Macquarie University

Sydney, NSW

The Age of the Aboriginal Avatar:

Reclaiming the Sacred in a Virtual World

A thesis submitted in partial fulfillment of the requirement for the degree of the

MASTERS OF RESEARCH

in the

Department of Media, Music, Communication and Cultural Studies

by

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Dhälinybuy Ḻarrakitj

"This story is about ḏan'parr (Stringybark Ḻarrakitj). The *manikay* (songline) is about *ŋalindi* (the moon) and *djurrpun* (the evening star), *ḏalatj* the current of the stream, and the people and animals gathering at the mud plain at Warrawurr. This *manikay* belongs to the Wangurri clan."

Riyakurray Munyarryun

Figure 1: Ḻarrakitj at Dhälinybuy Homeland, N.E. Arnhem Land
Artists: Buwathay Munyarryun and Riyakurray Munyarryun
Wangurri Clan, Yirritja moiety
Photographer: Kevin Lucas

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Figure 2: F/G Dhälinybuy *larrakitj* B/G Funeral bunggul at Dhälinybuy Homeland.

CREATIVE WORK

Examination of the Creative Work component of this Thesis

will take place in Macquarie University's Simulation Hub (SIMHUB)

located in the Faculty of Arts building Y3A,

@ 2pm on Tuesday 1st August, 2017.

Abstract

The viability of remote indigenous homelands is threatened. One critical issue is how to provision adequate infrastructure to educate children on their clan estates through a system of traditional and western knowledge exchange known as two-way learning. By reducing the disadvantage of time and distance, new technologies offer solutions that could have a significant impact on this problem. Inter-generational knowledge exchange and digital archiving of intangible heritage are valued practices in these communities. Building on this we ask, "Through what process can a sacred cultural object be situated within the frames of Yolŋu epistemology and Virtual Reality?" Specifically, the investigation seeks to articulate the processes involved in transmediating a hollow-log coffin, known as the Dhälinybuy Ḻarrakitj, and its embodied performative knowledge, into Virtual Reality, as defined by the Milgram and Kishino (1994) mixed-reality spectrum. The cultural and technological frame of the investigation is interdisciplinary. It includes, digital humanities, intangible cultural heritage, performing arts and digital creativity. When Yolŋu culture and Virtual Reality converge, it is, I propose, a SPACETIME phenomenon. i.e., a Socially Performative and Collectively Emergent Transversal, Immersive, Mediated Experience. This conceptual frame identifies two overarching processes that define a SPACETIME event; its creation, and its reception. Research outputs include VR prototype.

Keywords: Mixed Reality, Virtual Reality, Indigenous, Intangible Cultural Heritage, Yolŋu Homelands, Ḻarrakitj, Arnhem Land.

Statement of authorship

I certify that the work in this thesis entitled "The Age of the Aboriginal Avatar: *Reclaiming the Sacred in a Virtual World*" has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree to any other university or institution other than Macquarie University. I also certify that the thesis is an original piece of research and it has been written by me. Any help and assistance that I have received in my research work and the preparation of the thesis itself have been appropriately acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Kevin Lucas (44718969)

10 June 2017

Acknowledgments

Figure 3: Dhälinybuy Homeland, Arnhem Land, Northern Territory

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Acronyms and Abbreviations

AI	Artificial Intelligence
BVH	BioVision Hierarchy
CEO	Chief Executive Officer
CPU	Computer Processing Unit
GPU	Graphics Processing Unit
GWAC	Goŋ Wanhurr Aboriginal Corporation
HMD	Head Mounted Display
ICT	Information and Communication Technologies
ITIC	Information Technology and Indigenous Communities
ML	Machine Learning
MoCap	Motion Capture
MR	Mixed Reality
SIMHUB	Simulation Hub
VR	Virtual Reality

Figure 4: Artist/Cultural Consultant Tommy Riyakurray Munyarryun
Ḏhäpi initiation body painting ceremony, Dhälinybuy Homeland December 2015

Figure 5: Dhälinybuy ḻarrakitj, Field Notes
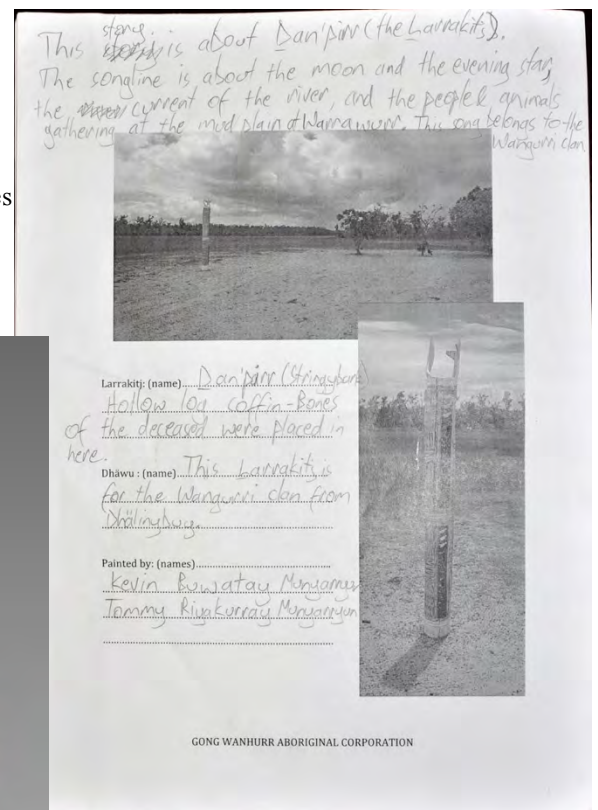
Figure 6 : 3D-model Djakapurra Munyarryun, Artist/Consultant

Chapter One – Introduction

1.1 Prologue: The Ancestors' Gift

I first met Djakapurra Munyarryun as a young man recently arrived into Sydney to share his cultural knowledge with a new Indigenous dance company[1]. He was 17 and had spent the previous year away from his homeland, living in Sydney, teaching Yolŋu culture to mostly urbanised, Indigenous Australians. Despite his youth and separation from family, there was an authority and stillness to his presence that was remarkable. Some years later, in his homeland at Dhälinybuy, he took me to a place amongst the cycad palms to film an interview. There was a strong wet season gale blowing up from the East and the horizon was darkening with looming thunderclouds. Whilst the crew hurried around to set up the filming equipment before the storm hit, Djakapurra, unflinching, told me that the cycad palm was the source of his strength. "Two feet planted firmly in the ground. Unmovable. Enduring. Sacred".

For many thousands of generations, the Yolŋu of N.E. Arnhem Land have maintained a continuity of cultural practice that is defined by an ontology of connectivity, spatiality and temporality. Life and death, spiritual and physical, time and place, quintessentially connect ancestral beings in a continuum of expressive reenactments to the here and now. No clearer example of this can be found than in Yolŋu mortuary rituals (Magowan, 2007; H. Morphy, 1991). By living in homelands and managing their cultural responsibilities per the law of their land, the Yolŋu maintain a connection to the ancestral beings (Wanggar) that is renewed generation after generation.

In this world, self-determination is not a choice between access to modern services and facilities versus the continuance of a timeless tradition in clan estates. It is about the Human Right to endow an expression, a language, a culture - the ancestors' gift - to the next generation. However, with the sustainability of remote indigenous communities threatened, this future is held in the balance (J. Altman & Kerins, 2012; Barwick, 2005; F. Morphy, 2008b).

Like many Indigenous homeland communities across Australia the Yolŋu of North East Arnhem Land are concerned for their future - particularly their children's future. With a mean age of 23 years in Northern Territory's Indigenous communities, and a significant majority of these of schooling age, stability and certainty remain primary concerns for community elders

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[1] Bangarra Dance Theatre

(ABS, 2011). Spiritual belief, cultural practice, and kinship responsibilities, contribute to why Yolŋu choose to remain in close connection with their clan estates – their homelands – as they work toward an independent, self-determined, sustainable future. In the wake of the Howard government's 2007 "Intervention" and more recent political decisions[2] threatening the stability of remote homeland communities, a clear pathway toward sustainability and self-determination, remains obscured by some very big challenges. Most prominent, the resurgence of the assimilation agenda to the detriment of the traditional and enduring homeland model.

Pre-colonial indigeneity was about difference. Location was one of the main determinants. One's connection to Country spawned different languages, characterised different communities, and gave rise to different culture and expression (R. M. Berndt, 1962; Fogarty, 2014; Keen, 2000; Warner, 1958). How this was managed is significant. In N.E. Arnhem Land, respectful difference of clans and their estates is enshrined in Yolŋu law (Gaykamangu, 2012; Gaymarani, 2011). The Yolŋu have well-established protocols for negotiating transcultural difference. It derives from their own intracultural frame and extends to cross-cultural relations with outsiders. The Macassan traders and fisherman are but one example (McIntosh, 2013). In 1976 Yolŋu leaders led an historic victory with the Northern Territory Native Title Act (Gooda, 2015; R. Marika, 2006). Today, fighting for their homelands has become the day to day reality. To do this they walk in both worlds. As the words of emblematic Yolŋu band Yothu Yindi's song reminds us, it is all in the balance. Maintain and practice customary law whilst managing a both-way engagement with the 'mainstream' (society).

> Go go go go living in the mainstream
> Go go go go under one dream
> We're living together
> Yolŋu, Balanda[3]. Yo. (Yunupingu, 1991)

Indigenous engagement with information technology and communication (ITC) across Australia is extensive. Connectivity to a global conversation through both-way relations is an established "Closing the Gap" initiative in remote, regional and urban Indigenous communities nationally (*Information technology and indigenous communities*, 2013). However, in NE Arnhem Land homeland communities, infrastructural deficits are frustrating the success of these programs. This research addresses this gap.

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[2] In NE Arnhem Land, "Closing the Gap" promotes hub community infrastructural support over homelands. The national curriculum agenda and attendance-based funding policies, work against the cultural diversity of a two-way bilingual homeland school pedagogy [Pers. Comm. with Principal of Yirrkala Homeland School. Leon White May 2017).

[3] Non-Yolŋu, European person

1.2 Research Frame: The Digital Divide

One critical issue facing Yolŋu homeland communities, like Dhälinybuy, is how to provision adequate infrastructure to educate children on their clan estates through a system of traditional and western knowledge exchange known as two-way learning[4]. By reducing the disadvantage of time and distance, new technologies offer solutions that could have a significant impact on this problem (Christie, 2015; Corn, 2013b; Fisher, 2005; Guyula, Gotha, Gurruwiwi, & Christie, 2010; F. Morphy, 2008b; Ober & Bat, 2007; H Verran & Christie, 2008).

The Information Age of the 21st century brings with it rapidly evolving digital technologies, some of which demand cultural remediation in a virtual world. Immersive virtual worlds are often negotiated through an intermediary or avatar: a 3D object, controlled by a performer/player, through which users project themselves into the virtual environment to interact with other avatars and virtual objects. The design and purpose of the avatar in a virtual world reflects a diversity of cultural meaning and technical solutions (Çapin, 1999; Clark, 2005; Devine, 2007; Mooney, Riley, & Kutay, 2011; Pauly, 2013; Pearlman & Allen, 2015; Shapiro et al., 2014; Wagner, 2012). The impact of this new digital age, offering new processes of integration into virtual worlds is set to transform society, particularly for the younger generation. However, the rapidity of change has led to a new technological division in society. It is called the Digital Divide (*Information technology and indigenous communities*, 2013; Langton, 2013; Notley & Foth, 2008). The sustenance of Yolŋu culture and its self-determinate aspirations will, in part, be a measure of how well these new transcultural digital pathways are negotiated (Corn, 2013b; Langton, 2013). This research investigation into Yolŋu sacred cultural forms and Virtual Reality[5] attempts to addresses this issue. It does so by employing a both-

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[4] Two-way learning is a philosophy of education that 'brings together Indigenous Australian traditions of knowledge and Western academic disciplinary positions and cultural contexts, and embraces values of respect, tolerance and diversity. Originally the expression was interchangeable with both-ways education (Ober & Bat, 2007). Two-way learning has been described by Morphy (2002) as the, 'context in which both pupils and teachers can interrogate the differences and similarities between the 'two' systems of knowledge and develop the ability and understanding to apply them jointly in particular contexts' (P.8). It is now used across the country, in different Aboriginal cultural settings with differing emphasis, but essentially serving to describe respectful transcultural knowledge exchange through pedagogical practice.

[5] Throughout the thesis, the expressions Virtual Reality and Mixed Reality are used to describe degrees of immersiveness, experienced through a technological intervention on reality. Both expressions draw from a concept first proposed by Milgram & Kishino (1994) to taxonomically describe the degree of technological intervention experienced through a visual display, along a 'virtuality continuum' (see *Figure 12, p.35*). In this context, Mixed Reality describes the overall measure from normal reality at one end of the scale to fully immersive HMD virtual reality experience at the other extreme.

ways[6] approach and framing the investigation around a transcultural digital media experiment. To achieve this, I engage traditional knowledge practices and computational systems within the matrix of Material Thinking (Bolt, 2007; Christie & Verran, 2010; Johnson, 2013; Kavakli & Gero, 2002).

Developing a methodology and process for embedding sacred cultural knowledge into Virtual Reality (VR) is potentially significant to preservation and pedagogical activities in remote Indigenous communities (Christie, Guyula, Gurruwiwi, & Greatorex, 2013; Kral, 2013). It also offers insights into cultural objects and the knowledge embedded in these objects as an expression of Yolŋu ownership, rights, and connectivity to their (home)lands (Christie & Verran, 2013; Keen, 2000; F. Morphy, 2008b; H. Morphy, 1983). This aspect of the research implies a socio-political dimension to this investigation framed around creative expression, pedagogy, traditional culture and the Rights of First Nation people (Fogarty, 2014; Gooda, 2015; *Information technology and indigenous communities*, 2013). Engaging homeland communities in the cultural economy suggests another level of significance. One that is framed around successful community programs focused on building sustainable homelands through the convergence of traditional knowledge practices with new technologies (J. C. Altman, 2001; *Information technology and indigenous communities*, 2013; Throsby & Petetskaya, 2016; Helen Verran & Christie, 2007). The ability of these new technologies to affect change in remote Indigenous communities by diminishing the impact of time and distance is at the heart of this investigation (*Information technology and indigenous communities*, 2013).

1.3 Research Question: The Virtuality Continuum[7]

Inter-generational knowledge exchange and digital archiving are valued practices in remote Yolŋu homeland communities (Deveson, 2011; Dunlop et al., 1996; Gumbula, Corn, & Mant, 2009). Building on these valued practices, this research project asks, "Through what process can a sacred cultural object be situated within the frames of Yolŋu epistemology and Virtual Reality?" Specifically, the investigation seeks to articulate the cultural, theoretical and technological processes involved in transmediating a hollow-log coffin, and its embodied knowledge, into Mixed Reality (MR). The investigation anticipates future iterations that will engage remote Indigenous homeland communities in the process.

