Beyond the Portal

Tangible and Intangible Rituals within Sacred Spaces

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Acknowledgement

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Abstract

This research project began by asking the question, *'How does mixed reality aid the creation of an inexhaustible three-dimensional world that supports the evolution of inhabitable narratives within sacred spaces?*

Imdat As states, **'The user in the digital age is not only a spectator but also an active participant of a parallel world.'** Within this environment, **'we experience and manipulate virtual space (Imdat AS, 2006, p.60)'.** As such, this notion of 'experiencing and manipulating virtual space' can provide a valuable set of tools to aid the evolution of inhabitable narratives within sacred spaces. To answer this question, the research proposes a proof of concept for a mixed reality multifaith environment. In its current conception, the multifaith space is limited to room scale spaces, treated as purely functional entities to the point where the experience within each space becomes monotonous. Religious architecture, whether it may be a church, mosque or temple, has been successfully translated into the collective memory of larger society, but within multifaith spaces, our focus has been on neutralization and in the process voided the space of any rich phenomenological experience.

In order to activate the space, the research aims to digitally overlay 'cultural information' on top of a multifaith space in order to alter its use, essentially transforming it to the spiritual needs of the user. Hereby, a Muslim immersive experience was developed by investigating and interpreting both the tangible and intangible rituals of prayer. By incorporating an 'altered' immersive experience, the project aids the evolution in design and concept of a multifaith space that moves beyond the notion of an **"empty white room (Crompton, 2013, p.487)".** By creating an MR environment for users of the Muslim faith, the project contributes design concepts and methods for others, furthering research in this field.

Keywords
Multifaith Space, Mixed Reality, Religion, Mosque Architecture

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Digital prayer space experience

Thesis Overview

In *Chapter 1*, we introduce the thesis, its aims and objectives, research topics, principal theo-rists, design methods and the scope of design. *Chapter 2*, a project review will critique and discuss Mosque architecture, multifaith spaces, and MR environments in order to illustrate cur-rent concepts and potential solutions. *Chapter 3*, collates relevant research and ideas to pro-vide an in-depth understanding of the thesis issue and possible solutions. *Chapter 4*, defines the methodology and elaborate on how these issues will be explored and developed. *Chapter 5*, employs the research and theory to form a design response. *Chapter 6,* reflects on the thesis discussing its achievements and possible future research.

1.0

INTRODUCTION

1.1 Background

Through the passage of time, places of faith have assumed certain architectural forms. Progressively, they have increasingly become adorned by symbols that are recognizable by all. For adherents to a particular walk of faith, the religious symbols invoke peace, a sense of solidarity and spiritual awakening. Navneet Kaur states, **"Symbolism for any community or group of people is a direct expression of their beliefs, ideas, fears & celebrations" (Kaur, 2012, p.05)."** However, this rich collection of texts, artworks, garments, artefacts and practices that associate with specific religions also distinguish one people's group from another. Due to the socio-political climate of today and the ever-changing demographics of our world, religion and the symbols associated with it are more relevant than ever before. Even while living in multicultural cities we seem to be more ignorant than ever before on the various cultures and religions that have shaped our communities. This ignorance leads to fear and apprehension, disrupting the social fabric within the community.

The struggle between secular, religious and inter-religious ideologies is growing globally and especially in multicultural communities. Research suggests that by sharing spaces, communities are introduced to alternate beliefs that challenge the existing system prompting a greater understanding and cohesion. A recent article in the New York Times, *A Battle Over Prayer in Schools Tests Canada's Multiculturalism,* highlights such a clash in beliefs. The title quite evidently reveals the nature of the problem; Should religion be accommodated at public schools? The article does not conclude with a solution but instead brings to our attention the continuous attempts being made by the school board, parents, students and the larger community to resolve the matter through dialogue. Such efforts to seek an ideal solution to the problems of living in multicultural societies is commendable. By accepting our differences and facilitating these discussions we only come closer to a more united society.

In *Living with Difference: How to Build Community in a Divided World,* the authors introduce us to the idea of **"emergent spaces (Seligman, Wasserfall and Montgomery, 2015, p. 35)"**, that manifest once a community accepts its differences and is able to reframe collectively its goals and desires. An example of such a space is that of a multifaith space, a platform that aims to accommodate all members of a community regardless of their religious or spiritual beliefs. Theoretically, the notion of a multifaith space is exciting as one begins to imagine how members of a community can look towards a common architectural body to fulfill their spiritual and religious needs. However, in its current conception, the multifaith space resides withinselect fragments of the urban infrastructure such as airports, shopping malls, hospitals etc. In most scenarios, the rooms are treated as purely functional entities to the point where the experience within the space becomes monotonous. They are spaces that are meant for everyone yet, spaces where no one desires, or is able to belong. Contrarily, religious architecture, whether it may be a church, mosque or temple, have been successfully translated into the collective memory of larger society, but within multifaith spaces, our focus has been on neutralization and in the process voided the space of any rich phenomenological experience.

As a result, this research looks towards advanced technologies such as Virtual, Augmented and Mixed Reality (VAM) as a possible toolset for evolving the inhabitable narratives within multifaith spaces. By doing so, the research attempts to activate the space in order to create a rich experience that captures the imagination and furthers the role of multifaith spaces within communities. The opportunities presented by mixed reality technologies enable the designer to rethink how a space functions and is experienced. Not limited by the permanence of a physical architecture, VAM spaces can be generated in ways that that are transformable, responsive and adaptable; concepts, that this thesis consider to be fundamental to the spiritual needs of every user. Hereby, this research proposes a proof of concept for a VAM environment that digitally overlays on an existing multifaith space in order to optimize its use. In order to do so, further research needs to be conducted in the framework of a specific religion. In this case, Islam was defined as the principle faith of study. This allowed an interrogation of Mosque architecture to understand how users of the Muslim faith can be accommodated within such a space.

By focusing on Islam and the evolution of Mosque architecture, this research gained an understanding of what is today deemed 'Islamic Architecture'. Furthermore, an investigation and interpretation of both the tangible and intangible rituals involved in Islamic prayer along with a study of MR theories and concepts, helped to determine the use of VAM in developing an immersive experience. By incorporating an immersive experience, the project promotes the idea of a multifaith space that moves beyond the notion of an **"empty white room (Crompton, 2013, p.487)"**. Hence, by creating an MR environment for users of the Muslim faith the project may be able to contribute design concepts and methods for others, furthering research in this field.

1.2 Research Question

How does mixed reality aid the creation of an inexhaustible three-dimensional world that supports the evolution of inhabitable narratives within sacred spaces?

1.3 Aims and Objectives

The aim of this thesis is to theorise an immersive experience for Muslim users as part of a larger notion of a Mixed Reality (MR) multifaith space.

The objectives of the thesis will, (1) Investigate Spaces for Prayer within selected tertiary educational institutions in Wellington in order to establish parameters for their optimization, (2) Study current MR theories and technologies in order to build a methodology that incorporates MR design tools within traditional architecture frameworks, and (3) Apply this research to designing an environment that supports the notion of an **Adaptive Multifaith Space**.
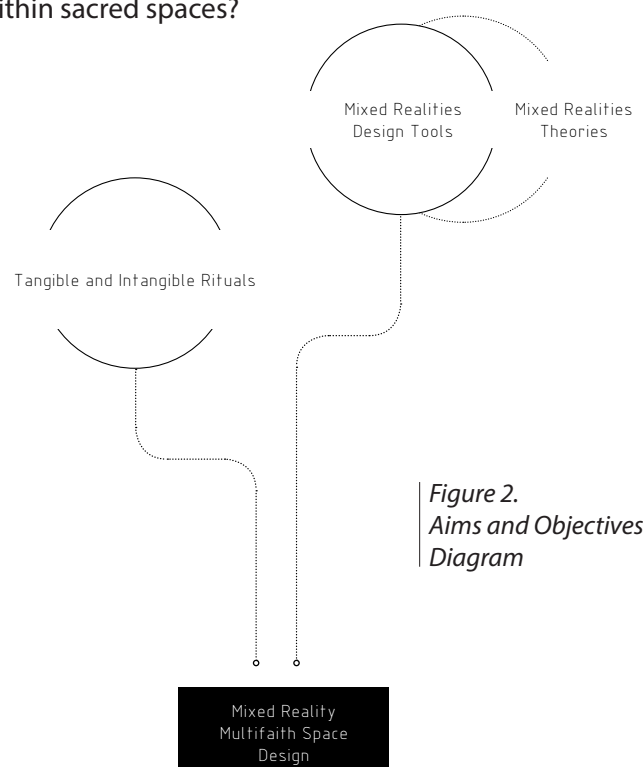
Mixed Realities Design Tools

Mixed Realities Theories

Tangible and Intangible Rituals

Mixed Reality Multifaith Space Design

Figure 2.
Aims and Objectives
Diagram

3

1.4 Research Topics

Sacred Space

The topic of sacred space aims to be understood through two perspectives; primarily, through the lens of history, evolution in design and religion; In order to do so, a focused study of Mosque Architecture may provide better insight. Secondly, the architectural and conceptual study of the more contemporary notion of a sacred space, that is, the Multifaith Space.

○ **Mosque Architecture**

For practicing Muslims, *salah*/prayer is essential to daily life as they perform it five times a day. The daily prayers are considered to be an act of worship and a conversation between the believer and *Allah*, they can be performed either in commune or in isolation. As a result, the mosque in Islam can be considered as any **'bounded space (Longhurst, 2016, p.49)'** that houses prayer. The only requirements assigned for this practice are that one should cleanse themselves before prayer through a ritual known as *wudu/*ablution and that the selected place for worship should also be clean. As a result, Muslims perform prayer with ease as they go on about their daily lives; they can be seen praying at their place of work, while studying at school or university, as they make their travels on vacation and so on. As a result, the mosque as a place for worship retains both ephemeral qualities and those of permanence, the mosque can be a single prayer mat and at the same time, the size of a city block. In *New Mosques: Design and Vision,* Holger Kleine states, **"The Quran neither prohibits nor encourages the design of monumental buildings for the worship of God or other artistic expression" (Kleine, 2014, p.11)."** Limited by no restrictions, the architectural notion of a mosque is forever evolving, adapting and being reimagined according to regional and cultural shifts that come with the spread of Islam. The study of its history and evolution will help to clarify the concepts behind its design and functional role within society. Furthermore, it will provide a greater understanding to the future of mosque architecture, especially within the context of a digital society.

○ **Multifaith Space**

Diversity enables change and by embracing it we open ourselves to spiritual and religious pluralism. Although not a historically recent concept, the notion of spiritual pluralism has existed in some form, actively or passively, within communities across the globe. Today, this idea of a shared space for religious activities has materialized architecturally as a **multifaith space**. Professor Andrew Crompton explains this as, **"A new kind of sacred environment in which anyone can pray whatever their religion...The most common and characteristic type is a windowless white room with a few religious texts on a shelf and the paraphernalia of religion, when not actually in use, kept out of sight in boxes (Crompton, p.474, 2013)."** The challenges that come with the designing of such culturally rich spaces are plenty, however, the opportunity to tackle the theoretical and architectural problems of religious spaces are tenfold. For instance, multifaith spaces offer an alternative to separate prayer rooms for distinct religious groups. Considering the limited amount of space available within public buildings this helps to resolve a crucial issue faced by designers and planners.

4

Mixed Reality

Architecture has often been the center stage for social interactions but today, these interactions have moved beyond just the built environment and onto digital platforms. Within most advanced faculties: technology, education, medicine etc, VAM environments are being developed, researched and implemented.   Considering the new paradigm shift, religion and the practices involved must also adapt and evolve. Within academic discourses, we begin to see the generation of new ideas and concepts. In the paper, *The Digital Mosque: A New Paradigm in Mosque Design*, Imdat As, considers technology as a platform by which to advance our current understanding of a mosque and the various Islamic practices involved. He introduces the idea of a **"convergent mosque (Imdat As, 2006, p.61)"**, an online mosque paradigm converging the virtual and physical spaces. Furthermore, *Whispering Walls: Cultural augmentation with augmented reality at a range of scales* by Krishna Duddumpudi aims to translate traditional handicraft ideologies to augmented reality in order reconnect individuals to the Hindu temples of South India. By exploring the notion of **'info-tectonic'** details and the digital medium, the project allows users to engage, learn and document their culture that responds to the needs of contemporary society.

Tangible and Intangible Rituals

Religious spaces evoke certain spiritual experiences through an amalgamation of tangible and intangible rituals that aim to stimulate the human mind and body. The rituals become the primary driver for inhabitable narratives within sacred spaces influencing the architecture and the phenomenological experience within. Tangibility in the context of rituals can be understood as any practice that can be perceptible by touch, for instance the ritualized cleansing of oneself with water before entering Sikh gurdwaras and Islamic mosques or to heal oneself with the smoke of burnt incense as practiced in some Buddhist and Shinto shrines and temples. While intangibility moves beyond, attempting to awaken the mind and spirit through ritualized acts of prayer, recitation and a plethora of music and soundscapes; for instance, listening to a choir at a church or chanting of mantras at Hindu temples. In order to house these ritualized practices, architecture embraces the notion of tangible and intangible rituals by forming spaces that support the function and create an environment around the space to enhance the human experience. Tangible and intangible rituals will be further discussed in Chapter 5.

1.5 Design Methodology

With advancements in design, construction and fabrication technologies, research in the field of design is also constantly evolving. Designing for a mixed realities environment incorporates the use of new tools and techniques that are not used within traditional design. We must broaden our understanding of design and include concepts from other disciplines such as game design or film. However, the introduction of newer technologies does not mean the abandoning of tradition. Architecture is and will always be driven by parameters (societal, cultural, historical, phenomenological, technological and/or materiality) that merge and interact, influencing the outcome. The advancements in technology should be seen through the lens of supporting and enhancing these parameters in order for their optimization.

The research and design methodology begins by asking crucial questions targeting the politics of symbols within architecture in order to understand how it affects us as a globalised society. Investigation of literature and case studies helps to build the core ideas on how to pursue this thesis. Furthermore, primary research in terms of site visits and discussions with experts and individuals provides direction. As the design aims to create an immersive environment, various tools and techniques needed to be studied, learned and tested. All of these processes supported the formulation of architectural principles that in the end forms a design that acts as a proof of concept for an adaptive multifaith space.

Background

Case Studies
+
Literature

Research Question

Aims + Objectives

Mixed Realities
Theories

Tangible
+
Intangible Rituals

Data Collection

Quantitative

Qualititative

Data Interpretation

Evaluation

Testing

Mixed Reality
Design Tools

Implementation

Design
Evaluation

Design Process

Figure 3.
Methodology Diagram

Proof of Concept

1.6 Scope of Design

A proof of concept for an MR mosque was designed and developed.   Due to limitations in the quality of experience within current MR headsets such as Microsoft's Hololens, the designed environment is experienced through the lens of a VR headset - HTC Vive.

