The product should be tested on the target audience before being considered final.
- Using IVR requires to be familiar with the usage of technology before learning.
- Setting tasks motivates users to spend more time in the learning environment.

Additional Resources

- The first version of myVOR:
  https://www.youtube.com/watch?v=fiCKNVYc5Ao&t=11s
- The second version of myVOR:
  https://www.youtube.com/watch?v=rjbzTvmFrq8
- The third version of myVOR:
  https://www.youtube.com/watch?v=KarOiSSPVgo

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About the author

Zeynep Tacgin has worked in the education technologies field for more than 10 years. She is a postdoctoral researcher at Charles Sturt University (Australia) and a Lecturer at Marmara University (Turkey). Zeynep received a PhD in Computer Education and Instruction Technologies in 2017. Her PhD thesis was about immersive virtual reality learning environments. She has been working on educational AR/VR/MR technologies for seven years. Her fields of interests are educational, wearable technologies, innovative learning environments, technology integration to education, education management and policies, distance education, augmented reality, virtual reality, simulations, instructional design and material development.

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Night and day – 7 months

Bärbel Ullrich[1]

Abstract

In this article I will examine the role of photography in my art making process with particular reference to the project ***7 months*** (2016–2017). I will outline how photography supports my work which is in collaboration with the environment. The digital photography using an outdoor camera with infra-red and motion sensing technology tells a story about the land and place that is unobserved by humans.

Keywords

Photography; Land; Collaboration; Ecology; Environment; Colonisation

As an artist I would argue that a pencil is technology, but I will extend this idea to focus on photography in the following article. I have always used photography as a support for my artwork. Maybe because I'm lazy and don't want to sit in the bush for hours sketching, and as such, the camera can replace the pencil with much more accuracy and detail! As the camera is portable it also allows you to walk through the environment creating the state of being present in the world through looking, listening and touching.

The camera provides a renewed attention to issues of *movement* and *mobility* in landscape – *perception-in-motion*. Landscape now ceases to be understood as a static, framed gaze, and becomes instead the very interconnectivity of eye, body and land. This embodied experience "turns landscape from a distant object or spectacle to be visually surveyed to an up-close, intimate and proximate material milieu of engagement and practice" (Wylie 167-170), through which self and the world emerge and entwine. As nature and culture are bound together, humans become embedded in landscapes using the body and the senses to experience this phenomenon. Thus, the camera becomes a tool or a 'lens' for connecting sight and the senses with the ground space.

Tim Ingold states that the mind and the ground are one and the same. The ground of knowledge is *itself* the very ground we walk where "earth and sky are tempered in the ongoing production of life." He says:

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[1] *mountain creek artworks*, Australia

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> *Walking along, then, is not so much the behavioural output of a mind encased within a pedestrian body as a way of thinking and knowing. …the walker is thinking in movement … Thus, the ground comprises a domain in which the lives and minds of its human and non-human inhabitants are comprehensively knotted with one another. (48-49)*