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[6] In this context, both-ways reflects a state of mind, a course of action. It informs the work that we do. It is a shared learning journey that strengthens Indigenous identity.
[7] See *Figure 12*. Chapter 2,p35 'The Virtuality Continuum' (Milgram & Kishino, 1994)

1.4 Research Scope

The research seeks to define a process for transmediating Yolŋu sacred knowledge into MR and make a prototype as a proof-of-concept. To manage this within the scope of the Masters of Research, I narrowed the investigation to the cultural knowledge embedded in a single object, a hollow-log coffin known as the Dhälinybuy *Ḻarrakitj* or *ḏan'parr* (*Figure 1*, et al). This object embodies knowledge relating to the ancestral beings at a place on Dhälinybuy homeland near the mouth of the Cato River on Arnhem Bay, called Warrawurr.

For the MRes, the *ḏan'parr* SPACETIME prototype is presented as a work-in-progress. It includes animated 3D Aboriginal avatars, situated in virtual spaces, rigged to motion capture data that was performed and recorded with professional Indigenous artists expressing traditional Yolŋu culture. The prototype, to be viewed through a personal head-mounted display (HMD), is submitted as the creative practice component of this thesis. For technical reasons, the prototype is only available for viewing under supervision at the Simulation Hub at Macquarie University. The version submitted for examination includes draft components, rather than the total designed immersive experience that will be produced in future research. The next iteration anticipates additional funding and public exhibition.

1.5 Research Methodology

In this investigation, I produce an immersive Mixed Reality digital media object where sacred knowledge is remediated into Virtual Reality and space-time is disrupted and reconfigured into a single interwoven continuum. To achieve this I adopt a practice-based research methodology that employs creative Material Thinking processes (Bolt, 2007; Carter, 2004). I refer to this work as the *ḏan'parr* SPACETIME prototype. Yolŋu cultural protocols defined by Maḏayin sacred law guide the process. These concepts are unpacked in the written thesis. The theoretical investigation reflects an interdisciplinary transcultural approach that draws upon traditional Yolŋu knowledge and other academic deliberation and ethnographic material.

1.6 Thesis Outline

The thesis examines the processes involved in defining, developing, designing, and making a mixed reality SPACETIME prototype. It seeks to articulate a Cultural, Technical and Logistical model for VR production involving two-way pedagogy, and a both-way engagement for

homeland communities. It is structured around four chapters including the Introduction and Conclusion.

In *Chapter One: Introduction,* I situate the thesis culturally and theoretically, whilst providing an overview of its Methodology, Scope and Objectives. I describe how the research objectives are need-based, community-driven and outline the structural relationships formed to manage the investigation, including a close working relationship with the Wangurri Clan from NE Arnhem Land.

In *Chapter Two: The Cultural Map* I examine the research questions through a cultural lens. My analysis situates the cultural object and its sacred connection to the Wangurri clan and Dhälinybuy homeland, within Yolŋu Maḏayin law. I consider the transcultural implications of engaging with tangible and intangible cultural heritage in a remote homeland environment. Further, how to remediate these into an immersive interactive Virtual Reality environment in a culturally appropriate way.

Chapter Three: The Technological Map describes the methodological approach I have taken to construct the SPACETIME prototype. I start by examining the theory of Mixed Reality and the relationship of digital and information technology to Indigenous culture. I situate SPACETIME within this frame. I then outline the design process and technology deployment that informed the development and production of the *ḏan'parr* SPACETIME prototype. I consider how each impacted my process, and what this reveals about relocating the 'sacred' into a Virtual Reality environment. I propose that the dynamic engagement between the content-creators and audience is a key relationship in this process.

Chapter Four: Conclusion offers a review of the issues, challenges and successes of the research project by contextualising the outcomes against the expectations. I surmise that the research promotes the principals of homeland-based two-way learning and cultural maintenance, through a performative engagement with immersive MR technologies. I further argue that such an engagement promotes knowledge scaffolding opportunities, within and outside of these communities, that could produce other social and economic benefits through an engagement with the cultural economy. In promoting these outcomes, I also acknowledge the serious technological challenges to be addressed in the short-term, to overcome the impact of time and distance and the Digital Divide. Finally, I outline what implications this research has on future investigation in the doctoral program.

Figure 7: Dhälinybuy Homeland, Ḻarrakitj
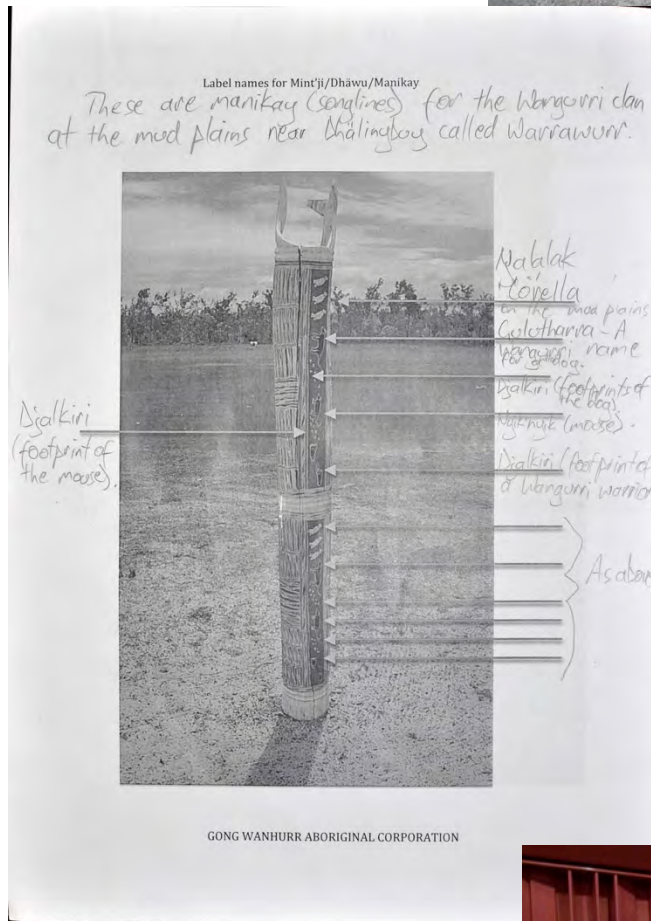
Figure 8: Dhälinybuy Homeland, Ḻarrakitj Field Notes

Figure 9:   Recording session, Macquarie University
Djakapurra Munyarryun and Kevin Lucas (Researcher)

Chapter Two: Cultural Mapping

2.1 Chapter Summary

The investigation outlined in this thesis suggests a new form of intangible cultural heritage engagement.[8] One that merges living cultural practice with preservation and archiving of traditional culture. It does this by transferring traditional cultural objects and performative knowledge into a Virtual Reality environment.

In this chapter I respond to the key research question, *"Through what process can a sacred cultural object be situated within the frames of Yolŋu epistemology and Virtual Reality?"* I do this by describing, procedurally, the cultural pathway we followed to create an immersive Mixed Reality media object that is referred to as the *ḏan'parr* SPACETIME prototype. I also provide a context and analysis of how the sacred is embodied in the cultural object used in our investigation. I explicate the procedural issues associated with creating the Virtual Reality experience, which I define as a SPACETIME[9] event. I consider this process through a transcultural lens, between Yolŋu and Balanda (Non-Yolŋu). I then examine the conceptual frame of Mixed Reality (MR) and how a SPACETIME event, involving Yolŋu cultural forms, is located within this space. I conclude by considering some potentialities for Yolŋu knowledge scaffolding, that MR technologies and immersive experiences anticipate and how this could involve Yolŋu remote homelands in a wider cultural, social and economic context.

2.2 Framing the Research: The Dhälinybuy *ḻarrakitj*

In this section I contextualise my investigation around sacred knowledge of the Wangurri clan from the remote homeland community of Dhälinybuy.

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[8] "Cultural heritage does not end at monuments and collections of objects. It also includes traditions or living expressions inherited from our ancestors and passed on to our descendants, such as oral traditions, performing arts, social practices, rituals, festive events, knowledge and practices concerning nature and the universe or the knowledge and skills to produce traditional crafts. The importance of intangible cultural heritage is not the cultural manifestation itself but rather the wealth of knowledge and skills that is transmitted through it from one generation to the next" [https://ich.unesco.org/en/what-is-intangible-heritage-00003].

[9] When Yolŋu culture and Mixed Reality (MR) converge, it is I propose, a SPACETIME phenomenon. That is, a Socially Performative and Collectively Emergent creative process that produces a Transversal, Immersive, Mediated Experience. SPACETIME is also a concept that has been developed through this research to describe the cultural and technological processes involved in transferring Yolŋu (sacred) knowledge into a Mixed Reality environment.

Limiting the investigation to one clan and one cultural object was a heuristic that helped scope the research into something manageable for the MRes process. However, it was also a heuristic defined by the research participants through their discussion about the sacred knowledge involved and how best to manage this process, from a Yolŋu perspective. These cultural considerations informed the selection of the object to be used in the investigation and defined the nature of my investigation into remediating it into a virtual world. I characterize this methodology as a holistic heuristic (Hiles, 2001).

Once selected, it was necessary to understand how the object was related to the Wangurri clan. Also, how they are connected to other Yolŋu clans and homelands through this object and its connection to the living and the dead. How this cultural paradigm impacts the research question, prompted a deeper investigation into the ḻarrakitj and its' relationship to Yolŋu cosmology. Relevant to this discussion is the nature and purpose of Yolŋu art in contemporary society and how sacred cultural knowledge is managed and transmitted within the paradigm of the art world, which remains a significant contributor to the Yolŋu cultural economy, and an important contributor to notions of self-determination and sustainability.

In his essay 'Ḻarrakitj – Death and the Celebration of Life' Howard Morphy (2011) proposes that for the Yolŋu, "Performing the songs and producing the paintings is…a sacred responsibility that keeps knowledge of the ancestral beings alive and embodied in place." He further suggests that, 'Yolŋu metaphysics does not separate off the ancestral dimension from the world of lived experience, but folds them one into the other. Hence death is both a moment of separation and a moment of union' (H. Morphy, 2011, p. 28). Such considerations are relevant to our investigation into the sacred knowledge embodied in the hollow-log coffin known as the Dhälinybuy ḻarrakitj.

Dhälinybuy[10] is the freshwater homeland of the Wangurri clan. The Dhälinybuy ḻarrakitj was made in the memory of a senior lawman elder who passed away at Dhälinybuy in 2015, aged 86 years old. His name is withheld in accordance with customary law. It was made by two of his sons. However, their purpose was much more than to create a memorial. The Dhälinybuy ḻarrakitj defines the Wangurri clan itself. It is a statement of Yolŋu ngärra law.[11] Gurrwanngu

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[10] Dhälinybuy homeland is located 600 kms East of Darwin, NT on the Cato river in North East Arnhem Land. It borders the Eastern shores of Arnhem Bay, about 1.5 hours south west of the remote mining town of Nhulunbuy. [see *Figure 3*]

[11] Yolŋu ngärra defines a hierarchical order of sacred knowledge management which entitles certain people to speak to certain aspects of law and others not. Irrespective of the medium, the artist or the audience reach, the process of Yolŋu cultural remediation, involving as it does, remediation of the sacred, must abide by the rules of ngärra (Corn, 2006; McLean, 2014). Ngärra defines all aspects of Yolŋu life including its relationship to the physical, spiritual, social and cultural world and all matters relating to its performative

Gaykamangu (2012) a Yolŋu scholar and teacher of traditional customary law to outsiders, describes the relationship of ngärra law and homelands as a sacred connection to place.

> The interconnectedness of land and the Ngärra law is very important. Yolŋu people see the Ngärra law as embedded in and emanating from sacred areas. (Gaykamangu, 2012, p. 247)

My objective is to unveil some of this knowledge, in a culturally appropriate manner, so that an outside audience might experience it through Virtual Reality technology. At the same time, define a methodology for broader homeland community engagement in the use and design of culturally based Mixed Reality experiences. The investigation relies upon the participation of two professional Indigenous artists and Wangurri elders, Djakapurra and Riyakurray Munyarryun, sons of the deceased. They were employed by research partner, Goŋ Wanhurr Aboriginal Corporation to convey performative knowledge embodied in the Dhälinybuy *larrakitj*. Their involvement included the selection of the cultural object used in the investigation, the painting and performance of its story, and the management of the knowledge it embodies. Their contribution helps define a methodology for future research to be conducted in an extended doctoral investigation, working with Wangurri intangible culture heritage and mixed reality storytelling techniques.

2.3 Homeland Mashup[12]

For some years, I have worked with the Wangurri responding to requests for assistance with homeland-based media-related cultural work. Through this period, I have come to appreciate the complex dynamic of a homeland community. How it survives in a subsistence manner as people live and hunt on country, nurture their children and tend to their elderly and sick, whilst maintaining their law and ceremony. All this alongside ranger training programs and intergenerational bilingual education activities taught at the community school. Two worlds bound together in a both-ways mashup that sees iPads mixing it with sacred dilly bags[13] in the blink of child's eye. I have also witnessed how rapidly and dramatically this intimate family setting is transformed into an ambassadorial one, where multiple-clans, numbering hundreds of

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cultural forms. It further defines three levels of knowledge engagement including garma (public), dhuni (restricted) and ngärra (highly restricted) (Corn & Gumbula, 2006).

[12] Mashup is a contemporary expression used to describe the abrupt mixing together of two cultural sources into one. It seems an appropriate term to describe the transition homeland youth are experiencing at the beginning of the 21st century. James Clifford refers to this phenomenon as the Inventive Syncretic (Clifford, 1988).

[13] Dilly Bags are one of the most sacred clan-owned power objects in Yolŋu culture. Each clan draws upon the authority it receives from their specific *dhulmu-mulka bathi,* a Maḏayin law sacred dilly bag (D. Kelly, 2014).

individuals, are hosted for important ceremony, stretching the homeland's infrastructure beyond its limit. These experiences have led me to appreciate how homeland people live a double-existence, between two worlds. Not, as is commonly expressed, between a mainstream lifestyle and a traditional one. But between inside and outside knowledge, within Maḏayin law. I also learned of the many issues homeland communities are struggling with daily. Like education, health and housing, a lack of services and facilities, and inadequate non-sustainable energy supplies. Wherein the desire for stability and self-determination is undermined by an ambiguous political frame. (F. Morphy, 2007, 2008a, 2008b) Where the "Nothing is a problem until it is a Problem" attitude delivers 'emergency' response to cyclone damaged houses within days, when appeals for improved housing and services have fallen on deaf-ears for decades.