The design caters to users of the Muslim faith, it consists of four key experiences:

- Experience I: The Prayer Room (Real Environment)
  Entering the physical space within which worship is to take place and upon which the digital elements are to be overlayed.
- Experience II: The Call to Prayer (Augmented Reality)
  Listening to the adhan/call to prayer, that signifies the time for prayer and initiates the mental preparation for worship.
- Experience III: Virtual Cleansing (Augmented-Virtuality)
  Cleansing of the mind and body prior to worship in an attempt to raise spiritual awareness.
- Experience IV: Performing Salah/Prayer (towards Virtual Reality)
  The act of worship within a digital prayer space.

The VR experience presents a gradual transition along the reality-virtuality continuum **(Real Environment - Augmented Reality - Augmented Virtuality - Virtual Reality)**. The sequence of events beholds a merger of sacred space design and mixed reality environments. The design was an opportunity to implement the methodology and in return, aims to activate the multi-faith space in order to optimize the experience for the users.

To develop an immersive experience that caters to people of all religious beliefs is beyond the scope of this project. Hence, by creating an MR environment for users of the Muslim faith the project contributes to design concepts and methods for others, furthering research in this field.
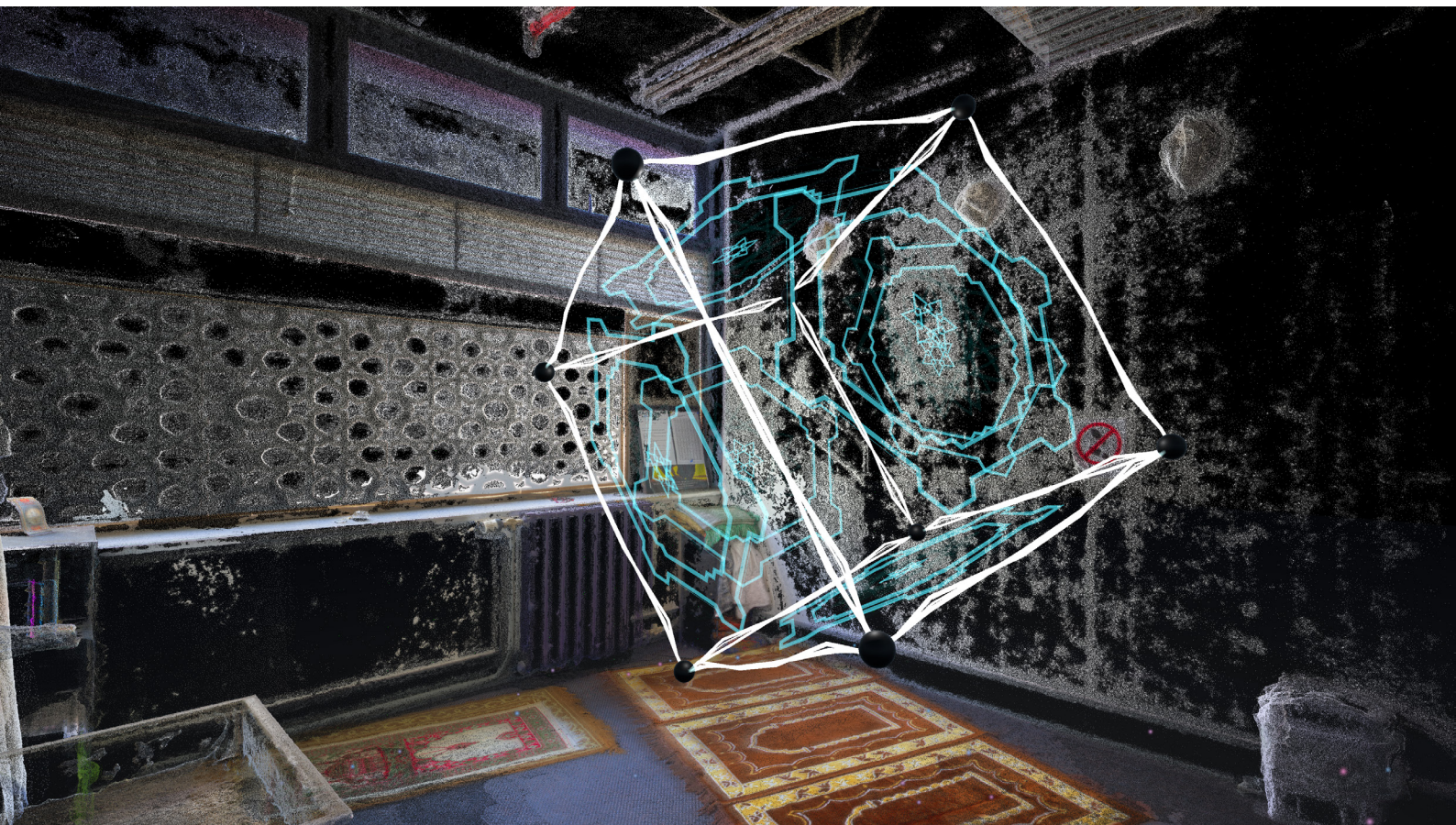
Figure 4.
Call to prayer experience

2.0

Project Review

2.1 The Prophets Mosque

In order to make sense of the evolution in design of mosque architecture in the 1400 year history of Islam one must look to the Prophet's Mosque, *Al-Masjid an-Nabawi* that still stands today in Medina, Saudi Arabia. Built by Prophet Muhammad (Peace Be Upon Him) in 622 AD, it is considered the second holiest site in Islam after the Holy *Ka'bah* within the Sacred Mosque, *Al-Masjid Al-Haram*, in Mecca, Saudi Arabia. Over the centuries, the mosque has seen numerous rulers all of whom have made their alterations and adaptation, inclusions and exclusions. The history of the Prophets Mosque embodies the evolution in the design of mosque architecture.

"If the *Ka'ba* was the architectural marker as the House of God, then the mosque-house of Medina was the House of the Slave of God. If the Master's House, in its emptiness, spoke of his transcendence, then the slave's house, in its fullness, expressed its earthly mission of establishing the *din* (creed/religion) of Islam. Here, the *Quran* was received; here, *din* (creed/religion) was formulated; here, the *Sharia* was refined; here, Islam was lived out with sincerity; and here, God's help was sought with devotion (Haider, 2003, p.636) ."

In its origins, the mosque consisted of an enclosed courtyard built of natural materials that were readily available in Medina. The enclosure measured 30.5m x 35.62m with boundary walls built of sun-dried mud bricks. A section of the courtyard was covered with a roof built of beaten clay and palm leaves, supported by palm trunks. The roof intended to protect occupants from the harsh desert sun. Three of the four courtyard walls consist of gateways or portals to the complex while the fourth wall, known as the *Qiblah* wall, demarcates the direction in which to perform *salah*/prayer. The mosque sat adjacent to the Prophets residence. According to Spahic Omer, in his paper, *Some Lessons from Prophet Muhammad (SAW) in Architecture: The Prophet's Mosque in Madinah*, **"The main roles performed by the mosque were as a centre for congregational worship practices, a learning centre, the seat of the Prophets government, a welfare and charity centre, a detention and rehabilitation centre, a place for medical treatment and nursing, and a place for some leisure activities (Omer, 2010, p.119)."** The series of functions within the complex catered to all of Medina's residents, Muslims and Non-Muslims. This first step at establishing the mosque as the centre of the city intended to unify the community. By introducing more functions within the mosque complex, people were given responsibility in its day to day activities. The mosque became the space within the city that anyone could turn to for support.
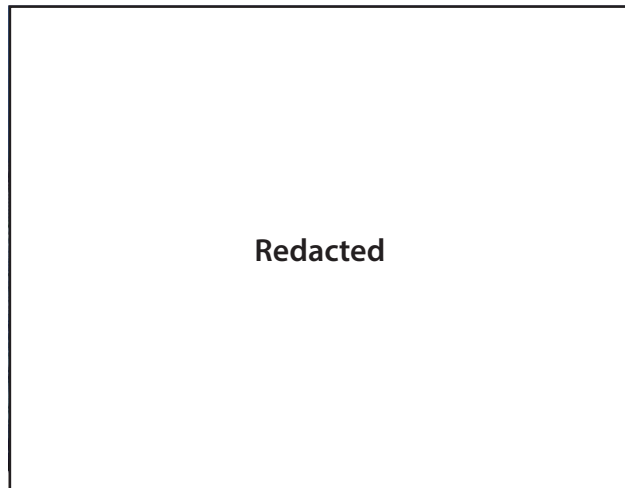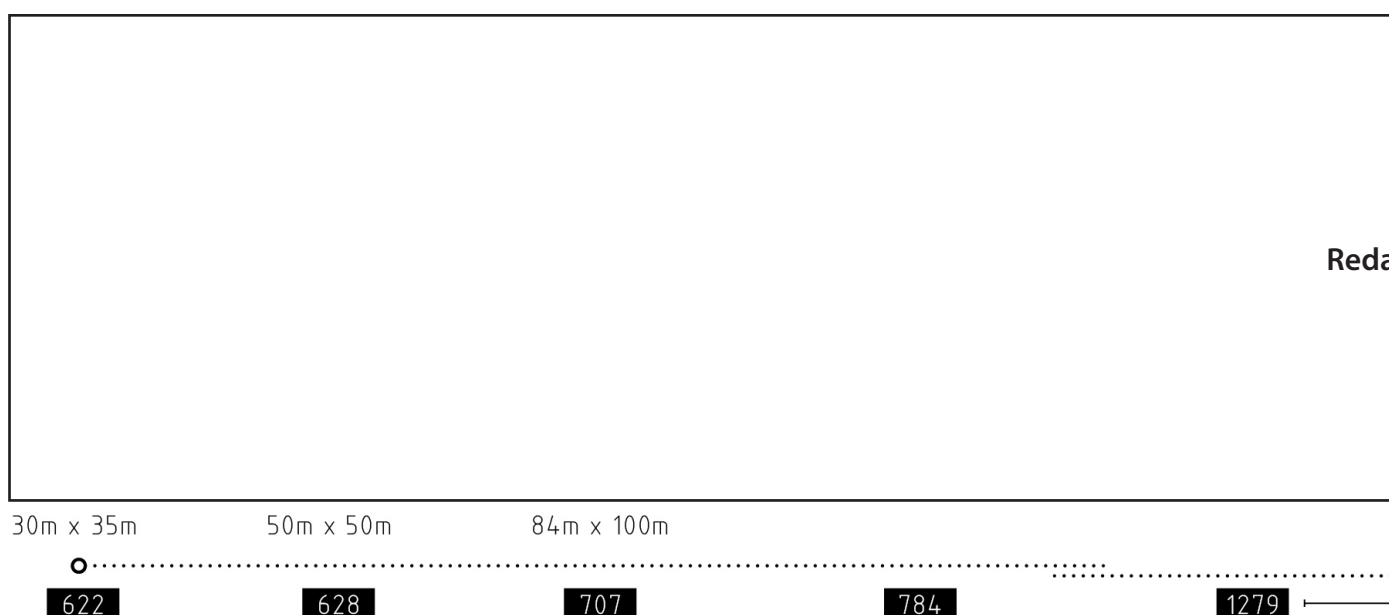
Figure 5.
The Prophets Mosque (Present)

Long after the Prophets death in 632 AD we begin to see a series of changes initiated by a succession of rulers. With the passage of time, the city of Medina grew and so did the mosque, in 707 AD the mosque was rebuilt by the *Umayyad Caliph Al-Walid*, this time it measured 84m x 100m. During the reconstruction we are introduced to the *mihrab*, a niche within the *qiblah* wall. The *mihrab* further enhances the *qiblah* wall acting as a signifier. It has today evolved into a highly ornamented and essential element within most mosques. Further expansions in 784 AD, introduce for the first time, *minarets*. By this time Medina had grown in size and population, the *azan*/call to prayer could not be heard by those on the outskirts of the city. Out of necessity, *minarets* were built, allowing the *muezzin* to climb to the top and from there give out the call to prayer so that everyone could hear him. The *minarets* also acted as landmarks, clearing identifying the location of the mosque to any travellers and visitors who may not be accustomed to the city. It was more than 600 years after the mosque was first built that the dome was introduced to the mosque in 1279 AD. The dome at that point aimed to identify the Prophet's tomb that now situated itself within the mosque. Apart from functioning as a marker, architecturally, the dome acts as a passive method for the transference of heat. Today, the same mosque now measures 400m x 240m, a 100 times larger than the original, covering beyond the old city limits of Medina. Its flat roof is now topped with 24 domes and the complex is surrounded by 10 *minarets*. Through this evolutionary process we come to learn how the mosque has materialized into its current conception.

Reda

30m x 35m   50m x 50m   84m x 100m

622   628   707   784   1279

Was built by Prophet Mu-
hammad after his *Hijrah*
(emigration) to Medina.
The mosque consisted of
a courtyard with entranc-
es along three walls. The
fourth wall demarcated the
Qiblah (direction of Mak-
kah, to which Muslims pray).

Umayyad Caliph al-Walid
rebuilt the mosque. Dur-
ing the reconstruction a
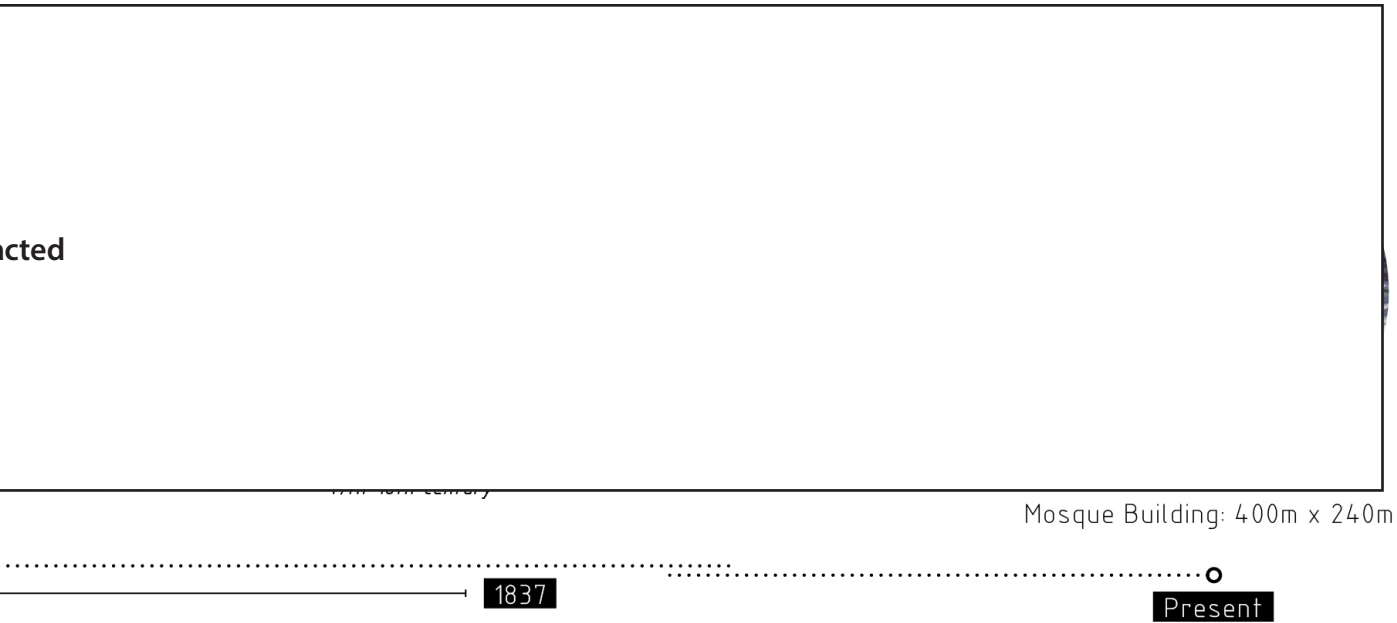*Mihrab* was added to the
Qiblah wall

The first four minarets were
added while the mosque was
being further expanded under
the rule of al-Mahdi, the third
Abbasid caliph.