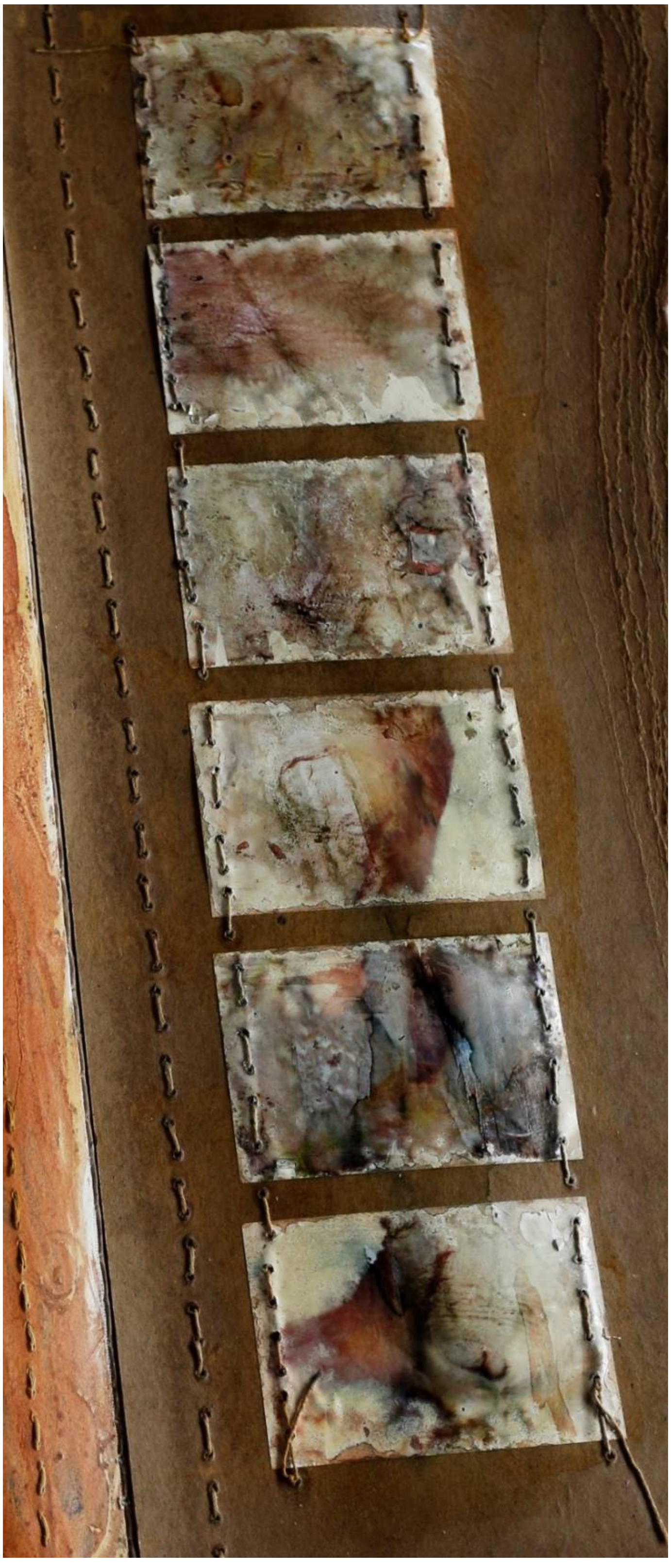
I have spent a lot of time walking through the bush with my camera, experiencing the space and place using all senses, where my body is caught in the fabric of the environment and the camera, as well as memory, readily records this experience.

The photographs are then a direct reference to place; they can be macro or micro where one needs to make decisions on what to frame and capture. I find that looking through the lens of a camera forces me to stop, see and focus on specific details which one would normally miss if just walking through the landscape. These photographs are then used as a reference for other works, drawing and specifically printmaking, and collage where the photographic reference is embedded in the work.

I have based my artwork for my studio-based research project on a specific site on our property which is situated under Mt Bogong in northeast Victoria. *THE SITE* I have used is in the bushland above the cleared paddock at the junction of two creeks. Using heavy machinery, I have had cleared a small area in which to work which is surrounded by hills and impenetrable bush. There is also evidence of previous human interference, such as road cuttings and large felled trees, even though one could easily imagine this place as pristine wilderness.

Through photographic documentation I have collected many images of *THE SITE* that explore the essence of the place, its form, structure and surface appearance. The photos I take of the land do not represent a traditional 'view' of the land but aspects of the rhythms, energy and movements in the environment. The details explore the microcosm, fractal patterns, textures, colours and shapes, especially the local characteristics of this specific place which include large tree ferns along the creeks, tall peppermints and blue gums engulfed in impenetrable bush.

This information along with the drawings/experiments produced on site, is taken back into the studio to produce and refine the finished works. I have also incorporated photographs in *The Book of Tears*, but rather than have them stand out and look like they are glued down, they have been sanded back, stained, stitched and shellacked, so that they merge with the paper and produce a vague and ghostly appearance. Only fragments of the image remain recognisable. The images have an organic ambiguous quality – fading in and out of focus which references the way we look at and see the landscape.