It is this gestalt of collective experience that led me to consider what role infrastructure and technology can play in diminishing some of the disadvantage of remote homeland living, whilst empowering communities to work toward sustainable futures. Keeping homeland schools open is a prominent one. But then through what model of education? The National curriculum, or something more robust? What James Clifford characterises as 'Inventive Syncretism'. A dynamic model of change built for the 21st century and beyond, that is attuned to localised needs and global conditions (Clifford, 1988).

2.4 Sustainable Futures: Developing a Methodology

My working relationship with the Wangurri embraces a both-ways approach and helps frame the research investigation around a holistic heuristic. Developing a methodology for expressing the story of the Dhälinybuy *ḻarrakitj* into Virtual Reality might seem to some, to be a diminishment of the sacred significance of the object. However, the Wangurri do not see it this way. To them it is a positive opportunity that will engage youth, elders and an outside audience in the story of the Wangurri and fulfill other objectives of their Goŋ Wanhurr Aboriginal Corporation (see Appendix A).

As a performing artist, Djakapurra Munyarryun, has established an internationally acclaimed reputation by sharing this knowledge and teaching and performing to outsiders. Now in his mid-40's Djakapurra wants to share the skills and knowledge of the outside world, with the children in Dhälinybuy. He also wants to keep the Wangurri story alive, by sharing it with the next generation, as it was taught to him.

There are a lot of people now talking about the kids. But that's my vision for a long time. They need something for them, to learn Yolŋu way and Balanda way, so when they leave school they can do something useful with their knowledge – to tell stories about their culture. It's a great thing for them, to share that knowledge. They can learn about their culture in both ways – Ngapipi[14] and Yolŋu – to make a balance. So, we are going to feed the young people with that knowledge, so they can learn to share. (Munyarryun, 2014, p. 4)

This view of the future promotes a sustainable framework based around pedagogical and performative outcomes that derive from 'Learning on Country' experiences. My discussions about this with Djakapurra and Riyakurray have led us to consider several options for exploring Yolŋu cultural knowledge through MR platforms, that offer creative ways for conveying and preserving traditional performative knowledge. This is when concepts like living both ways and learning two-ways starts to dominate our conversations. 'Learning on Country' is at the heart of both pedagogical schemes. It is a model that has successfully operated in NE Arnhem Land for tens of thousands of years. They call it 'Yolŋu university'. This led me to investigate the nature of learning in Yolŋu culture and ask, "How could this research help serve that ambition to sustain the homeland culture?"

Sustainability is a contested idea and traditional Indigenous knowledge has much to offer the conversation. Over two decades ago Indigenous scholar Patrick Dodson argued that "Knowledge practices of Indigenous people may provide valuable insights and strategies in our struggle to understand the processes and effects of globalisation" (Dodson, 1994, p. 1). Today, in presenting a global overview of sustainability models within the UN World Commission on Environment and Development (WCED)'s framework, Throsby & Petetskaya (2016) argue that Indigenous communities like the Yolŋu[15] are well advanced in practical concepts of sustainability, and have much to share with the developed world in shaping globally sustainable societies:

Concepts of sustainability and sustainable development in the contemporary Western world is a focus on intergenerational equity, taking account of the needs of the earth's future inhabitants. A similar concern with the long run underpins indigenous cultures whose very existence is grounded on the

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[14] Non-Yolŋu, European person
[15] Throsby & Petetskaya (2016) research data was informed by their field work in NE Arnhem Land.

inheritance of traditional knowledge and the transmission of cultural values to subsequent generations. In such cultures, the nature of sustainability is understood and experienced in terms of relationships to land, language, and knowledge systems. Linking these three dimensions together, the majority of indigenous societies recognise the importance of holism as a basis for interpreting the world. (Throsby & Petetskaya, 2016, pp. 123-124)

Such a holistic heuristic has framed my research investigation into the Dhälinybuy *larrakitj*. To construct effective outcomes that can be applied in the field and contribute toward a sustainable future one must look, in NE Arnhem Land, to processes ascribed by Yolŋu Maḏayin law. Situating these concepts within the specific technological framework of Mixed Reality is dealt with in the next chapter. Understanding the dimensions of this, culturally, is the focus of the present chapter. Discovering the meaning of the larrakitj is part of the process. Learning who can speak to that knowledge offers greater rewards.

2.5 Locating the Sacred: Ḻarrakitj *djama*[16]

Yolŋu sacred knowledge is managed through *Maḏayin*[17] processes. One's relationship to this knowledge is defined by degrees of exclusivity and restriction ('inside' and 'outside' knowledge). Who has the right to know, say and do characterises this mode of transmission (H. Morphy, 2007). As the lawful authority to paint and speak to the knowledge and stories embodied in the Dhälinybuy *larrakitj,* Riyakurray Munyarryun offers this explanation;

> "This story is about *ḏan'parr* (stringy bark ḻarrakitj). The *manikay* (songline) is about *ŋalindi* (the moon) and *djurrpun* (the evening star), *ḏalatj* the current of the river,[18] and the people and animals gathering at the mud plain at Warrawurr. This *manikay* belongs to the Wangurri clan." (R. T. Munyarryun, 2016)

The version of the story he conveys is 'outside' knowledge (*garma*). As with all knowledge in the Yolŋu world, other versions of the story, with deeper meanings, would be known in degree,

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[16] Djama means business in Yolŋu matha, the common language spoken across NE Arnhem Land.
[17] In Yolŋu customary law, Maḏayin describes sacred objects usually kept out of the public eye.
[18] 'All freshwater is not the same; all salt water is not the same. They have a different life force within them. Water is a vessel for the life force: spirits that are manifest in bodily form reside within water. When a pattern depicts the water of river, it is also referring to the land that feeds the river, and to which it is adjacent and related. Water is paramount because each person has the water from which they sprang, within them' (Stubbs, 2011, p. 39).

by those who have achieved higher levels in Maḏayin law (R. M. Berndt, 1962; Gaykamangu, 2012; Gaymarani, 2011; Keen, 2000; H. Morphy, 2007).

The *ḻarrakitj* is a multivalent object that embodies significant knowledge, including the five-dimensions of Yolŋu *rom*[19] (cultural law). Traditionally it was used to house the bones of the deceased and relates the story of the spirit's journey back to its spiritual home. Today, when used ceremonially, it more typically holds the clothes of the deceased, who would receive a Christian burial, whilst the ceremonial aspects of the spirit's journey still prevail. In his essay on the ḻarrakitj, Morphy notes;

> The archive of Yolŋu art was a virtual one residing in people's minds to be produced when required – with one possible exception. The most visible and durable manifestations of Yolŋu art were the ḻarrakitj or *ḏupun* (hollow log coffin). (H. Morphy, 2011, p. 27)

More often these days the *ḻarrakitj* is made as an art object and sold commercially[20] offering an important revenue contribution toward homeland sustainability. As Throsby and Petetskaya's investigation into comparative sustainability models emphasises, the potential economic value of new technologies and Yolŋu knowledge management suggests;

> New avenues by which the Yolŋu can earn revenue, including new media and the utilisation of copyright law, are seen as a means to underpin the continuation of Yolŋu culture. (Throsby & Petetskaya, 2016, p. 130)

Yolŋu artist Wanyubi Marika from Yirrkala remarks;

> We need to make [*ḻarrakitj*] for our own interest and education. We still use them in our ceremonies. We will continue to make [them] for the education of non-indigenous people, here or elsewhere in Australia, or anywhere else. We will continue to paint ḻarrakitj, the designs that represent our spiritual

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[19] The five-dimensions of Yolŋu *rom* are *ḏhäwu* (stories, history), *wänga* (land, country, place), *gurrutu* (kinship relations), *manikay* (clan/nation, song), *miny'tji (*art, totemic design, colours).
[20] The Aboriginal Memorial is an installation of 200 hollow log coffins from Central Arnhem Land. commissioned by the NGA to commemorate Australia's bicentenary. Another significant collection was produced by Yolŋu artists between 2000-2009 for West Australian media mogul and committed art collector, Kerry Stokes. The story behind their production, the artists, communities, clans and meaning is presented in an edited coffee-table publication called "*Ḻarrakitj - Death and the Celebration of Life*" (Brody & Equity, 2011).

foundation and essence. That is how it is. (Wanyubi Marika in Foreword. Brody & Equity, 2011, p. 7)

Understanding that 'inside' knowledge can operate within 'outside' practice, such as Wanyubi alludes, helps shed some light on the way the Yolŋu manage all relationships within a both-ways framework.

2.6 Homeland Survival: Both-Ways

Dhälinybuy homeland is one of 30 remote homelands in the Laynhapuy IPA (Indigenous Protected Area)[21] of NE Arnhem Land, where the Yolŋu have lived for thousands of generations. It was the second homeland built in the 1970's after Yolŋu elders departed the Yirrkala mission to reestablish their traditional clan estates. Like others, the Wangurri were driven away from Yirrkala by the negative impact of the mining town at Nhulunbuy, situated on the Gove Peninsula. The Yolŋu rightfully contested to Justice Blackburn of the Northern Territory Supreme Court in 1971 (Milirrpum v Nabalco), that the Nabalco bauxite mine was established without their permission (Deveson, 2011; Dunlop, 1990; H. Morphy, 1983; Murray, 2003). Despite their best efforts they lost the case,[22] and the mine continued operating. But there was a certain moral victory achieved in Blackburn's deliberations, particularly with matters concerning the Yolŋu's relationship to their traditional ancestral estates;

> On the basis of the evidence presented to me I judge that it is more correct to say that the Yolŋu people belong to the land than that the land belongs to the people. If ever there was a system of law that is not merely the product of human hands but comes from a higher order it is the one that has been presented to me in this case. (Blackburn, 1971, pp. 141-294)

Five years later, with the enactment of the Northern Territory Native Title Act, 1976, the Yolŋu claimed an historic land right's victory. The re-establishment of homelands through this period is properly viewed as an act of self-determination, inspired by the leaders of the time to take control of their destiny. However, there was much more than politics that took the Yolŋu back to their homelands.

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[21] Laynhapuy Homeland Association listing (http://www.laynhapuy.com.au/homelands/list-of-homelands).

[22] "The doctrine of terra nullius that brought so much shame on the beginnings of Australia denied that we Yolŋu existed as people. It forced Blackburn to deny us our land. But Blackburn did not deny the true nature of the link between Yolŋu people and their land" (R. Marika, 2006).

Ian Keen's (1994) examination of the ceremonial structures of the Yolŋu and the embedded transmission of knowledge found that land (*wäŋa*) was the key to understanding group identity, with each group possessing a body of myths, types of songs, designs and sacred objects and ceremonies that all related to their Country (Keen, 1994). Like the *ḻarrakitj,* homelands embody the multi-dimensionality of Maḏayin law. They are organised around a language-based, clan-based, land-sea bound framework defined by ancestral beings aligned to two moieties, Yirritja and Dhuwa. Significant to our investigation is the fact that the Wangurri clan is Yirritja, which may account for their openness to outside ideas. Berndt was first to acknowledge that management of outside transcultural forces is, for the Yolŋu, a moiety-influenced process:

> The dua [sic] moiety was more obviously concerned with what Aborigines categorised as being of traditional-Aboriginal derivation. The yiridja [sic] moiety could be seen as a medium for channeling and coping with items from outside. (R. Berndt, 1980, p. 284)

Berndt further elaborates on how Yolŋu mythology reveals a dynamic system of knowledge management that embraced outside influences, such as the Macassan. One that is renewed and added to generation upon generation. The Macassan influence has been well documented, where transcultural exchange and trade of such products as swords, tobacco, alcohol and flags are remembered in the collective performative knowledge of specific clans (Keen, 2000; Magowan, 2005; McIntosh, 2013; Toner, 2003). Likewise, the Bayini narrative speaks to pre-Macassan contact and exchange between the Yolŋu and other seafaring peoples (McIntosh, 2000, 2013). All these stories are held by Yirritja clans.

> Bayini narratives drawn from sacred sites across northeast Arnhem Land are centre stage for at least five Yirritja clans—the Warramiri, Wangurri, Birrkili, Dhalwangu and Gumatj—and a number of now extinct groups, such as the Lamamirri and Yalukal. (McIntosh, 2013, p. 100)

It would seem likely then that two-way learning and both-ways living have their provenance in these same traditional, moiety-based meta-narratives, just as iPads and Dilly-bags have in ours. Building on Bahktin's concept of 'Heteroglossia' and James Clifford's definition of the post-colonial transcultural dynamic as 'Inventive Syncretism', Balme proposes that;

> With expanded communication and intercultural influence, people interpret others, and themselves, in a bewildering diversity of idioms—a global condition of what Mikhail Bakhtin called "heteroglossia," This ambiguous, multivocal world makes it increasingly hard to conceive of human diversity as inscribed in bounded independent cultures. Difference is an effect of inventive syncretism. (Balme, 1999, p. 10)

Throughout this chapter I have discussed how the Yolŋu engage the concept of 'both-ways' to negotiate their world. Sometimes it is used as means of managing 'inside' and 'outside' knowledge in relation to sacred knowledge, within a clan or moiety. It is also a frame to understand how the two moieties work together in the management of interclan business, such as the Yothu-Yindi, mother-child frame. It is the preferred mode for managing inter-cultural relationships between Ngapipi and Yolŋu as Djakapurra says; "Working and Learning together" (pers. comm. Munyarryun, 2014). This has led me to consider how the both-ways frame is reflected in the making of Mixed Reality experiences. Where the transmission of sacred knowledge from the real world into a virtual one could be characterised as a both-ways transversal negotiation, between time and space.

2.7 Transversal Deliberations: Defining SPACETIME

SPACETIME is a concept that has been developed through this research to describe the cultural and technological processes involved in transferring Yolŋu (sacred) knowledge into a Mixed Reality environment. In Yolŋu *rom*, *Gurrutu* is a mathematical model that combines people and place, past and present, space and time, into a single interwoven continuum. When Yolŋu culture and Mixed Reality (MR) converge, it is I propose, a SPACETIME phenomenon. That is, a Socially Performative and Collectively Emergent creative process that produces Transversal, Immersive, Mediated Experiences. This situates SPACETIME within a 'both-ways' cultural paradigm, that describes a relationship between the creators and audiences of an immersive mixed reality event.

There are two aspects of the SPACETIME concept to discuss. The first is the epistemological knowledge embodied in the Dhälinybuy *ḻarrakitj* and its engagement with Yolŋu culture. The second is the notion of sacredness and its relationship to technology (De Largy Healy, 2014; Healy, 2013; *Information technology and indigenous communities*, 2013; H Verran & Christie,

2008; Wagner, 2012). Both address the question: "How does the VR experience situate the sacred within the virtual?"