The not
the mos
grave.

1279 – W
to
fir
1818 – Cu
M
1837 – P

an-Nabwi

ts Mosque

cted

17th-18th century

Mosque Building: 400m x 240m

1837

Present

able Green Dome in the South-East corner of
que marks the location of Prophet Muhammads

/as first concieved as a wooden cupola built on
p of the tomb. 657 years after the Mosque was
st built.
urrent dome was built by the Ottoman sultan
ahmud II
ainted green for the first time

The current mosque is a 100 times larger
than the original, covering the entire area
of the old city of Medina. Its flat roof is now
topped with 24 domes and 10 minarets. The
original mosque is now entirely engulfed by
the numerous exapnsions throughout the
various periods of the mosques timeline.

Figure 6.
Diagram showcasing expansions and
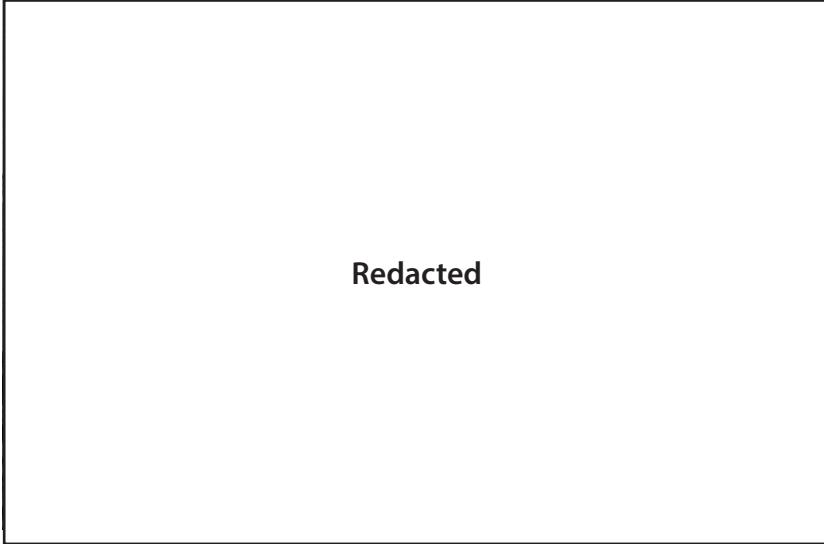*alterations of the Prophets Mosque*

2.2 *Namaz Khaneh*

Namaz Khaneh, 'The Prayer Room' by Kamran Diba consists of two open to sky cubes that house prayer and contemplation. The 'Praying Room' acts as a sculptural intervention within the landscape, while one cube orients to the site, the other to the Holy *Ka'bah*. The architect makes use of simple gestures that communicate clearly the functions within the mosque, a sculptural pair of metal shoes sit outside the entrance, alerting visitors to take off their shoes; a slit in the concrete wall opens views to the landscape signifying the *qiblah* wall, far from the grandeur of the mihrab in traditional mosques but as effective. Without dominating its context the mosque makes a powerful statement. The installation is minimal yet a wonderful case study that looks back to the time of the Prophet Muhammad (PBUH) for design inspiration.
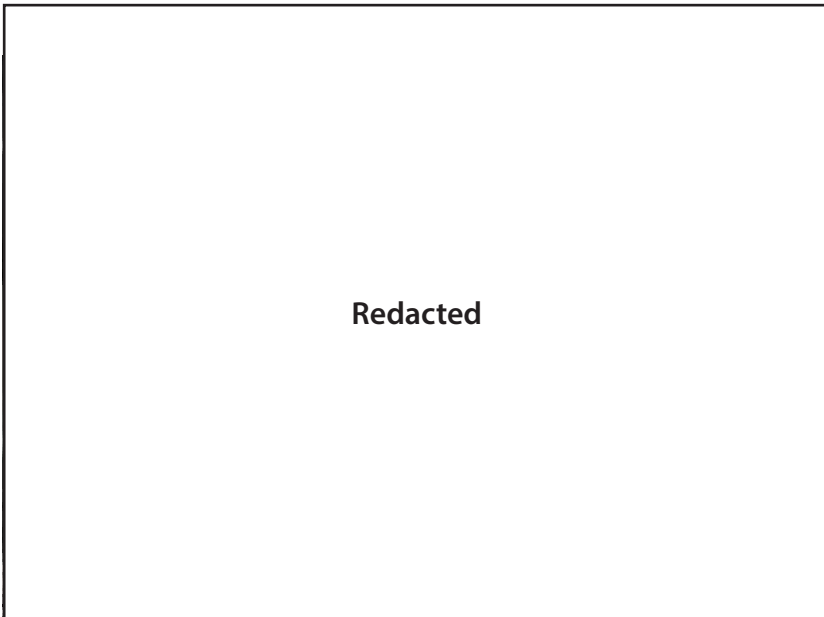
2.3 'Ground-Zero' Mosque

The highly controversial mosque and community center, 'Park 51' also known as the 'Ground-Zero Mosque' reveals to us the tarnished socio-political climate of today. Politics made use of misinformation, islamophobia, nationalism or any number of reasons to hijack the project, leaving it unbuilt. Many overlooked the fact that the chosen site for the mosque was in reality two blocks away from Ground Zero and upon which a mosque already existed. The developers wished to tear down the old structure and rebuild the mosque and community center with a number of functions that catered to Muslims and Non-Muslims alike. The debate surrounding the mosque and community center neither included discussions on the design nor its intended role within the community.

Of the 22-story building, only two floors were to house a prayer space for Muslims. The rest of the building was to include an auditorium, theater and performing arts center; a basketball court, swimming pool and fitness center; an art gallery, museum and bookstore; a culinary school and an array of restaurants; and finally, an Interfaith Center to promote dialogue and understanding between the various faiths. The vast functions within the building shows the intended inclusivity of the spaces that represent the true image of Islam within a multicultural context. Within multicultural societies, the community does not consist of either Muslim, Christian, Jewish, Buddhist, Hindu, Religious or Non-Religious, the community is anyone and everyone that resides in the area; and here we have a case study of a religious group that acknowledges this richness within the community and attempted to build bridges not walls. It is unfortunate that Park 51 could not be built as it would have opened numerous doors to help understand the role of religion within today's multicultural communities.

Redacted

Figure 7.
Namaz Khaneh - the 'Prayer Room'
Tehran, Iran

Redacted

Figure 8.
'Ground-Zero' Mosque - Park 51
New York, America

2.3 Shrine of *Zinda Pir*

As stated earlier, although not a historically recent concept, the notion of spiritual pluralism has existed in some form, actively or passively, within communities across the globe. The shrine of a saint, known by Muslims as *Sheikh Tahir*, by Hindus as *Jhulelal*, and collectively known as *Zinda Pir* in the village of Odero Lal, Pakistan, is an example of how constant engagement enables communities to live peacefully no matter the troubles faced by rest of the region. The saint is revered by both Muslims and Hindus and within the complex exists both a mosque and a temple. Caretakers who maintain the upkeep of the complex hold representation from both communities. Time sharing allows worshippers to perform rites without disturbing one another. During times of festivities, both communities come together and celebrate. There is diversity and engagement, differences and understanding, and most importantly, there is a commitment to furthering the relationship shared by both communities.

2.4 Multifaith Centre - UofT

A more recent project that aims to embrace the notion of spiritual pluralism is the Multifaith Centre at the University of Toronto by *Moriyama* and *Teshima* Architects. Institutes such as these are an oasis for multicultural communities. With that comes great challenges in order to accommodate everyone. The architects state, **"The uniquely versatile venue allows people of all faiths to feel equally welcome and equally valued. The design paradox was to create 'faith-neutral' spaces with a design aesthetic that is universally perceived as a sanctuary and retreat for all (Moriyama and Teshima, 2007)."** The idea of a sanctuary as presented by the architects creates an environment in which people interact, sharing different ideas, rituals and practices. The Multifaith Centre is an example for societies and communities all over the world that teaches us to embraces our differences in order for us to learn and respect one another.
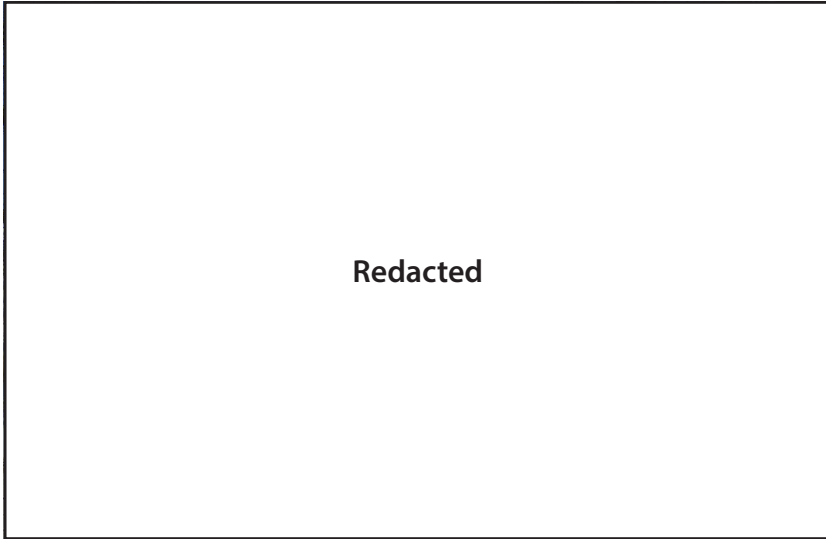
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Figure 9.
Shrine of Zinda Pir at
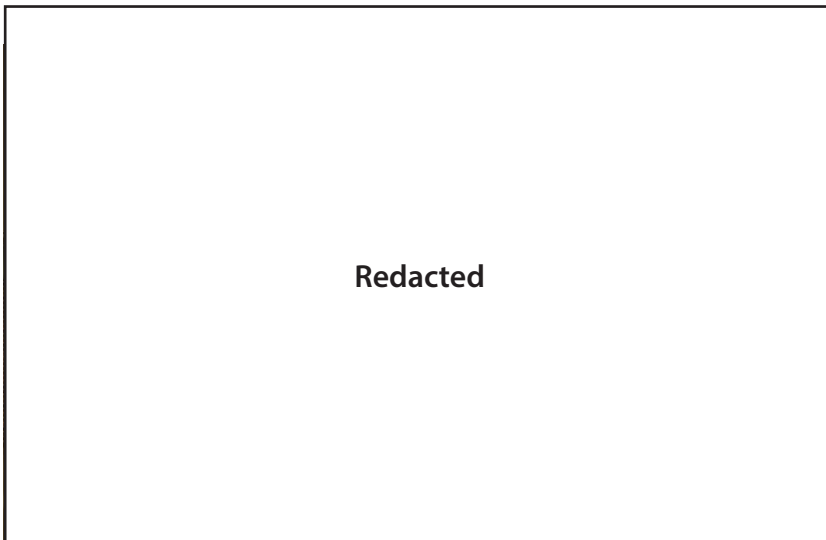*Odero Lal, Pakistan*

Redacted

Figure 10.
Multifaith Centre
Toronto, Canada

2.5 Hyper-Reality

Keiichi Matsuda, in his concept film, 'Hyper-Reality', presents to us a world embellished with layer upon layer of digital information, a world where the built, the virtual and social convulate. The depiction sheds negative light upon the potential impact of a VAM environment. The overall theme presents a disturbing scenario in which the digital realm has enveloped every aspect of our lives. *Matsuda* states, **"It will be the glue between every interaction and experience, offering amazing possibilities, while also controlling the way we understand the world. Hyper-Reality attempts to explore this exciting but dangerous trajectory."** The statement reveals the level of influence a digital world can have upon its users and aims to redirect researchers in the field towards finding a middle ground where technology and the built environment can go hand in hand to support and enhance the human experience.

2.5 Rez Infinite

The musical rail shooter game, Rez Infinite, immerses the player in a mesmerizing virtual reality environment. Conceptualised and produced by *Tetsuya Mizuguchi*, the game formulates a synthesis of electronic music with game play and a graphically rich environment. The game tempts the players sensory capabilities to 'evoke emotional and psychological responses'. The innovative approach sought in the design and development of Rez Infinite makes the game highly successful. Rez Infinite makes use of both hardware and software to allow the player to control the avatar, one is able to look around and shoot with the controller but simultaneously, the crosshair is also connected to the headset; this method enhances the gameplay within a VR context and furthermore provides the player with a more realistic sensation. Furthermore, the forms and materials explored in the game move beyond architectural realism as the visual graphics of the game do not shy away from promoting the purity of digital design language; the player is submerged in a world built of 2D and 3D polygons, vectors and point clouds.
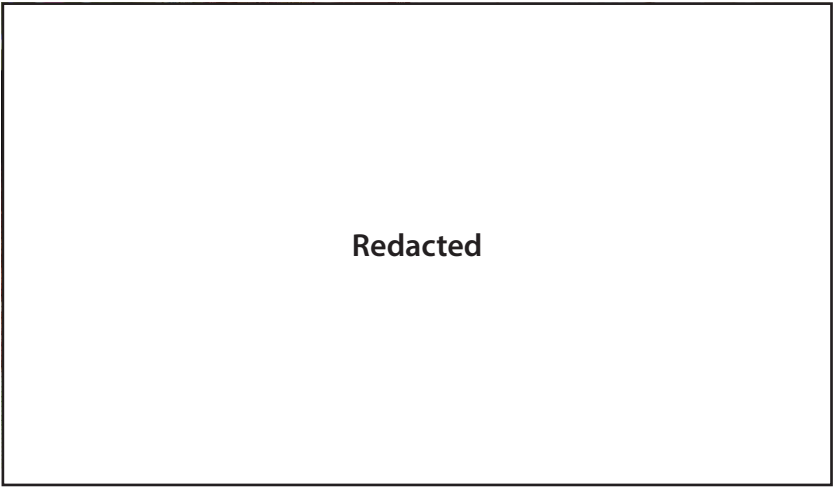
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Figure 11.
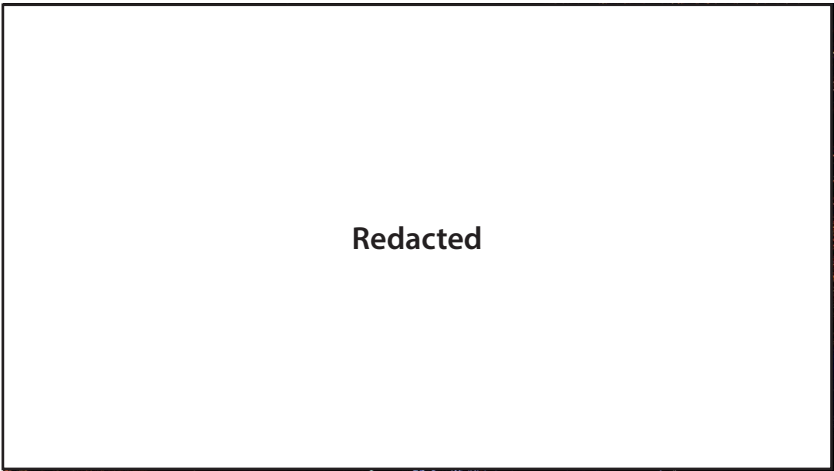*Hyper-Reality*
Keiichi Matsuda

Figure 12.
Rez Infinite

3.0

Literature Review

3.1 Sacred Spaces

Mass migration is a reality of our world today, creating diverse cultural communities that historical building fabric is unable to match. The impact of migration can be seen across the continents but no where is it more evident than in Western cities. For decades now, people have been migrating to Western shores either as refugees fleeing war/famine/persecution or as immigrants seeking employment and education for a better future. With migration comes the addition of distinct cultures, traditions and religions that attempt to fuse with those of the host nation. At times the integration of refugees and migrants can be successful culminating benefits, however, if done poorly, it can result in conflict and dissolution that can have a long lasting impact on the larger community as a whole. The mosque, has become the target of a growing dispute between Muslims and Non-Muslims within Western societies ranging from North America to Europe. The extent of the problem has reached a stage where in some regions the *minaret* and dome have been banned or are in the process of becoming banned.