From *The Seven Books of Tears* (DETAIL)
2016–2017
Mixed media, H80cm x W variable

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For the project ***7 months***,[2] I installed an outdoor camera with infra-red and motion sensing technology at *THE SITE* which was set to take photographs at half-hour intervals between 6am and 6pm. It was also set to take a photo when triggered by movement at all times of the day or night. There were many thousands of photographs over the 7-month period and throughout the different seasons which gave me gave me an insight to this environment and told a story about the land and place that is unobserved by humans.[3]

Many of the images captured through movement were not just of foliage in the wind and rain, but of many introduced species. The bush surrounding *THE SITE* is also a complex area of organisms and species that survive through their own ingenuity yet are vulnerable to destruction and invasion by exotic and dominant competitors which are prolific in the bush environment. These include Samba deer, wild dogs, foxes, feral cats – as revealed by my time lapse photography project ***7 months***.

The Samba deer are quite destructive to the natural bushland as well as to the introduced trees that were planted around the dwelling – fences don't keep them out. I would consider them an ecological crisis and local deer hunters cannot control the growing population. These animals have colonised our natural environment along with the blackberry bushes that create impenetrable spaces between natural areas and are spread and perpetuated by birds and introduced animals such as foxes.

The spread of blackberries throughout the bushland, especially in the gullies of the creeks, throttle the natural vegetation. Their seeds are spread by fox dung so that the cycle is continuous and impossible to eliminate. Even control is difficult as they thrive in inaccessible areas.

This photographic project has supported my work which is in collaboration with the environment. Collaboration of artist and process, artist and environment involve active participation with the environment and an engagement that is bodily wearing and internally strenuous**.** The outdoor infra-red camera was installed in one position for the duration of the project. It took photos of the environment without the human intervention of framing and selecting a view, thus 'controlling' what was to be seen. In this sense, nature, the environment was the photographer and the images taken were random at intervals without my intervention. Although I did play a role in the project by editing/selecting the images in the studio as there were many repetitions due to wind movement. These images were used for a digital installation for my final studio-based research exhibition.

An important aspect of my work, particularly as I collaborate with the environment to produce works on paper, is time. I have worked in collaboration with nature/land where I have created images ***from*** and ***with/within*** the landscape rather than ***of*** the landscape. It involves physical immersion in the landscape. Paper and canvas have been left out in the environment using earth and oxides over a period of time.

[2] For my studio-based research I had been working in series of seven.

[3] See images at end of article.

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My challenge has been to do a ‘representational justice’ to the complexity of landscape, and, the use of the technology through time lapse photography has demonstrated this. This type of photography also emphasises the natural aspects of cyclic time in contrast to cultural linear time. The outdoor camera has allowed me to see and experience this aspect of cyclic time where shadows and the movement of shadows change ‘the view’ of the landscape which is in a continual flux. It recorded the light at different times of day – the changing shapes and directions of the shadows in the environment.

The strong linear shadows of the eucalypts impinge their changing form due to the changing light and time of day on the landscape. The time lapse photography allows me to view these multiple moments in time, not just the one I would experience through physical presence. The constant flux and flow of nature creates subtle nuances as revealed by this photography. Through this technology, I view the visible pulse and inner nature of time and immerse myself in creative time.

Time in our modern world has become our captor. The essence of time has been reduced to a mere quantity, a numerical measure of seconds, minutes, hours, and years. We never seem to have sufficient time, yet when a little time is given to us, we waste it. Time’s qualities have vanished. For us, time has lost its inner nature.

> *In other societies, time is the energy of the Universe... chaos theory shows that it is possible to reconnect ourselves with the living pulse of time. (Briggs and Peat 125)*

Time thus becomes a measure of process in touch with its environment quite different from that measured by a clock. The time displayed by this digital technology shows an endless complexity of fractal dimensions revealing new patterns and intricacies in the living world of nature. Photographic technology can enhance our connection to place, and, at the same time, reveals an ecological perspective of the environment.

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About the author

Bärbel is a visual artist/printmaker, recently graduated with a PhD in Philosophy from CSU. She lives in a property at the foothills of Mt Bogong in Victoria, Australia, and her land-based art focuses on working in collaboration with the environment to produce prints that imbue the spirit of place. She has deliberately chosen to create site related works from her ‘place’ to which she has a strong spiritual connection. Bärbel has endeavoured to interact and use material from the environment. The concept that everything is alive is an important philosophy that underlies and informs her work. It is this participation and communication with place that forms the basis of her art making.

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