To answer this question, I need to separate SPACE and TIME procedurally and consider how the conceptual framework informed our processes in the making of the ḏan'parr SPACETIME prototype. More specifically, how and where the Yolŋu notion of sacredness sits within this investigation and how that is managed through Maḏayin Law.[23]

I will leave the discussion around the transversal immersive mediated experience (TIME) to the next chapter, as it more specifically deals with the issue of the sacred and technology. My concern here is how this is managed as a socially performative and collectively emergent process, from a both-ways perspective.

So, what do I mean by a Socially Performative and Collectively Emergent process and how did it help me understand the experience of situating the sacred within the virtual? My investigation revealed that the management of knowledge in Yolŋu culture is as important as the content. More specifically, who has the right to speak to it and express it is as important as what they express. Madarrpa clan elder, Djamabwa Marawili offers some valuable insight into the purpose of Yolŋu cultural expression and its relationship to the place from where it comes:

> The land is complete. It has all that it needs for its continuation and
> sustenance. But it cannot express itself. It cannot sing, paint and dance its'
> identity. And so, it has grown a tongue. That tongue is the Yolŋu. The

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[23] "In Yolŋu society, political authority and religious authority are 'distinct but related'. Religious authority is related to political authority in that religious authority 'establishes the rights necessary to maintain the viability of intra-group social and political structures, intergroup relations, and the relationships between people and land'. Because religious authority bestows political authority, the latter is subordinate to the former. The following key terms reflect how and where Maḏayin law is applied, particularly in its relationship to the sacred. Maḏayin is commonly referred to as 'Aboriginal customary law'. It is the complete system of customary and religious law for the Yolŋu people of Arnhem Land. ('Maḏayin', without the capital 'M', indicates the Maḏayin quality of sacredness). Wangarr are the Yolŋu ancestral beings who provide the mythical origins of the Maḏayin system. Garma is the largest and most unifying institution of the Maḏayin system; a combined legislative and judicial institution. Rangga: Secret sacred objects in the Maḏayin system; a rangga is 'an object up to about a metre long, made of wood, stone, paperbark or wax, incorporating string, fur, feather and painted decoration. It is sacred (dhuyu), described as very important, and imbued with the power of the Wangarr Dhuyu is Holy or secret/sacred. Jirrikaymirri is the highest office in the Ngärra system for the dhuwa moiety; a legal, religious and political leader in Ngärra. Dalkarmirri, the highest office in the Ngärra system for the Yirritja moiety; a legal, religious and political leader in Ngärra. a judicial officer. While 'they do not make laws binding on the community' they do interpret and proclaim the Maḏayin law. Jungay are complimentary and support officers to the Dalkaramirri/ Jirrikaymirri and may be regarded as roughly equivalent lawyers, police and correctional officers. Djunggaya is a caretaker of their mother's country. They learn as much about their mother's country as they do their own" (D. T. Kelly, 2014).

Indigenous people of Australia. They exist to articulate the land. That is their reason for existence.(pers. comm. WIll Stubbs, Marawili, 2015)

Morphy (2011) situates this need of the land to be expressed within Yolŋu sacred law;

In order to participate in ceremonies, people need to acquire the knowledge of the songs, paintings, and dances associated with their land and the lands of related groups. Collectively this knowledge is referred to as Maḏayin, or sacred law. (H. Morphy, 2011, p. 28)

This offers me a key to understanding where the sacred will be found in Virtual Reality; expression and possession. I have established that Maḏayin is an expression of the sacred in law, event, place, country and object. How then, did this impact on my processes of bringing that knowledge into a virtual world? In my investigation, all matters sacred were managed on the advice of Djakapurra and Riyakurray. They had the authority to proclaim, paint, perform and speak to the knowledge in accordance with the rules of Maḏayin law, which they did. The knowledge they conveyed defines the Wangurri clan's relationship to their homeland at Dhälinybuy. I was not always informed of the full content of their conversations, which were conducted in Wangurri language. So, I'm unable to remark on their internal process of knowledge management, except to observe that it was hierarchal in nature and I was sometimes made the intermediary in the discussion. For example, Riyakurray was the principal advisor on all matters relating to the Dhälinybuy ḻarrakitj. Djakapurra would defer to this authority when it came to speaking to the *miny'tji* (designs on the *ḻarrakitj*) and the meaning of the manikay (songs) and bunggul (dances). Djakapurra did however offer me an English name and brief explanation of what it was he performed and the associated songs and dances he recorded. These performances are used in the *ḏan'parr* SPACETIME prototype. And, as the artist/maker and guardian of the knowledge embodied in the Ḏhälinybuy *ḻarrakitj,* Riyakurray also directed me on matters concerning what knowledge could be transferred into the virtual object. Morphy (2011) helps contextualise this process of knowledge management;

There is a reciprocal relationship between people, land and Wangarr that is both individual and societal. As people grow up in country they acquire a growing spiritual identity that links them to people and place. They gain in spiritual strength through performing in ceremonies, through visiting places and through looking after country. Their spiritual identity is created through both knowledge and experience. In order to care for county, they need to know which people are

connected to land and who shares the responsibility for managing access to resources. Practical knowledge and religious knowledge are interwoven. (H. Morphy, 2011, p. 28)

In this section I have considered the notion of SPACE as a collectively emergent, socially performative process amongst the Yolŋu. One that involves the ancestral beings and the clans in the management and performative expression of their ancestral lands. In contrast, the TIME aspect of this SPACETIME analysis is more concerned with the 'outside' audience reception depicted as an 'immersive mediated experience' utilising Virtual Reality technologies. I will discuss this in detail in the next chapter. However, it does prompt the culturally-related question of "How can I remediate the Dhälinybuy *larrakitj* into a Virtual Reality experience that is inclusive / meaningful / respectful / significant / appropriate"? Wanyubi Marika shares some thoughts on this question, from a both-ways perspective.

> Originally, larrakitj and dan'parr were used by our old people in mortuary ceremony… Before the start of making art for sale, the sole purpose of larrakitj and dan'parr was for use in ceremony. Today a new purpose exists for larrakitj. We make them to sell for money and also in recognition of the old system used by our ancestors. This knowledge is being bought afresh into the contemporary world through the larrakitj. (W. Marika, 2011, p. 7)

Culture and commerce, tradition and modernity, Ngapipi and Yolŋu, all working together to find new solutions to sustain homelands into the future. Two-way learning, both-ways living. This is the cultural frame that situates this investigation into traditional Yolŋu knowledge and Mixed Reality. By offering new and engaging ways of scaffolding knowledge around the intangible cultural heritage of Yolŋu homelands SPACETIME proposes a new means of immersive transcultural engagement. One that joins the inside knowledge of the homelands with the outside world the 'mainstream', through modern information and communication technologies.

2.8 The Cultural Map: Summing up

In this chapter I outlined the theoretical and cultural concerns associated with the creation of the *dan'parr* SPACETIME prototype and where this sits within a broader definition of Mixed Reality and Yolŋu cultural law. I describe how this was informed by two professional Wangurri artists and Cultural Consultants, Djakapurra and Riyakurray Munyarryun. I contextualised their

engagement around my long-term relationship with the homeland community of Dhälinybuy and Wangurri clan, and considered how this has influenced / shaped / moderated the research outcomes and objectives. In the context of my research methodology, I characterised our working process as a both-way negotiation within a transcultural framework. One that reflects existing two-way pedagogy in homeland communities. I then discussed how and why the cultural objects used in our investigation, whether located in real or virtual worlds, are necessarily governed by Yolŋu ngarra protocols in accordance with Maḏayin law. And why this is a mediated cultural process deeply connected to place, relationship, identity and one's relative position to 'inside' and outside' sacred knowledge. Finally, I considered how the investigation promotes Indigenous agency, cultural preservation and engagement in remote homeland communities, whilst attending to some of the challenges defined by economic, pedagogical and social needs. I concluded by considering some potentialities for Yolŋu knowledge scaffolding, that MR technologies and immersive experiences anticipate and how this could involve Yolŋu remote homelands in a wider cultural, social and economic context (F. Morphy, 2008b; Throsby & Petetskaya, 2016; H Verran & Christie, 2008).

In the next chapter I will address the questions; "How do you locate a sacred cultural object in Virtual Reality?" and "What are the implications of this process?" I do this by outlining a methodology for the development and construction of an immersive media prototype, and propose a model for future community engagement through 'Learning on Country' programs in remote indigenous homelands (Guyula et al., 2010).

Figure 10: ḏan'parr SPACETIME prototype 3D model ḻarrakitj

"The continuity of artistic experience with normal processes of living is derived from an impulse to handle materials and to think and feel through their handling. Sensation, feeling and thought are progressively differentiated phases of our embodied relationship to objects in the world. In this framework one can say that creative arts research is "material thinking" that illuminates particular knowledge and data derived from interacting with the environment (material and social) and then locating this knowledge in relation to what is already presented in theory and general domains of knowledge" (Barrett, April 2007, pp. 1-2).
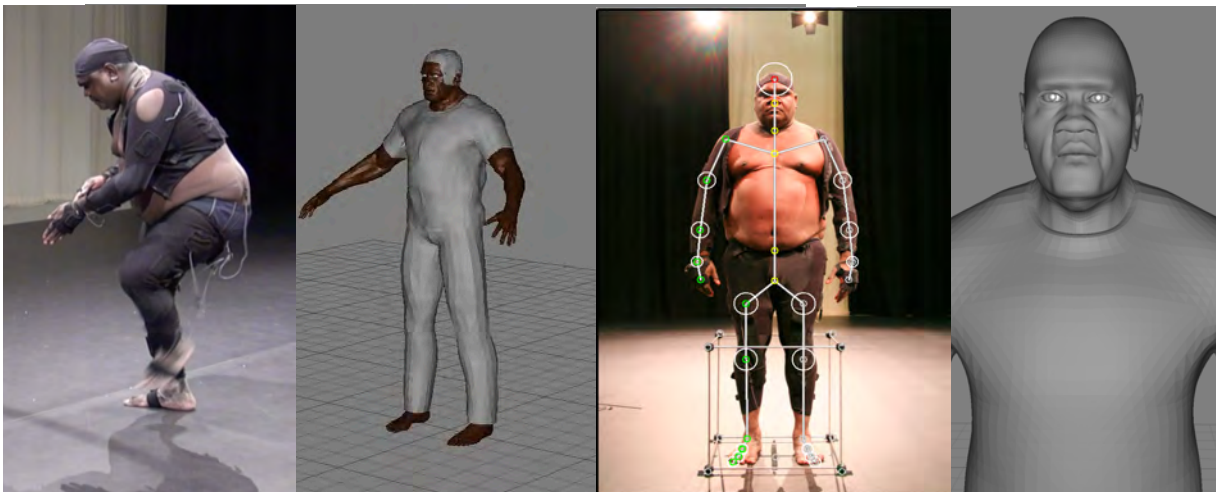
Figure 11: Djakapurra Munyarryun, MoCap session, Macquarie University, 2016

Chapter Three: Technological Mapping

3.1 Chapter Summary

In the previous chapter I outlined the theoretical and cultural concerns associated with the creation of the *ḏan'parr* SPACETIME prototype. I discussed where this is situated within a broader definition of Mixed Reality and Yolŋu cultural law. More so, how the investigation required an understanding of the five dimensions of Yolŋu rom, including a sensitivity to sacred matters relating to Yolŋu mortuary rites and the *ḻarrakitj*. I concluded, that the investigation promotes Indigenous agency, cultural preservation and engagement in homeland communities, whilst attending to some of the challenges facing these remote communities including economic, pedagogical and social needs.

In this chapter 'The Technological Map' I address the question; "How do you locate a sacred cultural object in Virtual Reality?" I do this by outlining the methodology for the development and construction of an immersive media prototype

The chapter is divided into two sections.

SPACETIME 1: Theory to Practice examines the theory of Mixed Reality and the relationship of digital and information technology to Indigenous culture. Through these considerations I seek an answer to the question; "Where is the practice of making a SPACETIME event situated?" I then consider what this tells us about the engagement between content-creators and audience.

SPACETIME 2: Process examines the design and production of the *ḏan'parr* SPACETIME prototype. I situate this discussion around – design processes and technology deployment. I consider how each impacted my process, and what this reveals about relocating the 'sacred' Dhälinybuy *ḻarrakitj* into a Virtual Reality environment. I propose that the dynamic between the content-creators and audience is a key relationship in this process.

3.2   SPACETIME 1: Theory to Practice

3.2.1   Situating Mixed Reality

Traditional media formats are rapidly being replaced by high-quality, mobile, locative, cloud-supported Mixed Reality technologies. MR's ability to merge reality with an immersive, haptic, locative and artificially intelligent virtuality can, quite literally, send our sensory world into a spin. Immersed in a MR HMD experience, it is not hard to 'believe' that you are really, flying like a bird, [24] walking on the moon, [25] attending the launch of the Wright Brother's first flight, [26] or ducking for cover from the salivating jaws of a T-Rex escapee from a virtual Natural History Museum.[27] Interfaced with Quantum computers, Artificial Intelligence (AI), Machine Learning (ML) and advanced computer processing technologies (CPU/GPU), the experience of MR will continue to confound the senses more and more, until it will be very difficult to distinguish the real from the virtual. SpaceX CEO Elon Musk (2016) believes the chances we are not already living in a simulation of reality is 'one in billions'.

> The strongest argument for us being in a simulation, probably being in a simulation, is the following: 40 years ago, we had pong, two rectangles and a dot. That is what games were. Now, 40 years later we have photorealistic 3D simulations with millions of people playing simultaneously and it's getting better every year. And soon we'll have virtual reality, augmented reality, if you assume any rate of improvement at all, games will become indistinguishable from reality. (Musk, 2016)

Mixed Reality, including Augmented and Virtual Reality, was first anticipated by a Harvard University Research team headed by Computer Graphics pioneer Ivan Sutherland in the 1960's. They developed the first Mixed Reality head-mounted display (HMD). It was so heavy and cumbersome it had to suspended from the ceiling of the lab. In 'The Ultimate Display" (1965) Sutherland anticipates immersive Human Computer Interfaces (HCI);

> The ultimate display would, of course, be a room within which the computer can control the existence of matter. A chair displayed in such a room would be good enough to sit in. Handcuffs displayed in such a room would be

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[24] Birdly® [http://www.somniacs.co]
[25] PlayStationVR/NASA
[26] [http://www.mattervr.com] Zypre / Wright brothers' first flight AMD's LiquidVR™ technology
[27] Oculus Dreamdeck VR Experience - Oculus Rift

> confining, and a bullet displayed in such a room would be fatal. With
> appropriate programming such a display could literally be the Wonderland
> into which Alice walked. (Sutherland, 1965, pp. 2-3)

30 years after Sutherland's "Sword of Damocles"[28] the technology had advanced considerably, prompting Milgram to propose a taxonomy of mixed reality visual displays (Milgram & Kishino, 1994). Their objective was to quantify the experience MR technologies delivered and grade them, by degree, between Reality (no technology) and a fully immersive 3D-modelled Virtual Reality HMD experience. To represent their findings Milgram devised a differential scale which he called the 'Virtuality Continuum'.
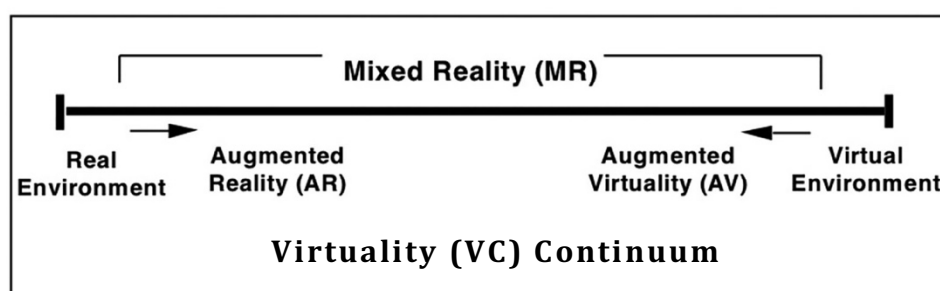
Figure 12: Simplified representation of a "Virtuality Continuum" (Milgram & Kishino, 1994).