Over the centuries, the mosque has assumed a certain typology termed as an 'Islamic Style' or 'Islamic Architecture' that is recognizable by all. With the ever-changing demographics of our world today, more mosques are being built in the West, but little has changed in terms of the design considering the new context. Martin Frishman and *Hasan-uddin Khan* in their book, *The Mosque: History, Architectural Development and Regional Diversity,* state, **"Islam is virtually without symbols other than the Ka'ba at Mecca, assuming that one leaves aside mystical or allegorical motifs such as the crescent moon and star which today serve as national or political emblems, and which in any case have origins that antedate the monotheistic religions (Frishman and Khan, 1994, p. 32)."** The statement highlights the contradiction in Islam today, the dome and minaret were the architectural and technical solutions to functional issues, but now have become sacrosanct symbols and dominant features that define the mosque. The intended purpose of these features are now obsolete due to technological advances.

In his paper, Professor Longhurst questions the notion of 'Islamic Style' or 'Islamic Architecture'. He highlights, **"In the history of mosque architecture there are Ottoman-Turkish styles, Arabic and Persian styles which may or may not be traditional, or a style after the Prophet's house – the Arab-plan, hypostyle, four-iwan, or centrally planned styles, etc., but no "Islamic style," because the term "Islamic" cannot be said of architectural style without betraying, an ignorance of Islam's inclusivity, a religion as a totality of parts, flexible and variant in architecture (Longhurst, 2016, p.51)."** Professor Longhurst emphasis the importance of a Mosque typology that moves beyond culture and time to a more universal concept of Islam as it is today represented by 1.6 billion Muslims from every region of the world.

As discussed earlier, the Prophets Mosque reveals the origins of mosque architecture as a minimal intervention within the built environment; it did not seek to dominate or impose itself. Only through later developments did the mosque grow into becoming a monument that has inspired almost every mosque since. In the book, *New Mosques: Design and Vision,* Holger Kleine discusses as to why monumentality may not have been intended in earlier mosques, he states, **"The construction of magnificent buildings could have been seen as a sign of temptation rather than piety for the rulers (Kleine, 2014, p.11)."** Designing and constructing exceptionally highly crafted, ornate and exquisite architecture requires immense expenditure and the support of an authority. One could possibly argue, by doing so, politics ensures the disengagement of the masses from the mosques day to day operations and responsibilities; in the process, establishing a hierarchical system. However, with the onset of digitization, we begin to see how society is re-engaging, the accessibility to information and different point of views has allowed the blossoming of discussions and debates that all support in the reconstruction of thought. Consequently, we begin to see new ideas formulating, one such example is that of the multifaith space that may help in rethinking and reimagining the mosque.

In his paper, *The Architecture of Multifaith Spaces: God Leaves the Building*, Professor Andrew Crompton introduces us to the several design problems involved in the architecture of multifaith spaces. A multifaith space can be explained as a space that is used by persons of any religion or no religion for prayer, meditation or contemplation. Considered as sacred spaces, the multifaith space intends to assist in the user's spiritual needs. Spaces such as these cannot resemble any place of religion, express symbols or styles that may make it evocative. In the paper, Andrew discusses the significance of an 'empty white room' and draws comparisons to art movements that changed how the world perceived art. He states, **"The blank paintings did not destroy art, rather they were a motor of its evolution, part of the dematerialization of art that has continued to this day (Crompton, 2013, p.493)."** Furthermore, in his research, he categorizes the multifaith space distinctively as 'inclusive' or 'exclusive' of physical symbols. By being physically 'inclusive', the space attempts to incorporate the numerous paraphernalia associated with each faith. According to Andrew Crompton, architectural solutions can be **'theatrical, expensive or potentially comic'.** On the other hand, by being physically 'exclusive', the space seeks to break away from the past in an attempt to provide designers with a clean slate.
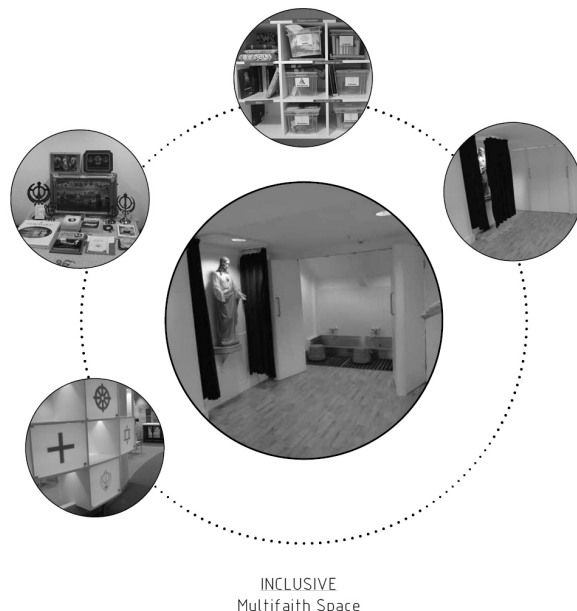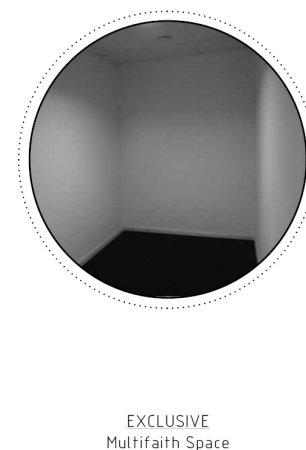

Figure 13.
Inclusive and Exclusive Multifaith Spaces
Professor Andrew Crompton

INCLUSIVE
Multifaith Space

EXCLUSIVE
Multifaith Space

However, by simply whitewashing the multifaith space we may be too quick to discard the rich cultural and historical past of religious spaces and in the process, refuse to acknowledge the sentimental value the paraphernalia may have for numerous users. Instead, by introducing current mixed reality technologies into the equation we may possibly achieve a space that embraces both the 'inclusive' and 'exclusive' taking elements from each space. Mixed realities provide us with the opportunity to intersect the physical multifaith room with digital religious elements in an attempt to create a multifaith space that is flexible, transformable and inter-changeable to the users' requirements; hereby this thesis proposes neither an 'inclusive' nor 'exclusive' multifaith space but an 'adaptive' one. By doing so, users gain the freedom to inhabit a space that caters to their needs without being intrusive into anyone else's beliefs. Hereby, acknowledging the rich history and cultural value instilled in religious spaces but also acting as a catalyst for the evolution of design.
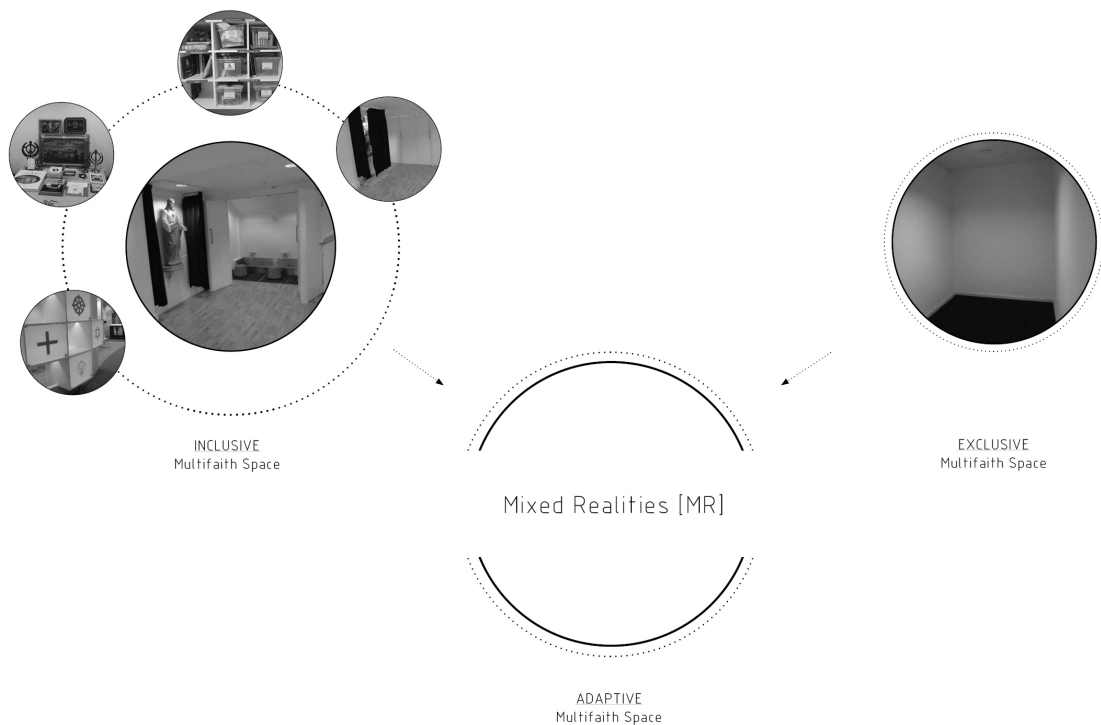

INCLUSIVE
Multifaith Space

EXCLUSIVE
Multifaith Space

Mixed Realities [MR]

ADAPTIVE
Multifaith Space

Figure 14.
Adaptive Multifaith Spaces

3.2 Mixed Realities

"Despite its past success architectures focus on materiality, both in theory and practice, has rendered it increasingly inadequate for the challenges presented by telematics and global culture (Anders, 2005, p.395)."

With the current advancements in Virtual, Augmented and Mixed Reality (VAM) technologies, the possibility of our built environment merging with the virtual environment is increasingly likely. Before, venturing into the concepts and ideas relating to VAM it is important to understand the distinct yet simultaneously, obscure realities. In the paper *Framing Mixed Realities*, Marc Aurel Schnabel discusses the role of emergent 'realities' and their 'supporting technologies' in influencing architecture. Mixed realities can be explained as, **"The intersection of real and virtual environments, within which physical and digital elements co-exist, and interact and intermingle in a more expansive form (Schnabel, 2009, p.6)."** This 'interaction' and 'intermingling' of the real and virtual can be further explained through the **Reality-Virtuality Continuum diagram (Schnabel, 2009, p.4)**. The diagram shows two distinct poles ranging from the Real Environment (RE) - the physical world, to Virtual Reality (VR) - the exclusively 'computer-simulated'. Between these two extremes exists Mixed Realities (MR) with sub-realms, that include; Augmented Reality (AR) - the addition of virtual elements to the real world environment; and, Augmented Virtuality (AV) - the 'augmentation of a Virtual Environment (VE) with real objects.'

Novel realities such as these enable a new construct for the way we perceive our world. As VAM becomes more integral to our daily lives, it is important to be mindful of the potential impact in order to use these technologies as a method to enhance and optimize our experience of the city rather than to dictate our every move. In his paper, *The Poetics of Augmented Space* , Lev Manovich introduces us to the notion of 'augmented space' that he describes as, **"The physical space overlaid with dynamically changing information, multimedia in form and localized for each user (Manovich, 2006, p.219)."** The paper dwelves on ideas that bring together elements of cyberspace, electronic media and technologies along with architecture and design to create an aesthetically and data rich environment. Notably, in the definition, he mentions that an 'augmented space' is a space that is 'localized for each user'; specifically, a smart space that recognizes diverse individuals, adapting to their needs and requirements, those maybe cultural, linguistic or any other such prerogative. This is one of the crucial ideas highlighted by Manovich; it is of the utmost importance that advancements in architecture allow it to respond to contemporary culture that situates itself in the information and digital age. By creating smart spaces we move beyond the permanence and uniformity of the built environment to creating spaces where every experience can be unique or shared or changed. Furthermore, through his paper, Lev Manovich highlights that most current precedents of augmented spaces treat architecture and the layers of information separately, where at times, **'new dataspace is laid over existing architecture'** or '**existing dataspace is used to drive new architecture'.** However, with the advent of new technologies, such as MR headsets, we only seem to be moving closer to a future where architects and designers can work towards creating a **'single phenomenological gestalt'.**

Within academic discourses, we begin to see the generation of new ideas and concepts relating to MR and religion. In his paper, *The Digital Mosque: A New Paradigm in Mosque Design*, Imdat As, considers technology as a platform by which to advance our current understanding of a mosque and the various Islamic practices involved. He introduces the idea of a **"convergent mosque (Imdat As, 2006, p.61)",** an online mosque paradigm converging the virtual and physical spaces. The research sees cyberspace as an opportunity to create a vastly connected Muslim community where individuals gain to have a more dominant role in the mosque functions and activities. He states, **"The user in the digital age is not only a spectator but also an active participant (Imdat As, 2006, p.60)."** Hereby, the 'digital mosque' becomes a dynamic platform for interactions, teaching, sharing of ideas and discussions within the larger community across the globe. Similar to Lev Manovich, the paper looks to electronic media for inspiration, for instance; an immersive experience that consists of a one-to-one human scale real-time projection of the Holy Ka'bah in Mecca, Saudi Arabia upon the Qiblah wall; and, connecting people in the virtual and physical realms through visualization, enabling them to socialise, discuss and even pray together, but more importantly, '**to make each user aware of the presence of fellow Muslims'.** The main aim of the digital mosque is to 'establish a religious paradigm' that is 'centralized around the *Ka'bah*, bringing together and housing a 'cross-cultural, global Muslim Community'.

Additionally, the paper, *Whispering Walls: Cultural augmentation with augmented reality at a range of scales* by Krishna Duddumpudi, Jules Maloney and Tane Moleta documents a design project that translates traditional handicraft ideologies to augmented reality in order reconnect individuals in a Western context to the Hindu temples of South India. By exploring the notion of 'info-tectonic' details, the project allows users to engage, learn and document their culture. The authors highlight, **"The carved temple walls developed by the people of the Hindu culture existed as a tool to document and dictate a way of living (Duddumpudi, Maloney & Moleta, 2013, p. 507)."** The inability to replicate these culturally significant ideas within a Western context due to unavailability of technical skill and cost forms one of the main drivers for the research. In order to explore the potential in AR technology the project incorporates the merger of the digital and the physical at 4 different scales; urban, building, surface and artifact. The scalar strategy used, aims to present AR technology as a catalyst that activates the built environment by drawing strong connections between not only the spaces and the community but also on a smaller more intimate level that includes groups and individuals. Initiatives such as these consider architecture not in isolation but within the larger context, inclusive of everyone.
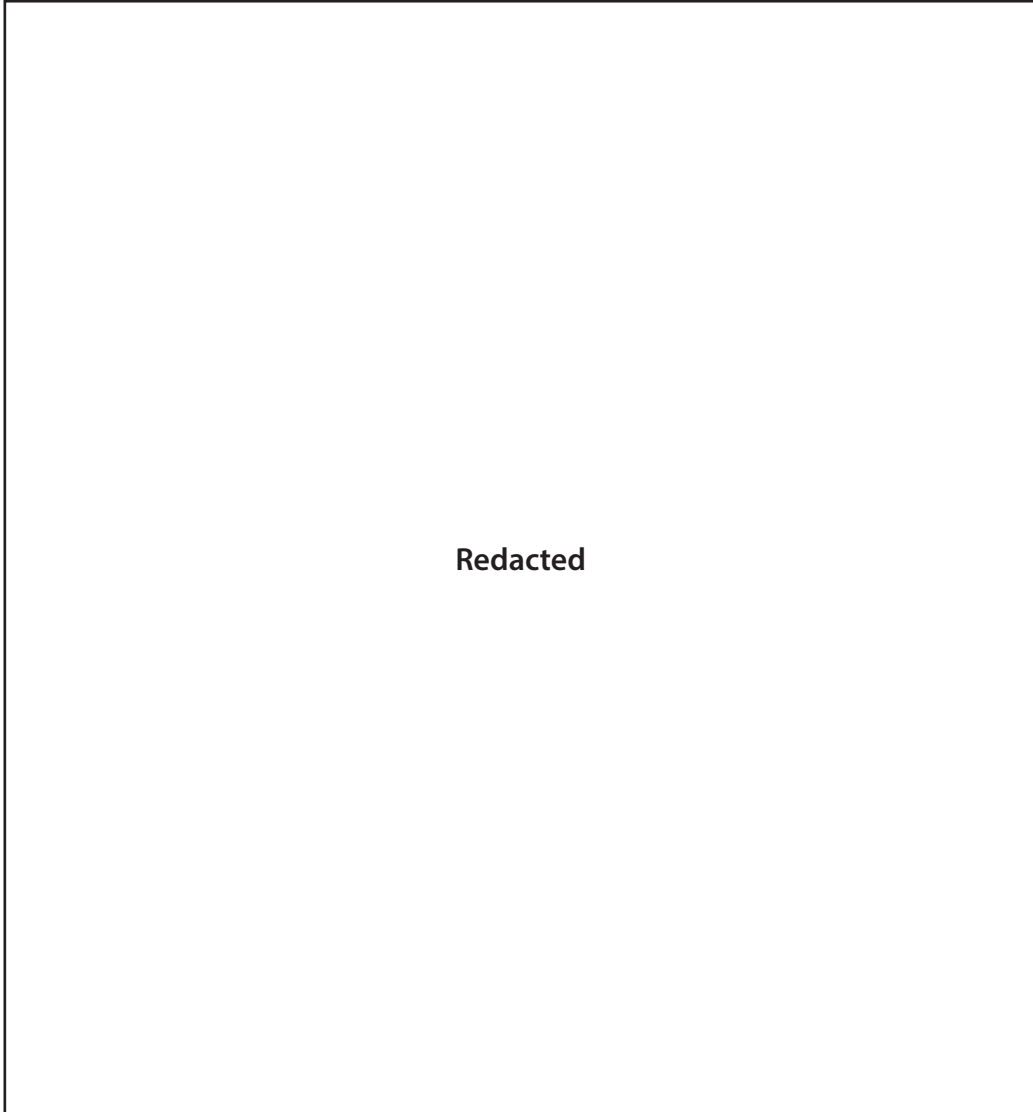
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Figure 15.
Virtual Immersion
Imdat As.

4.0

Methodology

4.1 Preliminary Outputs

Preliminary research involved the investigation of spaces dedicated to the spiritual needs of occupants within tertiary education buildings of Wellington. These include Victoria University of Wellington (Kelburn, Te Aro and Pipitea Campuses), University of Otago (Wellington Campus) and Massey University (Wellington Campus).

It was found, all university campuses provide two distinct spaces that cater to the spiritual/religious needs of its occupants. Firstly, a Chaplaincy run by representatives of the Church and secondly, an Islamic prayer room for Muslim occupants to offer their 5 times daily prayers. The Chaplaincy offers a range of services including spiritual guidance and a support network. As a result, within these university campuses we find that a significant group of inhabitants are neglected simply because they do not adhere to either of the two religious groups. To conclude, diverse universities such as these must consider the spiritual needs of all its students and staff. In order to do so, by incorporating multifaith spaces the university may be able to facilitate everyone.

Further research involved the investigation of the Muslim prayer rooms in order study how they facilitate Muslims in performing their Islamic duties. The pre-existing prayer rooms have been refurbished with some major to minor interior design altercations ranging from the addition of a *wudu*/cleansing fountain to the placement of paraphernalia such as prayer mats, garments, imagery and religious texts. The entities within each room formed a list of quantitative (the paraphernalia categorized according to its function or purpose) and qualitative (the interpretation of the paraphernalia from a physical object to a virtual concept) data. For instance, the physical prayer mat signifies not only the specific place upon which to pray but also orients the person towards the Holy *Ka'bah* in Mecca, Saudi Arabia (this is the direction in which Muslims are required to pray five times a day). This physical object can be reinterpreted within a virtual context as an abstract entity that does not need to be a permanent feature of the room. On the other hand, the *wudu*/cleansing fountain is more difficult to interpret and requires a study of the Quran in order to conceptualize it virtually. *Wudu*, is the cleansing of the mind and body prior to prayer. This is a very tangible act and requires one to physically wash themselves from head to toe with water. However, a study of the Quran revealed the notion of *tayammum*/dry washing.

"O Believers! When you prepare for prayers, wash your faces and your hands up to the elbows, and wipe your heads, and your feet to the ankles … and [if you] do not find water then betake yourselves to clean earth and wipe your faces and your hands with it."
(Holy Qur'an: Chapter 5, Verse 6)

This verse from the Quran reveals that *wudu* is more than just washing the body with water, it is through the enactment that a Muslim mentally and physically prepares themselves for the spiritual act of worship. As a result, through augmented-virtuality the Muslims can perform 'Virtual *Tayammum*' - the augmentation of the physical act of performing *wudu* with digital elements that can be considered as an abstracted representation of water. Through this process of data analysis, the conceptual framework and foundations for the design of the immersive environment were formulated. this will be further discussed in Chapter 5

Victoria University of Wellington
Pipitea Campus

Victoria University of Wellington
Te Aro Campus

Islam

University of Otago
Wellington Campus

Victoria University of Wellington
Kerlburn Campus

Massey University
Wellington Campus

Massey University
Wellington Campus

University of Otago
Wellington Campus

Christianity

Anglican Church

Victoria University of Wellington
Kerlburn Campus

Victoria University of Wellington
Kerlburn Campus

*Figure 16.
Prayer spaces at
tertiary level
institutions in
Wellington*

33

Male/Female
Combined Space

Male/Female
Combined Space
Separated by divider

Storage

Wudu
Ablution

Jali
Screen

Tangible

Qiblah
Orientation

+

Salah
Prayer

*Cleansing of
the Body*

Zakat

Quran

Qiblah
Orientation

Garments

Imagery

Tangible

Representational

Representational

*Physical
Barrier*

*Physical
Act*

Tangible

Tangible

*Digital
Currency*

Tangible

Tangible

Tangible

Tangible

Tangible

Tangible

Tangible

*Recitation/
Conversation with God*

Abstraction

Abstraction

Intangible

Intangible

Intangible

*Visual
Barrier*

*Cleansing of
the Mind*

Tangible

Garments

Intangible

Intangible

Tangible

Male/Female
Separate Rooms

Male/Female
Combined Space
Separated by loose
divider

ty of Wellington
Campus

University of Otago
Wellington Campus

Massey University
Wellington Campus

Library

Wudu
Ablution

Candle

Kursi
Chair

Qiblah
Orientation

Plantation

Imagery

Library

5 times daily
prayer

Caligraphy

Cleansing of
the Body

Representational

Representational

Representational

Cleansing of
the Mind

Tangible

Tangible

Tangible

Tangible

Tangible

Phenomenological

Tangible

Azaan
call to prayer

Tangible

Abstraction

Abstraction

Abstraction

Abstraction

Tangible

Intangible

Intangible

Intangible

Intangible

Intangible

Tangible

Virtual
Library
Audio/Video
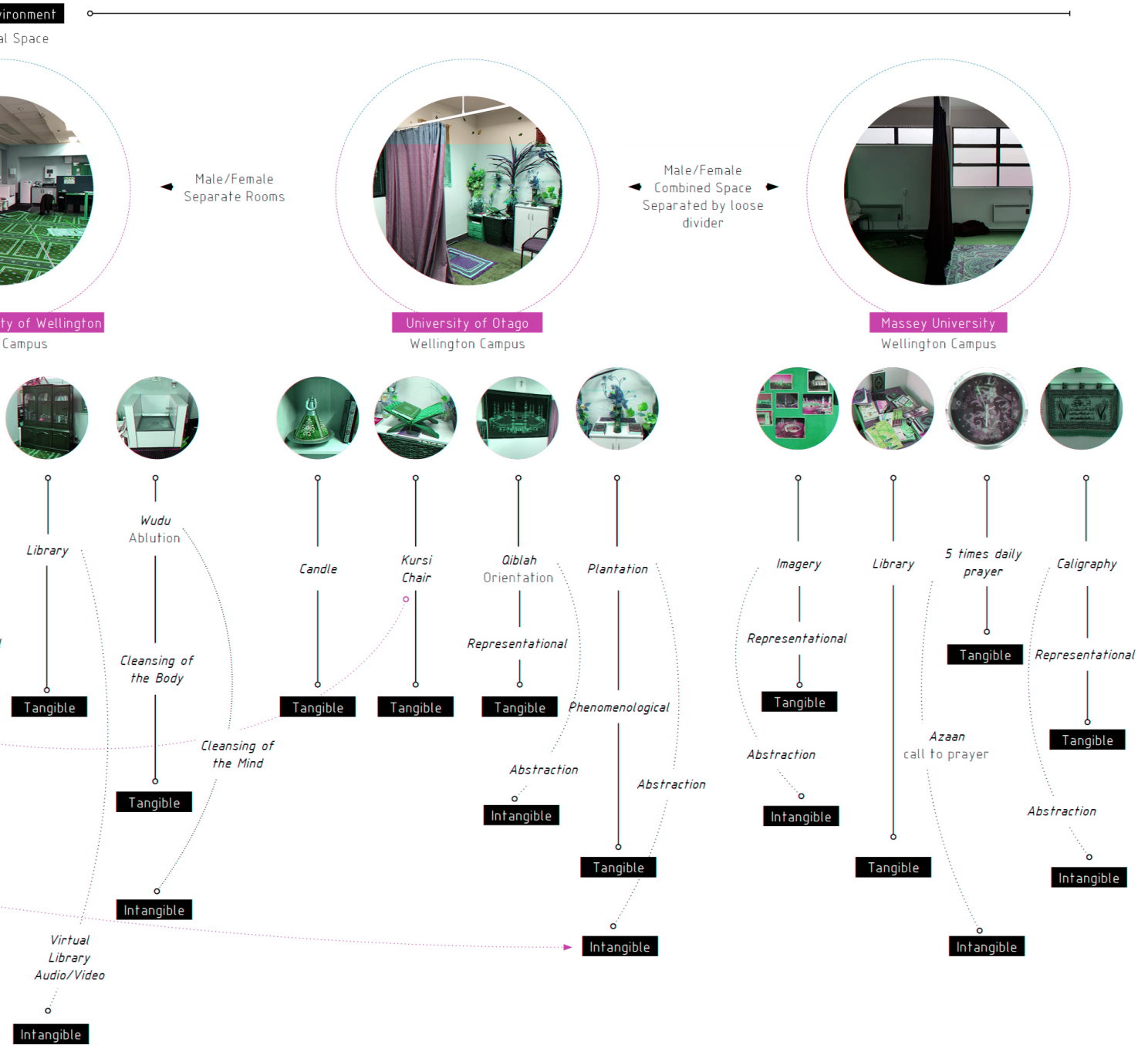
Intangible

Intangible

Intangible

Intangible

Figure 17.
Diagram interpreting tangible
and intangible rituals

35

4.2 Instruments of Design

Designing for MR environments requires venturing out in search for architecturally non-traditional instruments of design. The conceptual framework stated above aims to take us on a journey across the spectrum of mixed realities (real environment - augmented reality - augmented virtuality - virtual reality). As a result, within the methodology various tools and techniques had to be studied, tested and implemented in order to develop the MR experience.

○ **Photogrammetry**
The process involved a trial and error method for photographing the prayer room along with the exploration of various photogrammetry software in order to capture the room accurately. The software tested include Reality Capture, 3DF Zephyr, ReCap Photo and Agisoft Photoscan.

○ **Digital Design Tools**
Rhino3D (computer-aided design, CAD) and Grasshopper3D (a visual programming language) were used to design various geometry and game objects for interaction within the immersive experience.

○ **Game Engine**
Unity3D (real-time virtual engine) along with Monodevelop (a platform for writing code) was used to create the virtual environment.

○ **Motion Capture**
OptiTrack – Motive was used to capture the various movements of the human body involved in performing wudu/cleansing and salah/prayer.

○ **Mixed Reality Simulation**
For the purpose of grounding the proof of concept, the MR Mosque is to be experienced via the VR based HTC Vive headset. HTC Vive headset uses room scale tracking technology to allow the user to experience a virtual environment within a 3D space.