Milgram's taxonomy was framed around experimental laboratory research. But the technology was rapidly developing. Soon after it was a consumer item. In "Here We Are!" (2012) the authors propose MR research should extend 'beyond the laboratory to the real world' from 'technology to capability, space to place, and vision to perception' (Barba, MacIntyre, & Mynatt, 2012, p. 929). The wider social engagement of mobile devices prompted Barba to relocate the MR idiom to a 'smartphone ecosystem' and account for locative experiences (Barba et al., 2012). Rouse et al (2015) took it one step further by proposing a 'humanistic' extension that accounted for a growing class of cultural and social dimensions to MR experiences. 'We focus on a class of applications defined primarily by the quality of the experience they provide and only secondarily by the mediating technology' (Rouse, Engberg, JafariNaimi, & Bolter, 2015, p. 178). They called their schema MR^x. [*Figure 13*] The superscript 'x' indicating the user's immersive experience. Both schemas have much to offer the growing body of MR research.

MR technologies are expanding across an ever-increasing domain of industry and disciplines. AI and Deep Learning start to deliver more immersive, user-responsive algorithms to tailor

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[28] The research team's nickname for the unwieldy object suspended over their heads during experimentation.

learning experience to individual needs (Kollock & Smith, 1996). The spread of this revolution is no longer reserved to networked metropolises. It is impacting remote Indigenous communities around Australia (Kral, 2013; Langton, 2013). Traditional teaching practices are under scrutiny as interactive scenario-based and game-orientated experiences offer greater impact on learning outcomes (Kutay, Riley, Mooney, & Howard-Wagner, 2012; Rouse et al., 2015).
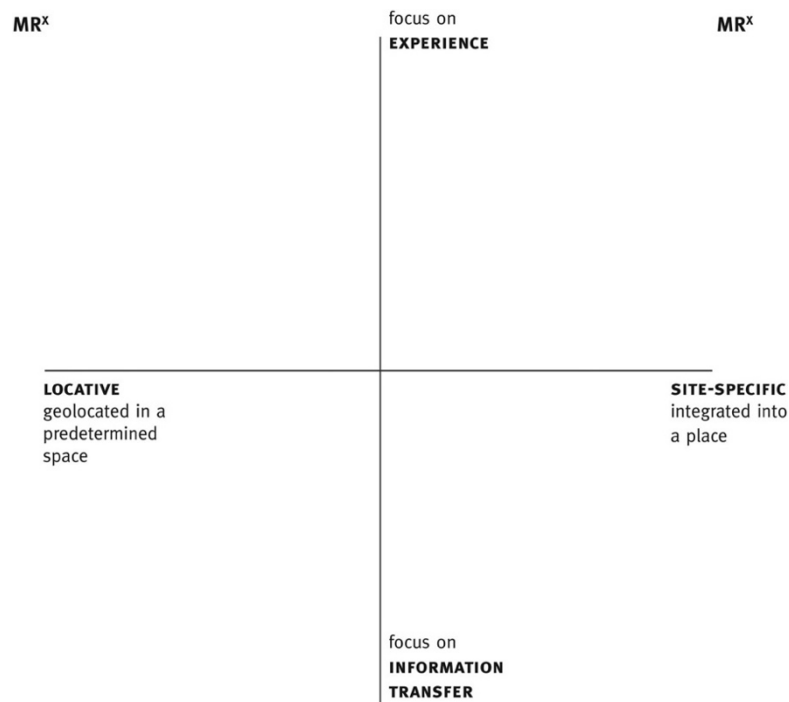
Figure13: A proposed two-dimensional grid for MR and MR^x (Rouse et al., 2015).

SPACETIME describes the nexus between content-creator and audience as a Socially Performative and Collectively Emergent process (SPACE) that is mediated through MR technologies to produce a Transversal Immersive Mediated Experience (TIME) for the audience. I propose this is a useful analytical and critical tool for evaluating the processes and relationships between content-creator-audience experiences. It also offers a frame for evaluating MR Production and Development practices more broadly.

There is a growing body of research concerned with the quality of experience MR offers an audience. These include notions of 'presence', 'immersion', 'interactivity' and 'simulation sickness'. For example, experience of intimacy afforded by 360VR brings the subject directly into the sensory experience of the audience to great effect. Some recent examples include 'Clouds over Sidra' (Arora, Milk, & Pousman, 2015) an intimate encounter with a 10-year-old Syrian girl imprisoned in a refugee camp in Sidra, dreaming of returning home. Lynette Wallworth's 'Collisions' (Wallworth, 2015) takes us on a journey to a remote Indigenous community in Western Australia's remote Pilbara desert to unveil an intimate account of the

British atomic bomb tests of the 1950's told from the perspective of an Indigenous elder who as a boy witnessed the explosion and its devastating after effects. '6x9' (Sprenger, 2016) offers a short virtual experience of solitary confinement. The connecting thread in all these works is pathos and transformation, afforded by the immersive connection between subject and audience.

360VR filmmaking suggests another powerful means of bridging the gap between audience and subject, that is immersive and transformational. The SPACETIME paradigm anticipates other forms of transformative MR experiences. For example, the potentiality for immersive 'live' VR streamed events that connect remote communities to an 'outside' audience; urban-based Non-Indigenous audiences with remote Indigenous homeland communities for example. By characterising the relationship of content-creator and audience as a SPACETIME event I am proposing a more holistic heuristic that shifts the focus away from technology-user to one between content-creator-user. These ideas will be developed further in the doctoral investigation.

3.2.2 The Indigital Revolution

In 2010 the ITIC[29] initiated a discussion around Indigenous engagement with IT and digital technologies across Australia – urban, regional and remote. Marcia Langton's remarks carry the sentiment of the symposium;

> That information technology and communication is now a major industry in Indigenous communities across Australia is evident and demands a comprehensive response from governments and service providers. (Langton, 2013, p. v)

ITIC 2010 co-convener Aaron Corn was so impressed by the reach and diversity of papers and projects presented he characterised the Symposium as an "Indigital Revolution" (Corn, 2013a). The published summary of the ITIC's Key Findings and Issues (ITIC, 2013, pp. xi-xiii) speak to both the success of Indigenous engagement with information technologies and the critical areas of support required into the future. Amongst them, the recognition of how IT is 'an essential service that delivers and creates opportunities for economic and social development by and for Indigenous peoples across Australia'. One, that 'generates unique opportunities for young Indigenous people, and is creating a new generation skilled in digital technologies'. Also,

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[29] 2010 Information Technology and Indigenous Communities symposium

how IT offers 'significant social and economic benefits for Indigenous Australians, and can make a significant contribution to 'Closing the Gap'[30](Rudd, 2008)[31]. The report also highlights some of the dangers of not investing into this area, including how a lack of access 'is a serious barrier to successful engagement in the creative and digital economy' and warns of the inadequacies of a 'one size fit's all' model. Instead, calling for 'investment in digital capabilities at a local level, supported by appropriate national policies and networks'. The report proceeds to identify where the priorities lie, including a 'recognition of the emergence of IT use by Indigenous Australians as a major industry, and the development of specific policy and investment to support Indigenous enterprise, training, digital services and access to ICTs generation of specific government policy and funding to ensure that high speed access to the internet'. It further suggests that positive action is required to overcome the digital divide by 'ensuring that IT is provided to Indigenous Australians across the country (whether on outstations, in remote towns, regional areas or urban centres)'. The report concludes with a call for 'tailored support for informal and formal training initiatives' with an engagement in IT at all levels, including 'content production and related archive management'(ITIC, 2013, pp. xii-xiii). These findings are relevant to my enquiry into MR technologies affordance with remote homeland communities and identify an area of investigation that will be followed up in the doctoral investigation.

Another noteworthy technology-driven Indigenous cultural project that has direct relevance to my investigation is Cyberdreaming's "Digital Songlines" (DSL), [32] an innovative project with an ambitious brief to express Indigenous Cultural Knowledge in an interactive game environment. DSL is an Australasian CRC for Interaction Design (ACID) supported project (2004-7) that has been developing, 'Protocols, methodologies and toolkits to facilitate the collection, education and sharing of indigenous cultural heritage knowledge' (Leavy, 2014) DSL raises issues of the effective management of Indigenous cultural material, including, sites recording, content management and virtual reality delivery capabilities that are culturally sensitive and involve the indigenous custodians, leaders and communities in remote areas of the Australia (Buchtmann, 2000; Gibbons, Wyeld, Leavy, & Hills, 2006; Wyeld, Crogan, & Leavy, 2008). DSL's ambition to map the entire continent and negotiate with all stakeholders

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[30] In his 'Apology' speech to Indigenous Australians Prime Minister Kevin Rudd indicated there was a need to close the gap on Indigenous disadvantage. For more background see, "Beyond closing the gap: Valuing diversity in Indigenous Australia" (Altman, 2009).
[31] For an update on latest report from the Department of the Prime Minister and Cabinet see (Dept, 2017)
[32] "The Digital Songlines" (DSL) project was originally funded by the Australasian Cooperative Research Centre for Interaction Design (ACID 2004-7). The DSL game engine was developed as part of a digital storytelling project undertaken by the Indigenous Communities Program at the Australasian CRC for Interaction Design (ACID). The engine was developed in collaboration with Cyberdreaming Pty Ltd.

over sacred sites transference into a game environment for multi-user access is possibly an overreach. The approach taken with the *ḏan'parr* SPACETIME prototype investigation highlights the benefit of having a specific focus, and dealing with a single community where matters of sacred knowledge management are concerned. Particularly in NE Arnhem Land, where such negotiations are subject to the rigorous scrutiny of Yolŋu Maḏayin law (Gaykamangu, 2012; Gaymarani, 2011; Healy, 2013; Keen, 2000; Murray, 2003).

3.3 SPACETIME 2 Process: Design

In the previous section I explored the relevance of Mixed Reality technologies in a broadening engagement with IT technologies and situated SPACETIME within this theoretical frame. I then provided a brief overview of Indigenous engagement with Information Technologies and MR technologies, as reflected in both the DSL project and the inaugural 2010 ITIC symposium findings. Such considerations suggest that delivering a MR program for two-way pedagogical engagement in remote homeland has useful precedents to draw upon as the research progresses into the doctoral investigation.

In this section I review the processes that have informed the design and production of the *ḏan'parr* SPACETIME prototype.

3.3.1 Material Thinking

My creative process is closely aligned to the ideas that inform the theories of Material Thinking. Barrett (2007) observes that the continuity of the artistic experience is derived from:

> An impulse to handle materials and to think and feel through their handling. Sensation, feeling and thought are progressively differentiated phases of our embodied relationship to objects in the world. In this framework one can say that creative arts research is "material thinking" that illuminates particular knowledge and data derived from interacting with the environment (material and social) and then locating this knowledge in relation to what is already presented in theory and general domains of knowledge. (Barrett, April 2007, pp. 1-2)

Barrett's description of the creative arts research process as a form of Material Thinking is by no means unique. Others have written extensively on the subject (Bolt, 2007; Carter, 2004).

However, in Barrett's description I find an accord with my own thinking about the relationship to knowledge and creativity that is also evident in Yolŋu culture. It is this aspect of interaction and relationship with the environment (material and social) that led me to define the process of content-creation as Socially Performative and Collectively Emergent (SPACE) phenomena. It is the process of emergence and connection, found in the objects and the cultural materials one handles, be they tangible or intangible in nature that defines the materiality of thought as inherently a creative Material Thinking process. It is also a helpful linkage to make when considering how to locate sacredness, as a virtual material, that is conjoined to an audience immersed in a HMD, as the design intention of the *ḏan'parr* SPACETIME prototype suggests.

3.3.2 Cultural Design

Virtual Reality is an experience of reality, which is not real, yet it offers sensory engagements that are real. The cognitive experience is crucial in understanding these affectations and offers an important insight into VR design considerations. The issues that backgrounds this research are questions about Time and Space. The technology of Virtual Reality is predicated on providing an experience of SPACE that is 'virtual' and a TIME frame that is non-linear. It is this perceptual shift that triggers the sense of immersion (Murphie, 2002).

The creative idea that framed my process was motivated by a desire to investigate the technological and cultural aspects of MR storytelling, via a constructed narrative experience about the Yolŋu's sacred connection to their homelands. The narrative was to be set in NE Arnhem Land in Wangurri country. The subject was the Age of the Aboriginal Avatar. My intention was to convey a unique event through immersive digital media. I sought a solution that exposed the viewer to an experience as unfamiliar as the world I was intending to lead them to. An event that would engage them emotionally and thoughtfully, in a performative experience. That would also offer an opportunity to include a homeland community in the production process in future iterations.

As discussed in Chapter Two, the decision as to what cultural object was appropriate to use in this investigation was not one I made alone. Rather, I arrived at this solution based on the input of my Yolŋu advisers. In the end, it came down to three possibilities; a body-paint *miny'tji* [*Figure 4]* that Riyakurray had done for his son's initiation ceremony (*dhapi*), a Wangurri song cycle transcribed by Ronald Berndt (1948) or the Dhälinybuy *ḻarrakitj*. Once the decision was made to use the Dhälinybuy *ḻarrakitj* in the investigation I then had to determine which MR

pathway I would follow to realise the narrative work. Would it be AR or VR or an immersive 240-degree interactive screen projection?

Which technical pathway I should follow was largely a cultural design decision. From a storytelling perspective, my interest was to create an experience that privileged transformation over information. As will be seen in the prototype, this does not mean I avoided providing information. But I chose to preference the emotional connection over the intellectual one. Immersive VR seemed to offer more possibilities to realise this intention. The question then became, "What technical elements would I have to master, or at least, familiarise myself with, to create an affective experience?" I will talk more about the technology options below, but the decision to pursue a Unity VR game-engine designed HMD experience came relatively late in my process. The prototype, whilst limited by resources, serves as an effective demonstration of the possibilities of the medium that could be pursued further in a doctoral investigation. The genre of the work is best described as a performative hybrid combining cinematic effects with theatrical performative elements. For the purposes of the MRes I am presenting it as a work-in-progress. It includes media segments that demonstrate technical processes and other experimental performative research elements. However, there is a unifying aesthetic design concept to the work that seeks to express the sacred experience of the Dhälinybuy *ḻarrakitj* within a SPACETIME event.

In the field of new museology, where the practice of manufacturing digital surrogates of ancient relics is used to help make collections more accessible, the notion of what is retained of the aura of the real object is put into question. The philosopher Bruno Latour together with conservator Alan Lowe (2011) emphasise the importance of the quality of the reproduction in determining the aura and affect on the audience of the digital facsimile (Latour & Lowe, 2011). Whilst an accurate and high-quality digital reproduction of the Dhälinybuy *ḻarrakitj* was produced for digital remediation, it remains something quite distinct from the physical object. For the Yolŋu, the medium is impartial to the object's inherent sacred quality. However, in seeking to impart a sense of spiritual connection, the question of how to lead an audience toward an emotional connection with the object in the immersive interactive virtual world, did arise. The methods I trialed were drawn from my filmmaking experience. To me, it became a design consideration that suggested the genre of magic realism be introduced into the 'visitor's' virtual experience of the object. This includes animations and soundscapes that surprise and enchant. The user feedback on the prototype suggests we are heading in the right direction.

3.3.3 Narrative Design

The *ḏan'parr* SPACETIME prototype offers a first-person open narrative experience, where the user makes their own decisions about where to go and what to do. However, there is an underlying narrative construction to the design of the experience. This section briefly describes one player's possible experience. The reader is encouraged to review the photo essay that accompanies this description included as Appendix B.

The 'visitor' arrives into a gallery space. On display are several 'art' objects. The Dhälinybuy *ḻarrakitj* stands tall in the middle of the space. There is an Indigenous man nearby, standing in the shadows. He keeps a watchful eye over the *ḻarrakitj*. He is a lawman. A jungay,[33] charged with ensuring that respectful behavior is accorded the exhibit. The visitor explores the objects in the gallery, in her own way and in her own time.[34] On the plinths are two busts and orbiting globes.[35] Closer inspection of the orbiting globes trigger surprising events.[36] The visitor becomes immersed in the space. She moves across to the *ḻarrakitj* and raises her hand toward the object. She discovers that her hand-controller allows her to interact with the *ḻarrakitj*. By moving her hand toward the painted image of a dog, a bushrat, or up higher toward the sculptured moon and star, she triggers mysterious songs; the embodied sacred sounds of the *miny'tji*. She hovers her hand close to the small bushrat (*nyik'nyik*). Again, the mysterious song is triggered. She pulls her hand away. The song stops. She moves it back toward the figure. This time she squeezes the trigger on her hand-controller. Suddenly she is in another world. The world of the ancestral beings; the Wanggar. A beautiful, mysterious place. She is surrounded by *birrimbirr* spirits, dancing the eternal steps of the ancestral bushrat. She stays here for a while and looks around. Up above a starry sky and full moon shine brightly over the *ḻarrakitj*. Colorful mists arise and swirl around her. In this world, there are more jungay watching over the proceedings. She tries to move out toward them. But her movements are restricted in this place. She must remain close to the *ḻarrakitj* for her own well-being. She decides to return to the gallery. But how? She has been told the sacred stream depicted on two

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[33] *Jungay* are complimentary and support officers to the Dalkaramirri/ *Jirrikaymirri* and may be regarded as roughly equivalent lawyers, police and correctional officers.
[34] The visitor can walk around the virtual objects physically. With touch-sensitive hand-controllers she can interact with some of the objects. She can also 'teleport' across the room in an instant with her hand-controller, defying space and time.
[35] The busts demonstrate two different production techniques used in the investigation of the *ḏan'parr* SPACETIME prototype. One is a 3D representation of the researcher captured by an ARTEC portable 3D hand scanner. The other is a 3D bust of Djakapurra, modelled in Blender, presenting an alternative photo-realistic approach for character modelling.
[36] The light coloured globes trigger projection on the wall in front of her revealing more about the *ḻarrakitj* and the production process of capturing the motion of the dance that was used in creating the ḏan'parr SPACETIME prototype.

sides of the *ḻarrakitj* connects life and death. She raises her hand toward the stream (*ḏalatj*)[37] and squeezes her trigger. She's back.[38]

3.3.4 Technical Design

Whilst my Yolŋu advisors deliberated on which cultural object was suitable for our investigation, I turned my mind to technical considerations. This meant acquiring a vast amount of new technical knowledge in the field of Virtual and Augmented Reality. In this I was assisted by the generosity of the Director of the Virtual Reality Lab at Macquarie University, A/Prof Manolya Kavakli. Her invitation to join the VISOR (Virtual and Interactive Simulations of Reality) research group and attend weekly meetings was a turning point in my investigation.

Coming from a traditional filmmaking and digital media background, VR and AR were new technological platforms for me to consider working with and the learning curve was steep. Research into available technologies helped inform the optimum MR experience I could pursue within the scope of the Masters investigation. However, I quickly learned that MR technology is emerging onto the market so rapidly, that finding the best solution is not a straightforward process. Continuous investigation into technological innovations is required. My limited IT programming skill was also a factor. This meant the technical solution should minimise the need for extensive programming knowledge.[39] Cost-effectiveness and resource availability dictated the final decision.

As challenging as these criteria were, I believe my research objective of finding solutions that would (a) involve a performative element and (b) offer production processes that could be applied in remote homeland settings, benefited from the scrutiny of a novice's eye. My appraisal of the best VR development and production toolkit ultimately led to a set of technical design solutions that are practical, scalable and adaptable to a two-way 'Learning on Country' inter-generational methodology. In application, they would rely on technical support and offer training opportunities. The ITIC findings discussed in 3.2.2 suggest that IT skill development in Indigenous communities is a key priority that may attract resources and funding.

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[37] One of the meanings of *ḏalatj* is wisdom.

[38] She can now continue her exploration of the other figures on the ḻarrakitj or end the experience, as she chooses.

[39] This decision was modified during the production phase. As I later learnt, it is possible to program in game-engines via a graphic user interface. However, a knowledgeable programmer is an essential member of any VR team. I learned a great deal from the SIMHUB Technical Director John Porte who's programming support was critical in my production pipeline.

The production hardware I used was sourced from the Faculty of Arts and, the Faculty of Science and Engineering and the VR equipment from the SIMHUB. All the required software was available as free downloads. Some of these, such as Adobe Create Cloud suite products, were freely available for students, academics and teachers. Others like Blender and Unity used in the 3D modelling and VR pipeline offer free versions that proved more than adequate for my purposes.

3.3.5 Aesthetic Design

In his essay "*Larrakitj* – Death and the Celebration of Life" Howard Morphy (2010) proposes that 'Yolŋu metaphysics does not separate off the ancestral dimension from the world of lived experience, but folds them one into the other. Hence death is both a moment of separation and a moment of union' (H. Morphy, 2011, p. 28). Such considerations are relevant to our investigation into the sacred knowledge embodied in the Dhälinybuy *larrakitj* and reflected in the prototype's design.

The Dhälinybuy *larrakitj* is designed in four vertical and three horizontal sections. Each opposing vertical block is the same design and conveys the same story. On each side, there is the stream (*Dalatj*). As we learned in Chapter Two, water is one of the most sacred elements in Yolŋu culture. The passage of life is described in the flow of the stream and river, which carries the spirits. It is where the Yolŋu come from and where they will return to. This concept was brought into the design of the prototype. When interacting with the stream you hear the *dalatj* manikay and then 'return from where you came', back to the gallery.

The central premise of the *dan'parr* MR narrative is the relocation of the sacred from the real world into the virtual one. The experience that VR affords suggests a narrative engagement that is more aligned to the living ceremony of theatre than the ritualized afterlife of cinema.

I have discussed how the songs and painting offer a sacred connection to knowledge of the ancestral beings, and performing and painting and pronouncing the names and singing the story, are in themselves sacred acts. Also, the relationship of the stories and the characters to moiety, clan, the river and the surrounding land. This represents another dimension of the sacred that immerses the performer into the spiritual world of the ancestors.

Riyakurray Munyarryun spoke to the *garma* (public) narrative embodied in the design of the *larrakitj*. He described the story that connects the Wangurri to the ancestral beings including the clan language names of the key characters of the narrative. [*Figure 5 and 8*]

This story is about *ḏan'parr* (Stringybark) hollow log coffin. This *ḻarrakitj* is for the Wangurri clan from Dhälinybuy. This songline (*manikay)* is about the moon (*ŋalindi)* and the evening star (*djurrpun*) and current of the stream (*ḏalatj*), and the people and animals gathering at the mud plain at Warrawurr. This *manikay* belongs to the Wangurri clan. (R. T. Munyarryun, 2016)

The *ḻarrakitj* is a narrative description of the Wangurri's connection to the *Wangarr*. Each painted figure has a song, a dance, a design, a name. Layers of stories, embodied in intricate designs and symbolic meanings, ready to be interpreted by those who carry the knowledge. Riyakurray described these beings, and their connection to the Wangurri clan and a place near the mouth of the Cato river. Events that unfolded at Warrawurr under the watchful gaze of the moon (*ŋalindi*) and evening star (*djurrpun),* engaging a Wangurri warrior, the wild dog (*gulutharra*), the bushrat (*nyik'nyik*) and the corella (*ŋalalak)*. He spoke of the sacred currents of the river (*dalatj*), the high-water marks (*räŋ*) on the banks of the stream, and of the surrounding mud plains of Warrawurr. All the figurative characters painted on the sides of the *ḻarrakitj* have footprints (*djalkiri*) left behind them, suggesting they are on a journey. In his story, Riyakurray shared more detail about the current of the stream (*ḏalatj*) – which has been described to me previously as meaning 'wisdom' – and the other the marks left in the mud (*manga*). On the *ḻarrakitj* these are bordered by carved circular markings (*mim'pu*) which circumscribe the stream in three places. These, he said, represent three sons of the deceased; himself, Djakapurra, and Buwathay – another senior law man of the Wangurri.

To create the Virtual Reality experience from this story I proposed to reduce the ḻarrakitj to its core components and then reconstruct them in a 3D environment. This meant create a 3D model of the ḻarrakitj, record the songs, and then capture the motion of the dances for later mapping onto 3D avatars.

3.4 SPACETIME 2 Process: Technology

3.4.1 Capturing the Sacred

The first stage of the production involved recording the *manikay* (songs) described by the *miny'tji* designs in the ḻarrakitj. [*Figure 9*] The second stage required capturing the motion of the dances performed to playback of the songs. [*Figure 11*]

Djakapurra Munyarryun is a professional performing artist who has substantial experience in live performance and studio production. He has performed traditional Wangurri clan song and dance in many countries around the world. He is also an important Wangurri songman who is often called upon to fulfill his clan's obligation at important ceremonies across NE Arnhem Land. The Wangurri have long been renowned for their powerful voices, beautiful melodies and evocative manikay (R. Berndt, 1948). Djakapurra started learning the songs we recorded as a small child. As he has once explained to me, "I would sit on my father's lap during ceremony listening to the melodies, feeling the rhythms. I learned the manikay that way" (pers. comm. D. Munyarryun, 2016). In Dhälinybuy, as in other homelands, you'll still find the same tradition of passing this sacred knowledge on to the next generation during ceremony. Morphy explains that for the Yolŋu, 'performing the songs and producing the paintings is a sacred responsibility that keeps knowledge of the ancestral beings alive and embodied in place. Following the footsteps of the *Wangarr* is seen by Yolngu as a necessary part of life' (H. Morphy, 2011, p. 28).

For the making of the *ḏan'parr* SPACETIME prototype, the plan was to first record the songs in a recording studio at Macquarie University, and then motion capture the dance the next day in the Dance Studio.

In Yolŋu ceremony, performing song and dance is a group activity. One I describe through SPACETIME as a Socially Performative and Collectively Emergent process. The music is normally performed by a group of songmen from the same clan (or closely related) who share the singing, often in harmonised parts. At other times, the verses are shared amongst the group. Each singer has their own bilma sticks[40] for creating the beat. When one is struck against the other it produces a sharp penetrating sound that punctuates the rhythm of the dance or story of the song. With each stroke of the bilma the dancer's foot strikes the ground. The sound of the bilma has deep meaning for the Yolŋu. It is the source of *ŋarra* (R. Berndt, 1948; Keen, 1978; Toner, 2003).

The recording session was directed per Djakapurra's wishes. He chose to perform all musical roles himself. This demanded a multi-track approach and a post-record mix session. The multitrack session included Track 1: Yidaki (digeridoo), Track 2 and 3: Bilma (clapstick) and Manikay (song) recorded simultaneously. Track 3 and 4 were used for additional vocal lines that are either expressed by the dancers during performance, or sung as harmonies to

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[40] Making bilma sticks in preparation for a ceremony is a sacred activity.

accompany the main singer. There were additional tracks used to record the sound from a distance, for spatial balance. This was an important design consideration; to help create a ceremonial sound that would offer a more immersive atmosphere for the VR experience. The multi-track recording session was mixed and edited in preparation for playback in the following day's Motion Capture session. Countdown 'beeps' were added as cue points for the Motion Capture session. [*Figure 14*]

Djakapurra (DM) directed the traditional dance sequences for the Motion Capture (MoCap).[41] He also arranged for another professional dancer, Elma Kris (EK) to perform the women's dances.

Description	Artist	Motion Captured	Artist	Motion Captured	Duration
Bushrat (*Nyik'nyik*)	EK	Dance	DM	Dance + Yidaki/Manikay	0:43
Dingo (*Gulutharra*)	EK	Dance	DM	Dance + Yidaki/Manikay	0:46
Evening Star (*Djurrpun*)	EK	Dance	DM	Yidaki/Manikay	0:47
Moon (*Dhun'pul*)	EK	Dance	DM	Dance + Yidaki/Manikay	1:14
Freshwater (*Dalatj*)	EK	N/A	DM	Yidaki/Manikay	1:52
Warrior	EK	N/A	DM	Yidaki/Manikay	1:49
General Action	EK	Sitting/ interacting	DM	Sitting/ interacting	
General Action	EK	Walking	DM	Walking	

Figure 14: MoCap session data notes, 2016

3.4.2 Modelling and Building

The modelling of the *larrakitj* was beyond my skill set and required professional input.[42] The modelling of the avatars is a process that can be managed through free on-line resources and additional work in Blender, to rig the MoCap data to the Avatar. [43] However, it proved one of the more difficult elements and one that will need considerable refinement to achieve the desired result. Other systems identified for capturing the MoCap remain untested. This may help resolve some of the issues. Highlighting this as an area requiring more investigation.