○ **Hand Tracking Technology** (Future Research)
Leap Motion is sensory hardware device that enables hand and finger motion tracking within MR environments. Future research aims to test hand tracking technology in order to develop a truly immersive augmented-virtuality experience as part of the wudu/cleansing and salah/prayer events.
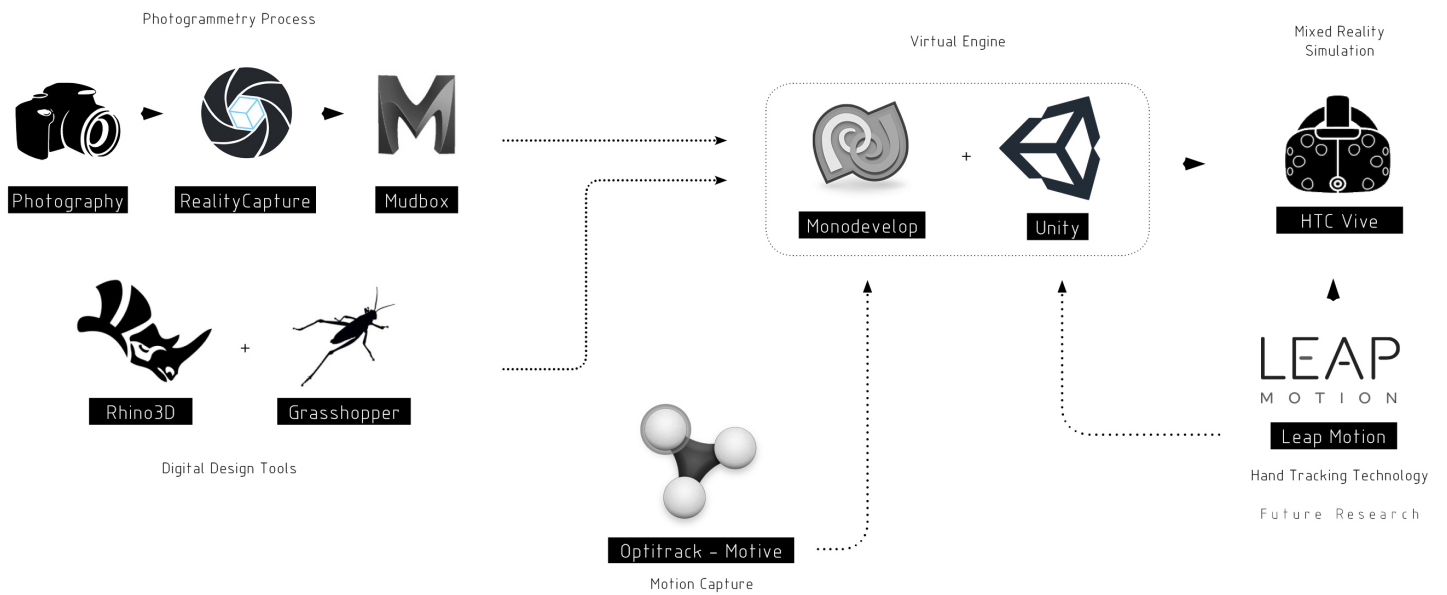
Photogrammetry Process

Photography   RealityCapture   Mudbox

Rhino3D   +   Grasshopper

Digital Design Tools

Virtual Engine

Monodevelop   +   Unity

Mixed Reality
Simulation

HTC Vive

LEAP
MOTION

Leap Motion

Hand Tracking Technology

Future Research
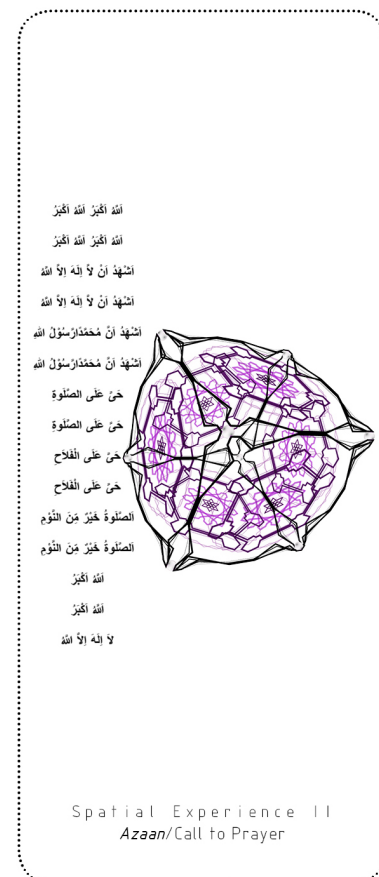
Optitrack – Motive

Motion Capture

Figure 18.
Instruments of Design - Workflow

5.0

Design

5.1 Overview

Experiencing the end design moves beyond architectural drawings, experientials and 3-dimensional models towards immersing oneself within the architectural environment that allows the user to explore and interact. Ideally, the user would walk into a physical room wearing an AR headset such as the Microsoft's Hololens and from there digital elements would overlay the room as the user transitions from one key event to another. Unfortunately due to the limitations of current AR headsets in providing a holistic immersive experience this technique was not implemented. Instead, for the purpose of grounding the proof of concept, the mosque is to be experienced via the VR based HTC Vive headset. HTC Vive headset uses room scale tracking technology to allow the user to experience a virtual environment within a 3D space.

Furthermore, the design acknowledges that most individuals who will be experiencing the immersive mosque will be unaware of the various religious practices involved and how the spaces facilitate those practices. So for the purpose of communicating the ideas clearly, the individual in the headset will take the perspective of an observer. Through the use of motion capture, the design has incorporated digital characters or avatars to perform the religious practices in order to guide the user.
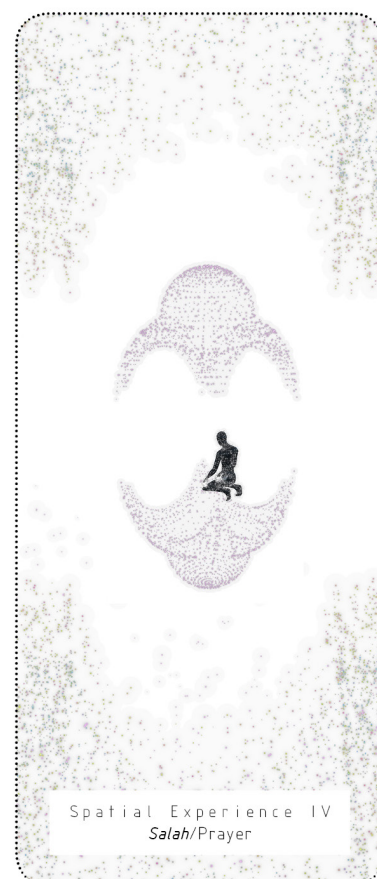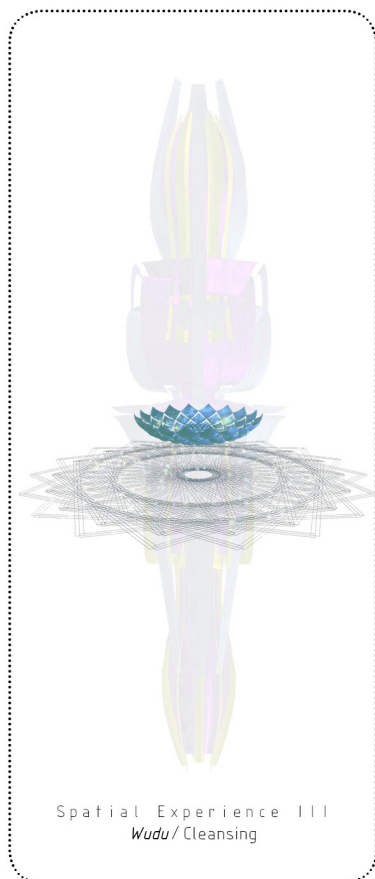

Spatial Experience I
Physical Room

الله أَكْبَرُ الله أَكْبَرُ

الله أَكْبَرُ الله أَكْبَرُ

أَشْهَدُ أَنْ لاَ إِلَهَ إِلاَّ الله

أَشْهَدُ أَنْ لاَ إِلَهَ إِلاَّ الله

أَشْهَدُ أَنَّ مُحَمَّدًا رَسُوْلُ الله

أَشْهَدُ أَنَّ مُحَمَّدًا رَسُوْلُ الله

حَيَّ عَلَى الصَّلوةِ

حَيَّ عَلَى الصَّلوةِ

حَيَّ عَلَى الْفَلَاحِ

حَيَّ عَلَى الْفَلَاحِ

الصَّلوةُ خَيْرٌ مِنَ النَّوْمِ

الصَّلوةُ خَيْرٌ مِنَ النَّوْمِ

الله أَكْبَرُ

الله أَكْبَرُ

لَا إِلَهَ إِلاَّ الله

Spatial Experience II
Azaan/Call to Prayer

◄   Mixed Re

Real Environment [RE]   Augmented Reality [AR]

5.2 Sequence of Events

The conceptual framework resulted in the design and development of four key expe-
riences within the immersion of the MR mosque.

- Experience I: The Prayer Room (Real Environment)
    Entering the physical space within which worship is to take place and upon
    which the digital elements are to be overlayed.
- Experience II: The Call to Prayer (Augmented Reality)
    Listening to the adhan/call to prayer, that signifies the time for prayer and
    initiates the mental preparation for worship.
- Experience III: Virtual Cleansing (Augmented-Virtuality)
    Cleansing of the mind and body prior to worship in an attempt to raise
    spiritual awareness.
- Experience IV: Performing Salah/Prayer (towards Virtual Reality)
    The act of worship within a digital prayer space.

Figure 19.
Sequence of events

Spatial Experience III
Wudu / Cleansing

Spatial Experience IV
Salah/Prayer

ality [MR]

Augmented Virtuality [AV]   Virtual Reality [VR]

5.2 Experience I: The Prayer Room (Real Environment)

One may wonder as to why the physical room is important when VAM environments are not limited by the real world and can be experienced virtually anywhere. The simple answer is that the physical room is crucial to the idea of sacred space as it is what grounds us, permanence provides context and ownership for the users. The notion of a MR multifaith space can only be truly experienced within a certain context, by association, the space requires privacy in order to build a sanctuary within which one is able to fulfill their religious and spiritual needs. A mixed environment does not mean substitution of the real with the digital but using the later to enhance and optimize the real.

For the purpose of this research, the prayer room for Muslims within the architecture campus (Te Aro campus) of Victoria University of Wellington was selected as the site. By choosing the existing prayer space the research aims to showcase the translation of physical religious paraphernalia within that room into digital interpretations. Due to the complex nature of this project it was important to make clear connections between the real objects and their virtual interpretations so that Muslim and non-Muslim users of the immersive mosque can grasp the concept comprehensively.

The room measuring 10'-8" x 9'-7" (3.5m x 2.9m), provides a secluded and intimate space for Muslim men and women to perform their daily prayers. Interestingly, most non-Muslim occupants of the building are either unaware of the space or have never stepped inside. For those who have never entered the space, one can speculate that those unfamiliar with the religion would feel as if they are intruding or interfering. As a result, this key event is the first step to breaking the barrier that invites and introduces users to the prayer room.

User Experience
The user begins their immersive experience in the real environment, standing in an empty corridor facing an open door that leads to the prayer room. The significance of the open door plays on similar ideas of a gateway or a portal that can be found at Mosques around the world; The significance of this architectural feature aims to highlight the transition from the earthly space to that of a more sacred one. This shift in spaces makes the user aware of their new surrounding and here begins the spiritual journey. Once the user enters the room, they begin to observe the physical paraphernalia within the space, a few seconds later the *azan*/call to prayer is given.
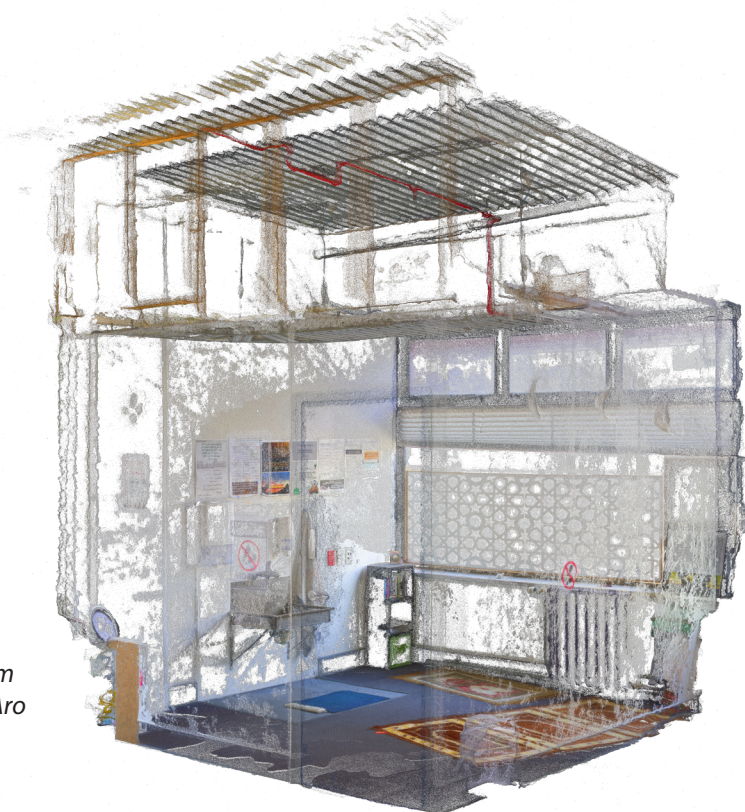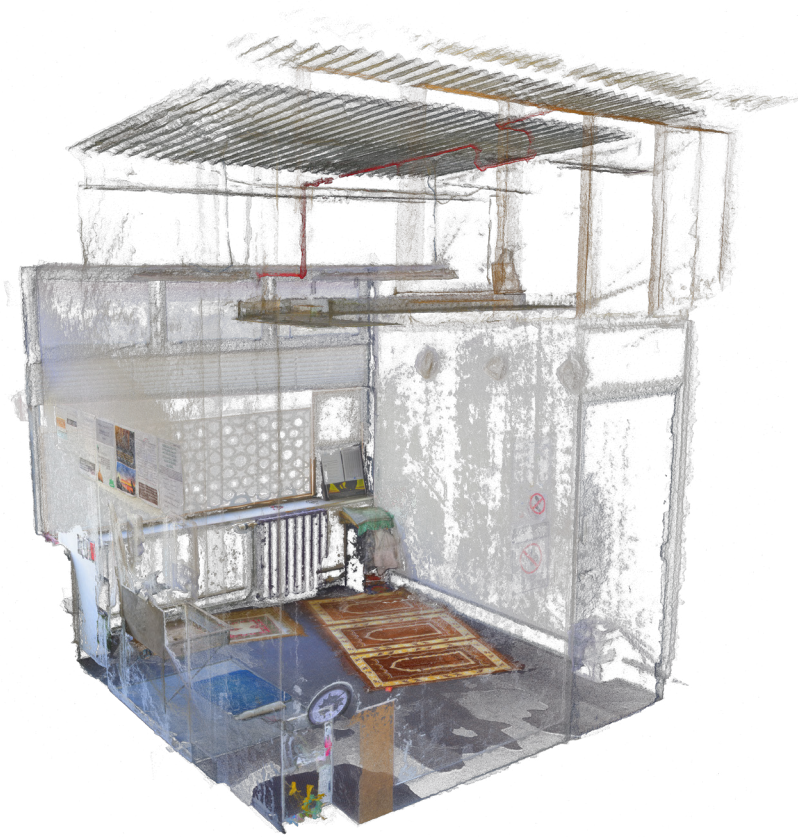
Figure 20.
Experience I: The Prayer Room
Digital replication of the Te Aro
prayer area for Muslims
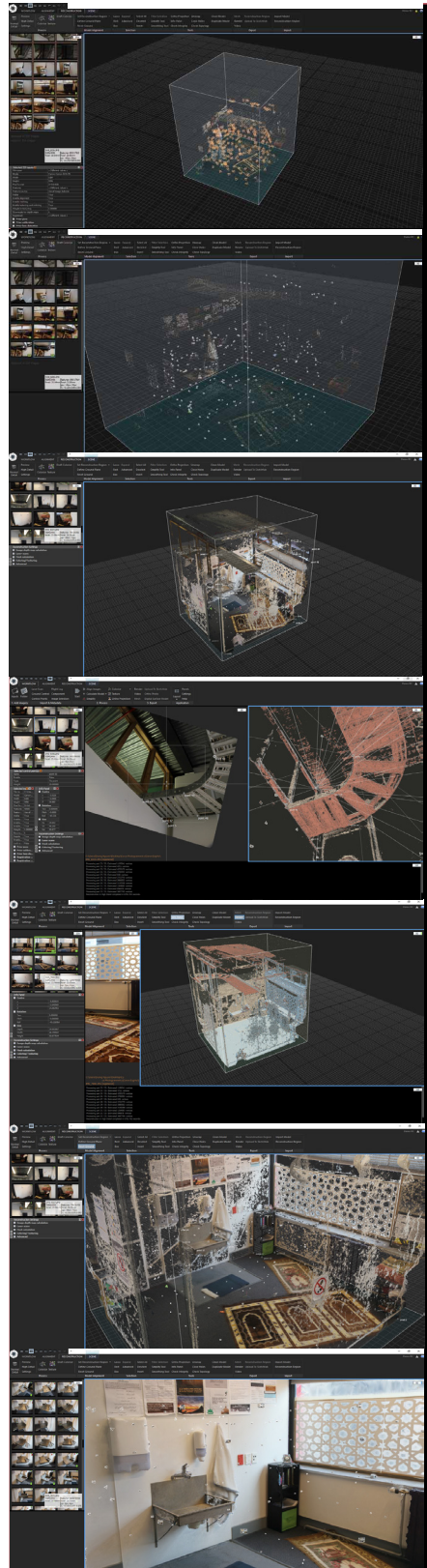
Photogrammetry