3.4.3 Technical Resources

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[41] We used the IGS-180 inertial motion capture system. It records simultaneously data from 17 inertial measurement units (gyros) via a Wi-Fi router. The data is converted into biovision hierarchy files (.bvh) that are later mapped onto the armature of a 3D avatar model.
[42] For future research, I would look at using ARTEC 3D hand scanner that belongs to the Arts faculty.
[43] This process was manageable but I relied on in-house SIMHUB support.

The prototype design concept was to immerse the user in a transformative both-ways experience of the Dhälinybuy *ḻarrakitj*, that conveys a sense of 'outside' and 'inside' knowledge and evokes a sacred connection to the *Wangarr*. It employs an open narrative design that allows the user to make their own choices about how they proceed through the world, within the limitations built into the design, some of which are in respect of cultural considerations.[44] It is spatially limited to three environments in this iteration, however it is conceived around a more elaborate experience with differing levels of engagement. The experience is designed for viewing on both the HTC Vive and Oculus Touch VR HMDs. It offers haptic interactivity through two programmable hand controllers. We used a multi-platform 3D VR design for a room-scale experience, allowing the user to physically move around a space as well as teleport through virtual space. The prototype is built on Unity game engine v 5.6. and incorporates locational sound and effects, 3D modelled virtual environments, objects and avatar characters. It employs 360VR and traditional video media assets. I utilised traditional media production tools to create these, such as a digital video camera, still camera, digital sound recorder, sound studio, avid editing suite, multi-media computer labs.

The following list identifies those that were used to most effect in my process.

Production Technology
- Image capturing (MoCap, Digital Video, 360VR, 3D Scanning, Photogrammetry)
- 3D modeling (Blender, Fusion, Maximo, Unity)
- Interactivity design (Unity 3D game engine v5.6)
- Sound design (Multi-track sound studio, Unity, LogicPro, Zoom Digital recorder)
- Non-Linear Editing (Avid, Adobe Premiere)
- Computer graphics (Adobe Creative Cloud)
- Animation (Blender, UNITY, Photoshop)

Immersive and Interactive Technology
- VR Technology Oculus Touch, HTC Vive.[45]

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[44] e.g. In the Wanggar environment you witness the bunggul of the *birrimbirr*, but you are not allowed to approach these spirt dancers, as your teleporting ability is restricted and you must to stay within range of the *ḻarrakitj*. **Yolŋu** believe that a person has two kinds of spirit: *birrimbirr* and *mokuy*. The *birrimbirr* spirit is the one associated with the *Wangarr* ancestral beings, and on a person's death it returns to the ancestral domain. (H. Morphy, 1992)

[45] "The more fully realised VR experience involves a dedicated Head Mounted Display (HMD). This sophisticated, higher-cost VR experience includes lean-in tracking, and can include hand tracking, body tracking, eye tracking, brainwave monitoring, haptic feedback, specialized controllers, and other capabilities and devices. Currently these HMDs must be tethered to a computer due to computational power and bandwidth requirements.

- VR Hardware System. (PC OS: Windows 10, NVIDIA Titan Graphics Card)

<u>Technical Support</u>

The areas I required the most Technical Support included:[46]

- Sound design (Digital recording and mixing)
- Image capturing (MoCap, 3D Scanning)
- 3D modelling (Pipeline and Technique)
- Interactivity design (C++ programming support)
- Avatar animation (Character rigging, MoCap data management, Unity integration)

3.5 The Technological Map: Summing up

In this chapter I have situated SPACETIME within the theory of Mixed Reality and examined its relevance to the wider context of an Indigenous engagement with digital and information technologies. I have discussed the design and production considerations of the *ḏan'parr* SPACETIME prototype within this context and considered the relationship of content-creator-audience as a SPACETIME process of transcultural engagement. I have discussed my creative process within the theoretical context of Material Thinking and drawn comparison to the Yolŋu cultural processes and management of the sacred as a mode of creative expression. Through the design and production of the *ḏan'parr* SPACETIME prototype I have established a MR pipeline that will help guide future research around transmediation of culture knowledge, through a homeland-based two-way pedagogy. I have concluded that additional investigation is required in the Mocap to animated Avatar pipeline. I have also identified VR narrative construction: immersion and agency and technology/technical pathways as two areas that present challenges to be overcome in the short term, as a research priorities. These outcomes are framed around identified priorities for Indigenous engagement with ITC through programs of cultural engagement.

Examples of HMDs are the HTC/Valve Vive, Oculus Rift, Sony Morpheus, Fove, Razer, and StarVR. Examples of peripherals are Leap Motion hand-tracking, and Sixense hand- and feet-tracking, Control VR body suit, Tactical Haptic's Reactive Grip, Birdly's flying platform, and Virtuix Omni treadmill controller." (Lelyveld & Entertainment, 2015)

[46] Key support in 3D modelling and animation rigging came from Paul Gee and Meredith Taylor.

Chapter 4 Conclusion

In this thesis, I have addressed the research question, *"Through what process can a sacred cultural object be situated within the frames of Yolŋu epistemology and Virtual Reality?"* To address this, I examined the iterations involved in defining, developing, designing, and making a mixed reality SPACETIME prototype, the creative component of my MRes thesis. By structuring my investigation around a creative process, I align my research with a growing body of creative-based investigations, defined within a theoretical frame of Material Thinking.

In Chapter One, I introduced the research objectives through a need-based, community-driven discourse, arising from the experiences of the remote Indigenous community of Dhälinybuy homeland in NE Arnhem Land. This included identifying the nature of the connection the Yolŋu have with their homelands, as well as contextualising some of the social, cultural and economic issues involved in sustaining these communities. Considerations of spatial dislocation leading to infrastructural inadequacies weighed up against cultural and technological engagement, were demonstrated to characterise the socio-political context of Yolŋu homeland communities today. My investigation examined this dynamic through a transcultural dialogue, around the Yolŋu's spiritual connection to their homelands and an engagement with Mixed Reality related information and communication technologies. I concluded, that the investigation promotes Indigenous agency, cultural preservation and engagement in homeland communities, whilst attending to some of the challenges facing these remote communities including economic, pedagogical and social needs.

In Chapter Two, I discussed how I was led by my Yolŋu colleagues, through a transcultural negotiation process, to examine the protocols required for transmediating Wangurri sacred knowledge into a Mixed Reality environment. This process began by defining the cultural object to be used in the investigation as the Dhälinybuy *larrakitj*. It then led to Maḏayin law protocols, needs and outcomes. More so, how the investigation required an understanding of the five dimensions of Yolŋu rom, including a sensitivity to sacred matters relating to Yolŋu mortuary rites and the *larrakitj*. This revealed that matters concerning sacred homeland connectivity can be situated in a grand schema of moiety-based, inter clan relationships that are contestable and dynamic. My investigation into the sacred knowledge of the Wangurri clan was made possible through the support of the homeland-based Goŋ Wanhurr Aboriginal Corporation. More particularly, a close working relationship with two senior Wangurri artists and Cultural Consultants, Riyakurray and Djakapurra Munyarryun. With their input, I could contextualise my research objectives from a Wangurri perspective. My experience of working

with the Wangurri in their homeland, also reinforced the value of spending quality time 'on country'. During the MRes investigation my resources were restricted to personal contributions, suggesting an area to be addressed for an extended doctoral investigation.

In Chapter Three I examined the theory of Mixed Reality and the relationship of information technology to Indigenous culture. I then considered what this revealed about relocating the 'sacred' Dhälinybuy *larrakitj* into a Virtual Reality environment. Through this methodological approach, frameworks emerged that brought Yolŋu epistemological issues to the forefront of the technological discussion. Theoretical frames, such as SPACETIME, also emerged through this process, offering a new paradigm that seeks to express the innovation of the indigenous knowledge being incorporated into the technological process. These considerations were led by the creative process of developing and producing the *ḏan'parr* SPACETIME prototype. I located the theoretical frame around remote homeland pedagogy and Yolŋu performative knowledge by asking, "What affordance Mixed Reality could offer remote homeland communities in the future?" This question was in part answered by contextualising my research around the "Indigital Revolution' as characterised by the breadth and depth of Indigenous engagement with Mixed Reality related technologies, around the country. Of relevance is how best to address the homeland community need for enhanced IT engagement and training through the creation of culturally relevant material based on localised needs and conditions. The outcome of this research has afforded a transcultural framework for engaging with tangible and intangible Indigenous cultural heritage in remote homeland environments, and remediating these into immersive interactive Virtual Reality worlds. It has also helped guide future research around Mixed Reality transmediation of sacred material, through homeland-based two-way/both-way pedagogical practice. These outcomes are framed around identified priorities for Indigenous engagement with ITC through cultural engagement. They aim to contribute positively toward homeland stability and sustainability whilst promoting a strategy for addressing Indigenous disadvantage and need. This is an area I look forward to further developing with the community in the doctoral investigation, where I believe the scope of this investigation will allow a fuller and closer examination of the theoretical frame defined by SPACETIME, and its contribution to new knowledge in the field of designing and constructing both-way immersive virtual environments. Such an approach is in keeping with the dual motivation of seeking a framework for homeland pedagogical engagement through 'Learning on Country' programs, such as *Galtha Rom*, whilst producing an output that engages a wider audience in issues relating to the homeland's needs and issues. I believe this approach helps ensure the research project's longevity, as it is founded on strong relationships and trust within the community. This includes a sensitivity to the cultural material and processes demanded by

the Yolngu contributors and participants. In future iterations, it is anticipated the engagement with the community will be expanded beyond those professional artists involved in the production of the prototype, and be subject to the establishment of an appropriate ethical framework.

With the Wangurri consultants and Goŋ Wanhurr Aboriginal Corporation I have identified future needs for research around intangible cultural heritage sacred material that offers an extended both-way engagement for homeland communities, as well as a methodology to culturally engage outside audiences through MR technologies. I surmise that the research and outcomes outlined in this thesis promote the principles of two-way learning and cultural maintenance through a performative engagement with immersive MR technologies. I have argued that this engagement promotes knowledge-scaffolding opportunities both within and outside these communities. It can also produce other social and economic benefits through an engagement with the cultural economy. In promoting these outcomes, I acknowledge the serious technological challenges to be addressed in the short-term, to overcome the impact of time and distance and the Digital Divide. However, one encouraging sign as to how these issues might be overcome is found with Goŋ Wanhurr Aboriginal Corporation, who is now building community projects around the methods developed in this investigation, based on the needs and issues identified through the research. Attracting infrastructure support would be the next step.

Finally, a word about the research outputs. In preparing and developing this Thesis, I have assumed my readership would have access to the Virtual Reality creative work. This led me to situate part of the discourse, such as explanations of material processes, within the immersive VR Gallery. This included processes like Motion Capture, 3D modelling and scanning (digital surrogacy) and the interactive design and other VR experiments. I did this because I felt they were better expressed within the immersive virtual environment (IVE) context, where one can see, hear and experience the results of the research. This heuristic left the written discourse to summarise these material processes, within the context of the broader cultural and technical procedural analysis, without providing any detailed explanation. I admit such an approach has limitations and may leave interdisciplinary readers feeling short-changed. Certainly, in future research work, where the opportunity for expanding on a range of related subjects exists, I would look to explicate the technical elements in greater detail than I could afford within the limited frame of this MRes Thesis. That said, I believe the discourse contained in this thesis draws adequate attention to the most relevant aspect of the investigation; namely, addressing the Cultural frame, including the protocols and procedures to be developed from a community perspective, that will lead future community-based investigations. In such a scenario,

technological procedures follow cultural analysis. This approach helps align the research with community expectations around two-way learning – a system that privileges Yolŋu customary knowledge over western (technical) process. Adopting a practice-based research design, such as described in this thesis, implied a measure of economy be applied to the written discourse, set as it is against a limited word count. In such a case, identifying the key topic areas to pursue in a doctoral investigation was the tried and tested pathway I chose to follow in the preparation of this thesis. The potential of practice-based investigations involving immersive virtual environments based on transcultural digital knowledge pathways, as conceived through this investigation, has also led me to redefine my principal research area within the discipline of Digital Humanities (DH). This is an emerging field that demands an interdisciplinary approach, sometimes addressed through Science & IT and at other times, through Arts & Humanities (Cameron & Kenderdine, 2007).

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APPENDICES

APPENDIX A

Goŋ Wanhurr Aboriginal Corporation

Letter

APPENDIX B

ḏan'parr SPACETIME prototype

Photo Essay

GONG WANHURR ABORIGINAL CORPORATION

WWW.BUNGGULDJAMA.COM

Kevin Lucas
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13th May, 2016

Dear Kevin

RE: Consent to be involved in Macquarie University research project.

On behalf of Gong Wanhurr Aboriginal Corporation (GWAC), please let this letter be evidence of consent from this organization to be involved in Kevin Lucas' research project: *The Age of the Aboriginal Avatar; reclaiming the sacred in Virtual Reality*. In particular the VR adaptation of the Wangurri-Mandjigai *Moon-Bone Song Cycle* which we have proposed as a work to develop. We are very interested to work with Kevin to examine in more detail the translation by Berndt of our song line, which we can see from our initial review, has been altered significantly from the proper version.

Gong Wanhurr Productions (GWP) is the professional production arm of GWAC. Our vision is to build a stronger future for homeland kids through the Bunggul Djama performing arts initiative in partnership with homeland communities in NE Arnhem Land. GWP develops new works in media and performance, builds upon existing skills within the community and targets school children and youth through programs of engagement. Through Gong Wanhurr's programs we offer real community-driven solutions to remote Arnhem Land communities that engage school children, youth and elders in learning on country programs targeted at cultural language maintenance, land management and indigenous employment.

Kevin Lucas has been in consultation with the community about his VR research project. He has briefed us on the partnership and support Macquarie University can lend Gong Wanhurr in the realization of this important work. Kevin's research will help develop GWAC's programs by developing Learning on Country opportunities and offering genuine engagement for youth and elders to participate in new technological developments through VR storytelling. It also assists us with cultural maintenance and language preservation outcomes through the creation of new performing arts work for theatre and new digital media platforms. Kevin has a long history with our community and his personal commitment to Gong Wanhurr's on-going programs and projects is exemplary. We look forward to playing an active partnership role with Macquarie University and hope ILA is able to support our endeavor to see it succeed.

Your Sincerely

Djakapurra Munyarryun,
Chairperson

APPENDIX B
ḏan'pärr SPACETIME prototype

Photo Essay

INTRODUCTION: The narrative concept is to immerse the gallery visitor in a transformative experience of the Dhälinybuy _larrakitj_, that conveys a sense of 'outside' and 'inside' knowledge, evoking the sacred connection to the *Wangarr* and the homeland community of Dhälinybuy.

The 'visitor' arrives into a gallery space. On display are several 'art' objects.

The Ḏhählinbuy _larrakitj_ stands tall in the middle of the space.

There is an Indigenous man nearby, standing in the shadows. He keeps a watchful eye over the _larrakitj_. He is a lawman. A jungay. Charged with ensuring that respectful behavior is accorded the sacred object.

Photo Essay

The visitor can move about the gallery.

She can also walk around objects physically. Alternately, defying space and time, she can 'teleport' across the room in an instant with her hand-controller. With the touch-sensitive hand-controllers she can interact with certain objects in the gallery. Once familiar with the possibilities and limitations of her movement in this virtual world, she starts to inspect the exhibits in the gallery, in her own way and in her own time.

On the plinths are two busts and orbiting globes.

The busts demonstrate two different production techniques used for creating avatars.

APPENDIX B
ḏan'pärr SPACETIME prototype

Photo Essay
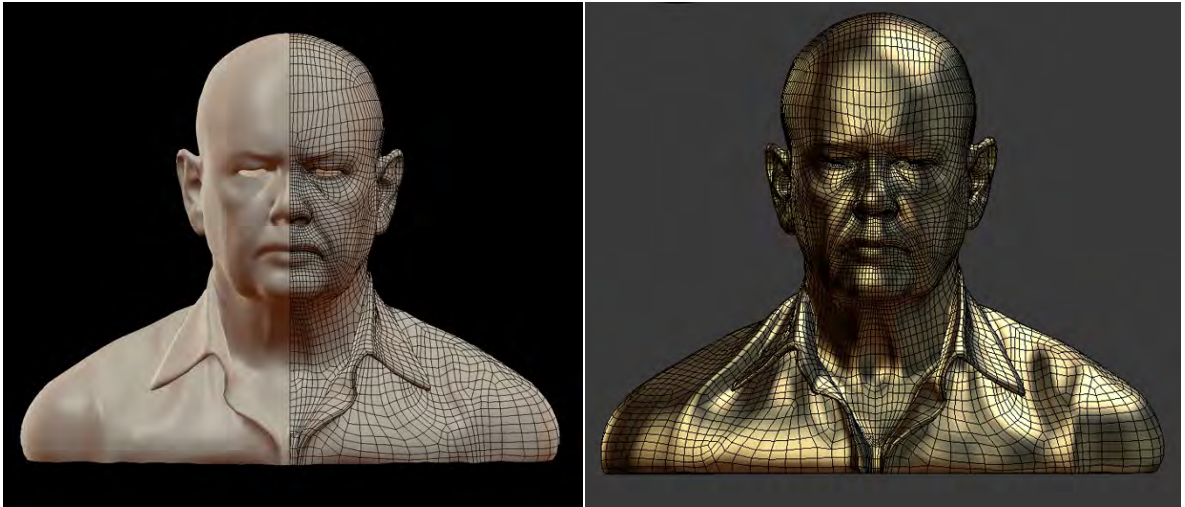
The bronze one is a 3D representation of the creator-researcher.

His image is captured by an ARTEC portable 3D hand scanner.

The other is a 3D bust of Djakapurra, modelled in Blender.

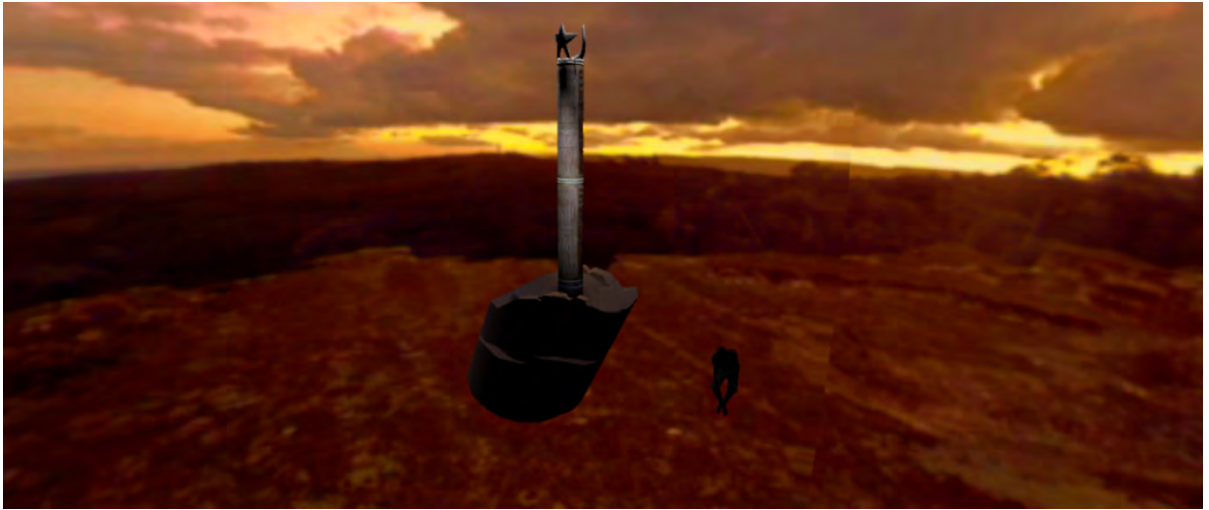This presents an alternative photo-realistic approach for character modelling.

Closer inspection of the orbiting globes moving around the plinth trigger surprising events.

Photo Essay

The lighter one triggers a projection on the wall in front of the visitor, revealing more about the *ḻarrakitj* and the process of capturing the motion of the dance that was used in creating the ḏan'pärr SPACETIME prototype.

The visitor becomes immersed in the space.

APPENDIX B
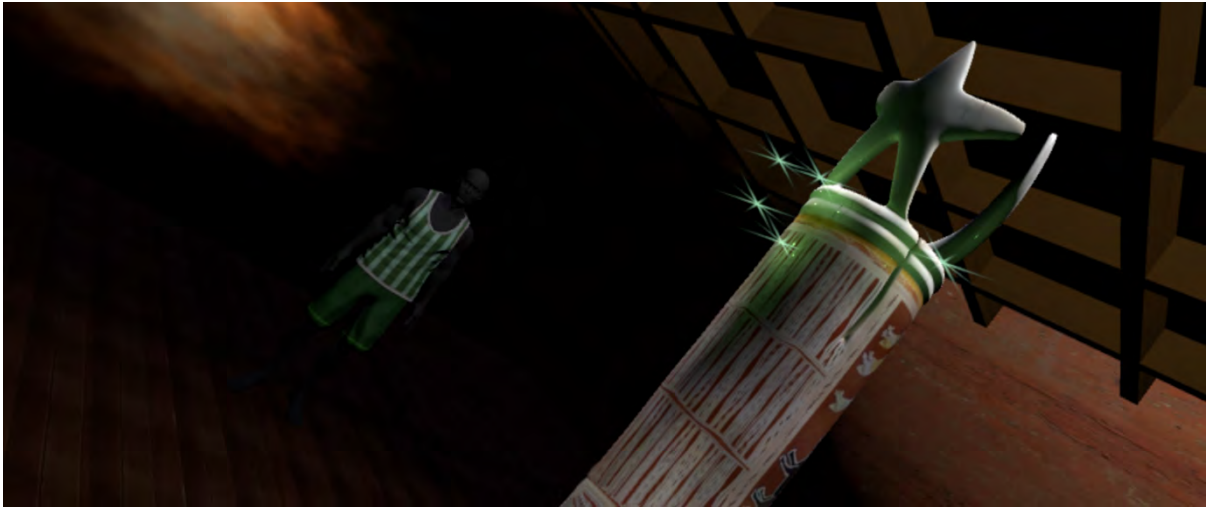## *ḏan'pärr* SPACETIME prototype

Photo Essay

She moves across to the *ḻarrakitj* and raises her hand toward the object. She discovers that her hand-controller allows her to interact with the *ḻarrakitj*.

By moving her hand toward the painted image of a dog, a bushrat, or up higher toward the sculptured moon and star, she trigger mysterious songs; the embodied sacred sounds of the miny'tji.

Photo Essay

Different painted figures and sculptured shapes trigger different sound events with magical effect.

She hovers her hand close to the small bushrat (*Nyik'nyik*).

Again, the mysterious song is triggered.

She pulls her hand away.

The song stops.

She moves it back toward the figure.

The song continues.

Then she squeezes the trigger.

Suddenly she is in another world.

APPENDIX B
ḏan'pärr SPACETIME prototype

Photo Essay

A beautiful, mysterious place.

She is surrounded by *birrimbirr* spirits, dancing the eternal steps of the ancestral bushrat.
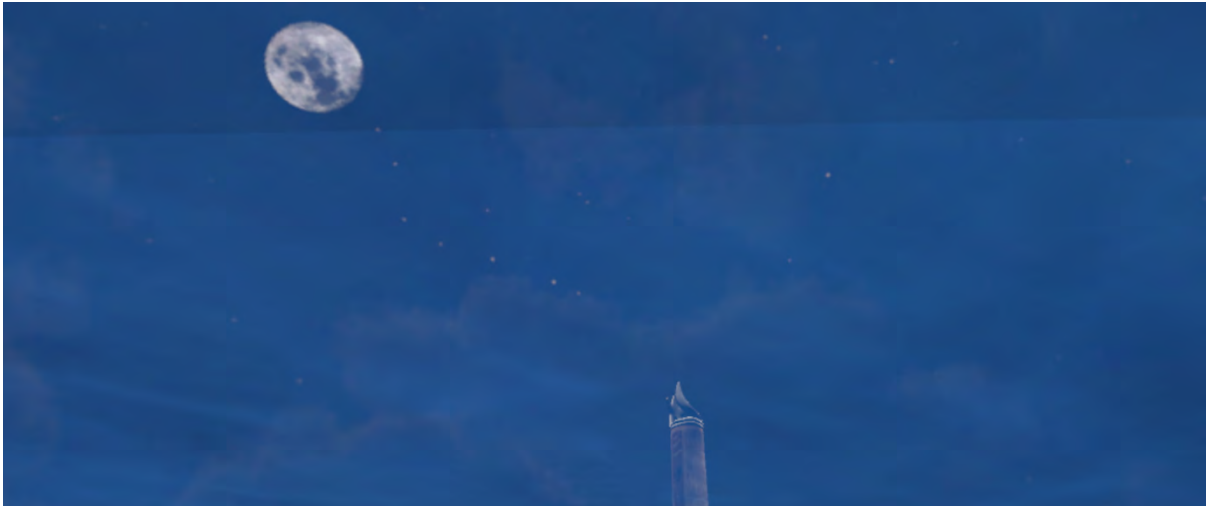

She can stay here and look around.

Photo Essay

Up above a starry sky.

The full moon shines brightly over the *ḻarrakitj*.

Colorful mists arise and swirl around her.

In this world, there are more *jungay*, standing near the dancers, watching over the proceedings.

Photo Essay

She tries to move out toward them. But her movements are restricted in this place.

She must remain close to the *ḻarrakitj* for her own well-being.

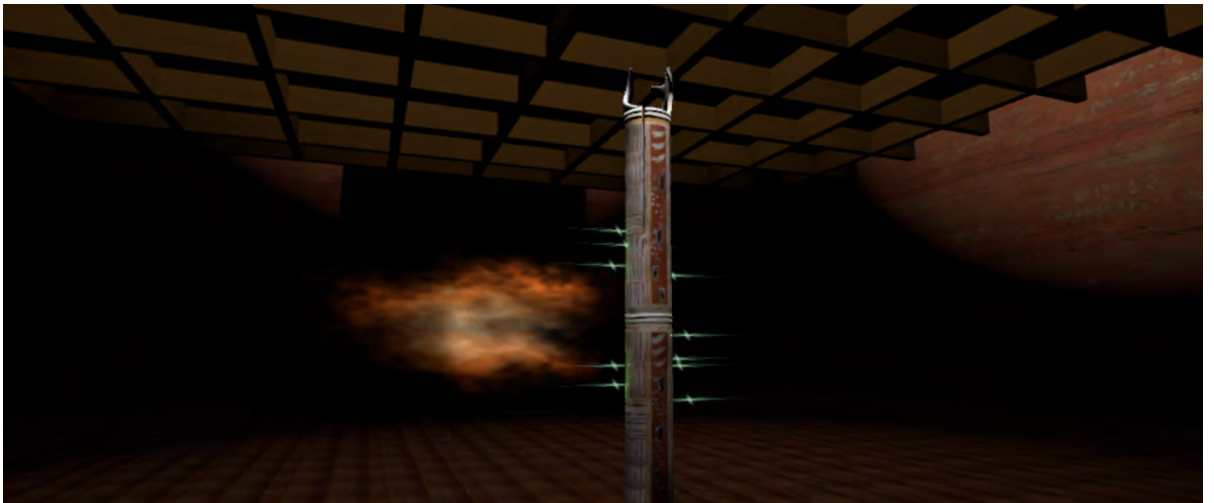She decides to return to the gallery. But how?

Photo Essay

She has been told the sacred stream depicted on two sides of the *ḻarrakitj* connects life and death

She raises her hand toward the stream (*ḏalatj*) and squeezes her trigger.

She's back.

APPENDIX B
ḏan'pärr SPACETIME prototype

Photo Essay

NARRATIVE EXTENSIONS

There are narrative extensions conceived both prior and following the events described. These included starting the experience in a hallway that adjoins the gallery space, behind the partition.

BRIEFING ROOM

The visitor is introduced to the VR interactivity and cultural experience she is about to encounter. This would be followed by a 'welcome to country' event. At the end of this sequence she would be offered a virtual brochure that would describe the exhibits on display. On occasion, these exhibits could be changed, and different virtual experiences designed around them. The visitor would be then 'pointed in the right direction' and invited to enter the gallery.

360VR GALLERY

The extended end experience would be designed for the opposite corridor adjoin the gallery. There are various scenarios being considered here including the incorporation of short 360VR documentaries (3-5 mins) that focus on the experience of living on homelands and the issues faced by children, youth and elders.

LANGUAGE GAME

There are number of possible knowledge scaffolding opportunities to be explored in these narrative extensions, including 'educational' tours, where the visitor is tasked with collecting certain information about the objects and then being tested on this knowledge at the end of the tour. These would be developed with the Ḏhälinybuy homeland community and Gong Wanhurr Aboriginal Corporation.