As discussed earlier, due to the limitations of AR headsets, such as the Microsoft Hololens in providing a truly immersive experience, the design had to be experienced through the lens of a VR headset, HTC Vive. As a result, a digital replication of the room was developed through the process of photogrammetry. This involved a two-part procedure to produce an accurate digital replication; firstly, photography of the room and secondly, generating the digital model through photogrammetry software. Laser scanning was also considered but due to the presence of metallic, reflective and translucent surfaces this was not opted for.

○ **Photography**

A Canon EOS7D mounted with a EF-S15-85mm (f/3.5-5.6 IS USM) lens was used for photographing the interior of the room. It was captured at early-morning as it was found to have good lighting conditions (indirect diffuse light so not to include high contrasting shadows). In order to maintain uniformity throughout all the images the focal length, ISO speed rating and exposure were fixed to 15mm, ISO 400 and 2sec at f/11, respectively. In order to have full coverage of the room, the tripod and camera were gradually moved around the room at 10-15 degree rotations, after ever complete rotation the height of the tripod was increased and the process repeated. Multiple overlapping horizontal and vertical images produced a reconstruction that did not have holes or undersampled areas.

○ **Reconstruction Software**

Various reconstruction software (Agisoft Photoscan, Autodesk ReCap Photo, 3DF Zephyr and RealityCapture) were tried and tested, at the end of which, RealityCapture was found to produce the best results, in the quickest time and the most user friendly. The reconstruction process involved; 1) Alignment of photos, 2) Point cloud generation, 3) Dense point cloud generation, 4) Control point setup, 5) Mesh extraction, 6) Colorization and 7) Textured mesh extraction.

Align Photos

Point Cloud Generation

Dense Point Cloud Generation

Control Point Setup

Mesh Extraction

Colorize Mesh

Textured Mesh Extraction

Figure 21.
Photogrammetry Process
Reality-capture

5.3 Experience II: The Call to Prayer (Augmented-Reality)

Throughout the Muslim world, the *azan* can be heard five times a day in every village, town and city. Signifying the time for prayer, many put a halt to all work and make their way to the nearest mosque. As they walk along the streets in perfect harmony, making their way through the built environment, the *azan* sounds loud and clear. Here the tangible qualities of the built environment and natural world work side by side with the intangibility of the *azan* to awaken inner spirituality of the Muslims. In order to interpret the experience virtually, the immersive space merges the *azan* with another prominent feature of mosque architecture, geometric patterns.

Many scholars and theorists have contemplated the intent behind the use of geometric patterns within mosque architecture. In *Islamic Architecture and Urbanism*, Professor Syed Gulzar Haider writes, **"The Ikhwan al-Safa (the Brethren of Purity) claimed that, 'geometry has as its aim the training of the soul, by which it realizes the promotion in knowledge from erection to conception, from the physical to the spiritual and from the concrete to the abstract. Geometry is of two kinds;** *hissiyya,* **tangible, sensible, or common plane and solid geometry, which helps man to acquire skill in crafts; and** *aqliyya***, intellectual or rational, namely, analytical and descriptive, which enables man to be versed in the theoretical sciences' (Haider, 2003 , p.652)."** Another similar idea, presented by Eric Broug, in the book, Islamic Geometric Patterns, suggests **"The purpose of Islamic geometric design is to raise spiritual understanding through contemplation of its complex patterns (Broug, 2008, p.12)."** It may be due to these reasons that we begin to see such extensive explorations of geometric patterns within mosques. The artisans begin with a basic shape, may it be a square, circle or hexagon but the with process of creating layer upon layer they are able to create a truly enriching experience that astonishes the viewer.

Historically the notion of *hissiyya*, was controlled by traditional tool sets but today we can look to the digital for the generation of geometry so as to further expand our skills and knowledge. By doing so, we attempt to form geometry and experience it through new and exciting alternative methods. In the context of the MR mosque, we look towards the *azan* to drive the generation of geometry.

User Experience
Through augmented reality the user is able to experience the *azan* not only through sound but also visually. A cube is augmented in the center of the room, its faces consist of layer upon layer of geometry that respond to frequency changes in the *azan*, in the process, generating dynamic geometrical patterns. Furthermore, the changes in frequency also alter the level of intensity in color and emission of these patterns. Gradually, the cube grows larger and larger transforming from an oscillating object to an architectural space. The amalgamation of sound and geometry, creates an experience in which the user listens to the *azan* while inhabiting an architectural space generated by that same *azan*; reminiscent of the real experience of moving through the built environment during the time for prayer as done by those in the Muslim world.
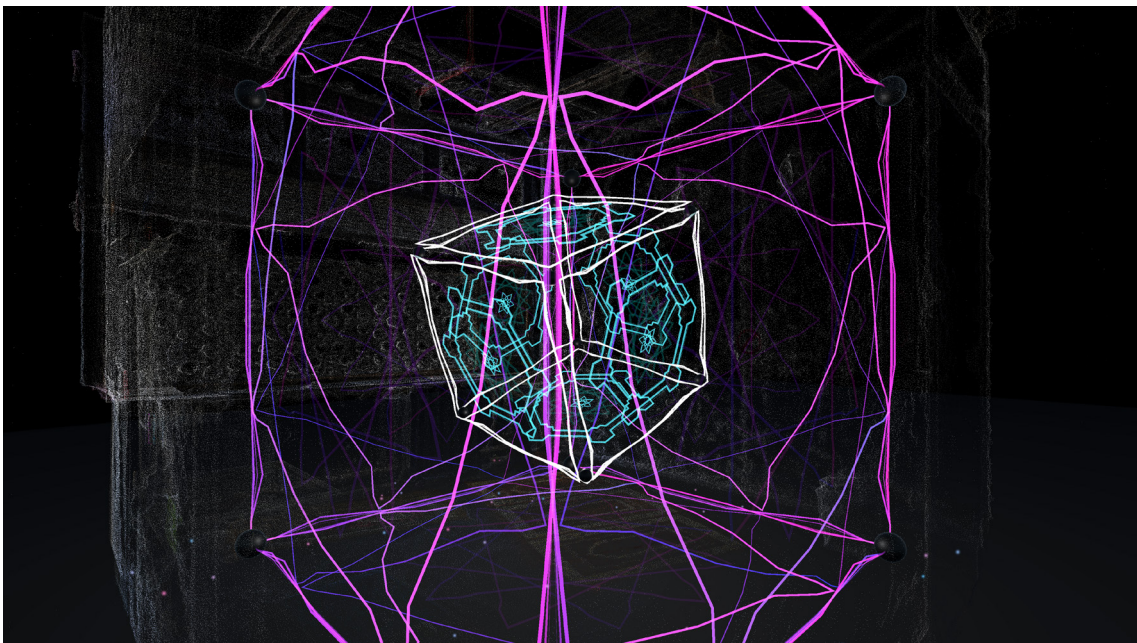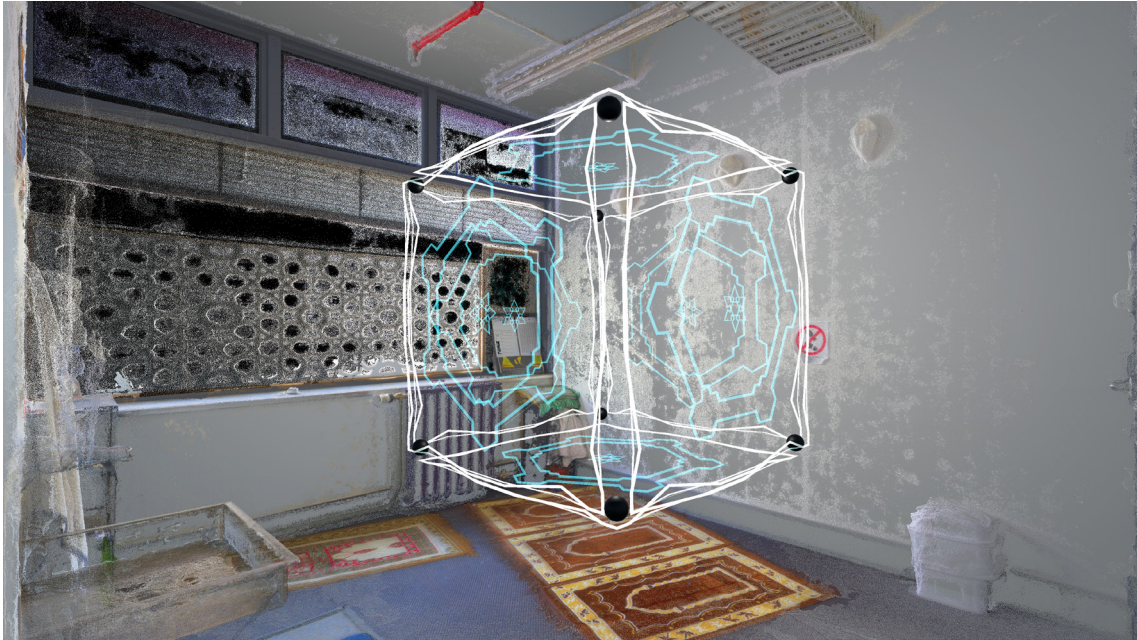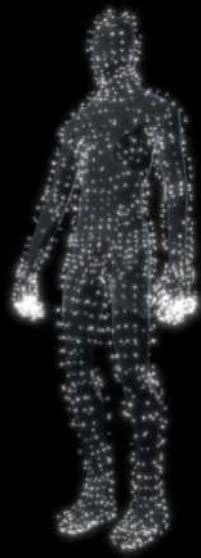
Figure 22.
Experience II: Call to Prayer
Inhabiting the augmented

5.4 Motion Capture

The next two key events, 'Performing Virtual *Tayammum*' and 'Performing *Salah*/Prayer' focus on human centric rituals, firstly the cleansing of the body and secondly prayer. The two rituals define the primary functions within mosques, as a result, they inspire the architecture and design of those spaces. In order to communicate these ideas with clarity, OptiTrack – Motive was used to capture the various movements of the human body involved in performing *wudu*/cleansing and *salah*/prayer. By doing this study of ergonomics, the design intends to highlight how specific human movements and activities can inspire inhabitable narratives and the design of architecture in the context of MR. By capturing, visualizing and interpreting the various movements the project aims to present a direct link between the body and the digital space.

Qiblah (Orientation towards Makkah)

Niyyah (Intention)

Takbir (Acknowledge – Mindfulness)

Qiyaam (Standing Position)

Ruku' (Bowing)

Brief Qiyaam (Standing Position)

Sujud (Prostration)

Jils (Sitting)

Sujud (Prostration)

Jils (Sitting)

Tashahhud (Testimony of faith)

Tasleem (Concluding portion of prayer)

Dua (Invocation)

Figure 23.
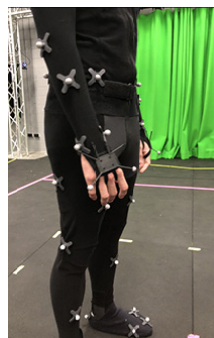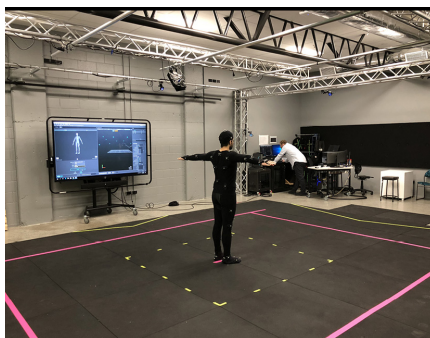*Capturing salah and wudu movements*
through Motion Capture

5.5 Experience III: Virtual Cleansing (Augmented-Virtuality

Prior to prayer, a Muslim must physically cleanse their body with water, within mosques, the cleansing occurs at the ablution or *wudu* area. Before the advent of modern day plumbing, mosques consisted of fountains or water pools that facilitated the cleansing process and were mainly located in the courtyards. The process involves; 1) Make *niyyah* (intention) to perform *wudu*; 2) Wash your hands; 3) Wash your mouth; 4) Clean your nose; 5) Wash your face; 6) Clean your head, 7) Wipe your ears; and 8) Wash your feet. After one has been cleansed, they then move to the main prayer hall.

As discussed earlier, by introducing the concept of *tayammum*/dry washing. If water is not available, one is able to clean themselves with clean earth or surface, but the physical act of cleansing is of the utmost importance, this acknowledges that *wudu* is not limited to simply cleansing of one's physical body but also deems the cleansing of the mind, considered as a type of ritualised purification, the entire process intend to spiritually awaken the soul. When one performs the physical act of cleansing, they are in fact also cleansing their mind. They are becoming aware that soon they will submit themselves to *Allah*. As a result, through this study, this research proposes the concept of virtual tayammum - the mindful and physical cleansing of oneself with digital elements that intend to represent water. This key event situates itself within the realm of Augmented-Virtuality (AV).

User Experience
The freedom provided to us by mixed realities allows us as designer to reimagine how the user transitions from one space to another. In the last event, the *azan* manifested as a cube that later transformed into an architectural space, the same cube now leads us into the next phase of the immersive experience. Reflections from the geometrical patterns can be seen on the floor, from these reflections, rises a virtual fountain emitting digital particles consisting of a subtle glow that calls to the user. Digital characters created from motion capture appear adjacent to the fountain and begin the ritualised purification, in the process, guiding the user. The digital particles are perceived as an abstracted rendition of water, that activate during the cleansing ritual by leaving behind an observable glow upon the body. The rich experience, intends to capture the imagination of the user through digital medium in order to immerse them into a space that facilitates the activities in a wholesome manner.
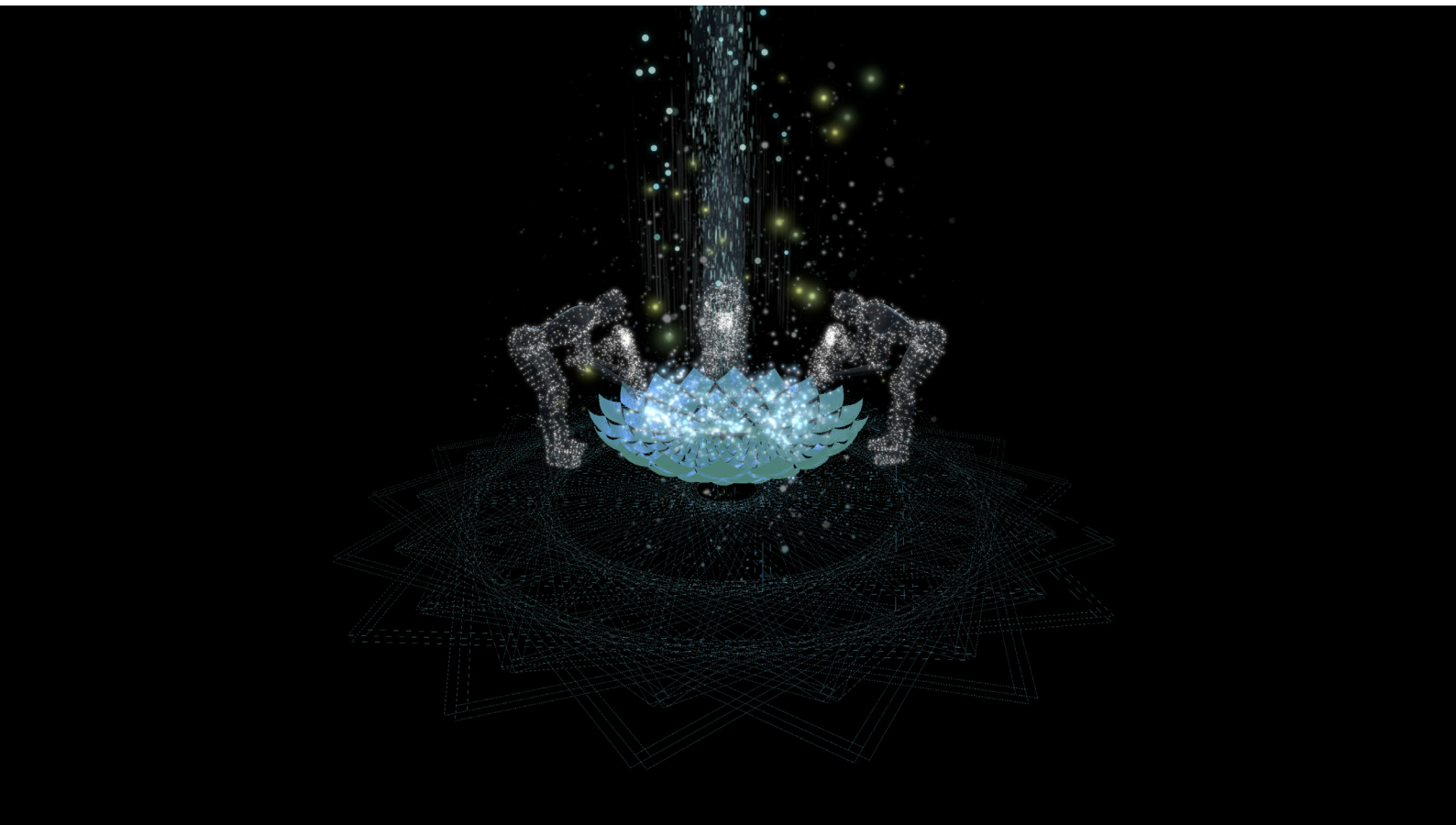
Figure 24.
Experience III: Virtual Cleansing

5.6 Experience IV: Performing *Salah*/**Prayer** (Virtual Reality)

As mentioned earlier, Muslims prostrate towards the Holy *Ka'bah* in Mecca, Saudi Arabia. This orientation is to be followed, no matter where on earth a Muslim intends to prayer and no matter where a mosque is to be built. Within the mosque, many architecture and interior elements act as guiding tools to communicate this orientation with clarity. In most cases this is achieved with the use of the *mihrab* within the *qibla* wall, or, with the direction in which the prayer mats are laid out.

The above examples, showcase entities of permanence that have become symbolic of the religion. However, within the context of the MR mosque and specifically this key event in which we move further along the 'reality-virtuality continuum', towards virtual reality; the symbolic entities need to be re-imagined. By doing so, we intend build a design concept that considers all the opportunities as presented by digital technologies. By now we have learnt that the mosque is not limited to a singular entity but manifests as a range of ideas and in order to design a mosque for a digital society we must conceptualise the mosque as an ever-changing and ever-evolving space that caters to everyone's needs and requirements.

User Experience
After having cleansed themselves, the user now awaits to enter the prayer hall, the space is conceptualized as an architectural form that encapsulates the users much like a pod that shelters seeds as they grow and develop. The pod consists of two layers, firstly a core within which the digital character performs *salah* and an outer layer for the user to explore and observe the religious practice. The pod extrudes from the ground, along both directions of the Z-axis, placing the character at its centre. While extruding, it searches for the direction of the *Ka'bah* by revolving around the user. Once found, the pod guides the user to the correct orientation by revealing an aperture in its periphery. By placing the user at the centre of the pod and hereby, removing the ground plane, the design intends to create a sensation within the user of floating in mid-space. The only significant orientation within the design is the direction of the Ka'bah.

Materialization is another crucial aspect for exploration in this design. While real materials such as concrete, wood and brick form our built environment, materials that uphold qualities of permanence; within VR, we must look towards digital materials and textures in order to build a space that remains true to its context, materials that present a sense of temporality. The digital mosque in this scenario is expressed through a set of data points in space or better known as a point cloud. The subtlety with which one is able to manipulate these points allows the designer to create a space that becomes rigid and fluid-like all at once; a space that is linked to the inhabitants, allowing it to transform and adapt to any changes in its surroundings. As the digital character performs salah where the body transitions from *qiyaam* (standing position) to *ruku* (bowing) to *sujud* (prostration) and, finally, to *jils* (sitting) the space around the character responds by adapting itself to these physical changes. The response of the space at this stage is only so slight, limited to scale and movement but with more research one could design and develop an architectural environment where the response is more dynamic including changes to form, materiality and spatial composition. To mark the end of the prayer and the immersive experience, the digital character concludes *salah* by turning its head to the right and then left while reciting *'As-salāmu alaikum wa-rahmatu 'llah'* (Peace and blessings of Allah be unto you - asking for *Allah's* blessing on all of humanity); here, a gentle breeze scatters the point cloud into abyss bringing the user back into the real environment.
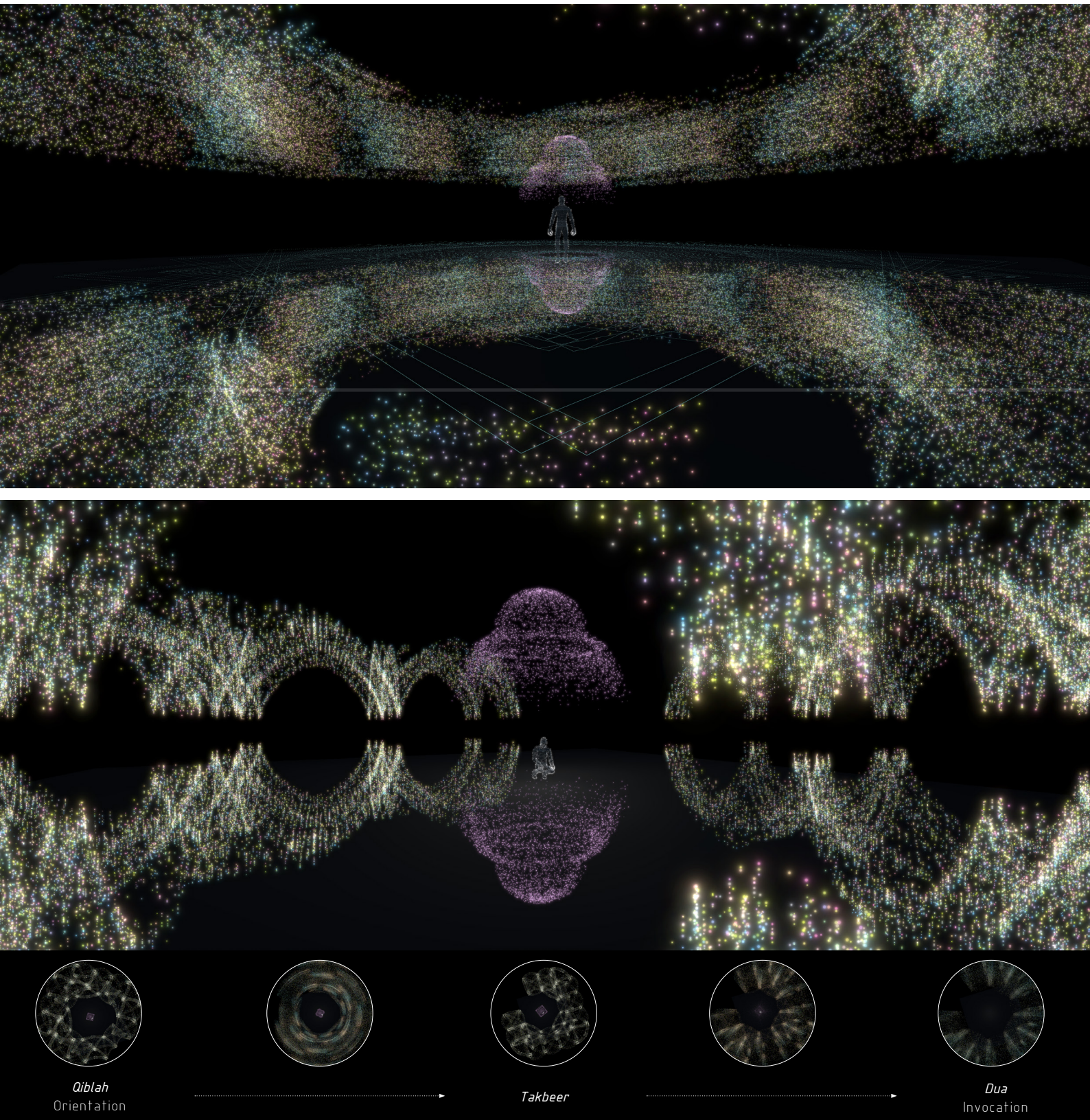
Qiblah
Orientation

Takbeer

Dua
Invocation

Figure 25.
Experience IV: Performing Salah/Prayer
Activating the digital prayer space

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6.0

Conclusion

6.1 Discussion

This research sought to answer the question, **How does mixed reality aid the creation of an inexhaustible three-dimensional world that supports the evolution of inhabitable narratives within sacred spaces?** The notion of sacred spaces is far-reaching and by establishing the research topics that focus on mosque architecture, multifaith space and mixed realities this research was able to develop a theoretical framework that contributes design concepts and methods for others. A study of literature and precedents helped to identify similarities between the architectural and philosophical issues in the current conception of mosque architecture and the multifaith space. Furthermore, it helped to seek answers on how mixed reality can support in the evolution of inhabitable narratives within such spaces. As such, the proposed aim of this thesis was to theorise an immersive experience for Muslim users as part of a larger mixed reality multifaith space. The objectives included the creation of a methodology and workflow that incorporates MR design tools within traditional architectural frameworks and apply it to designing an environment that supports the notion of an Adaptive Multifaith Space.

Through this body of creative works, my research identifies; how a synthesis of space and cultural information can provide impactful, poetic and deep immersion; how methodology can evolve and incorporate theories and technologies of mixed reality within traditional architectural frameworks; and, how the development of an adaptive multifaith space can blend the physical and digital in order to create an inclusive space for all. The development of the immersive experience intends to demonstrate how the merger of the virtual with the real can enhance our experience of the built environment within the context of sacred spaces. The phenomenological impact of this merger is significant but it goes further by engaging intuitive concepts related to society and culture. This immersive experience presented sacred spaces and rituals through the lens of contemporary culture that is widely connected and continually evolving.

6.2 Further Research

At this stage, this research focused on the building of a theoretical framework for an adaptive multifaith space that included the design and development of an immersive environment for Muslims. Further research needs to conduct tests that evaluate user experiences of this immersive environment. A user-lead qualitative experiment intends to gain understanding of the immersive qualities of the space related to aspects of geometry, movement, interaction and materiality. Furthermore, as discussed earlier, development and experimentation needs to take place with Leap Motion, a sensory hardware device that enables hand and finger motion tracking within MR environments. By doing so, the intent is to expand on the immersive augmented-virtuality experience as part of the *wudu* and *salah* events.

6.3 Personal Reflections

A very crucial idea explored through this research has been the notion of internalising the mosque. For a Muslim, their religion is a very personal and intimate relation that they share between themselves and *Allah,* it is a way of life. For this reason, the way individuals and groups practice their faith varies across the globe, from region to region and place to place. Through mixed reality we are able to venture into architectural phenomenons of ephemerality and permanence. As showcased through the immersive experience, ephemeral qualities provide us with the opportunity to to design, develop, generate and experience a mosque according to our desires. For instance, in Experience II: Call to Prayer, the voice of the azan that the user listens to is of Mai Kamal, a woman. Bahia Shehab, the academic, artist and activist that initiated the project states, **"For the past 1400 years only men have been raising the calls for prayer all over the Arab world; I felt that it was time for the feminine to raise their voices with the same chant calling for people 'to hasten to worship and to hasten to success' using Mai's melodious young strong voice."** Such initiatives act as a catalyst that pushes for engagement and discussion on the future of sacred spaces within a digital society. By interpreting the rituals and customs of our varying faiths, we are creating opportunity for many to experience religious practices through the eyes of others. An interpretation is different from depiction; interpretations re-conceptualize existing concepts and provide a varied perspective that in return may help to remove any preconceived notions. By conceptualizing a mixed reality mosque, we move beyond limitations of the physical world embracing the virtual. As a result, the two environments can no longer be treated as independent concepts but as a shared entity.
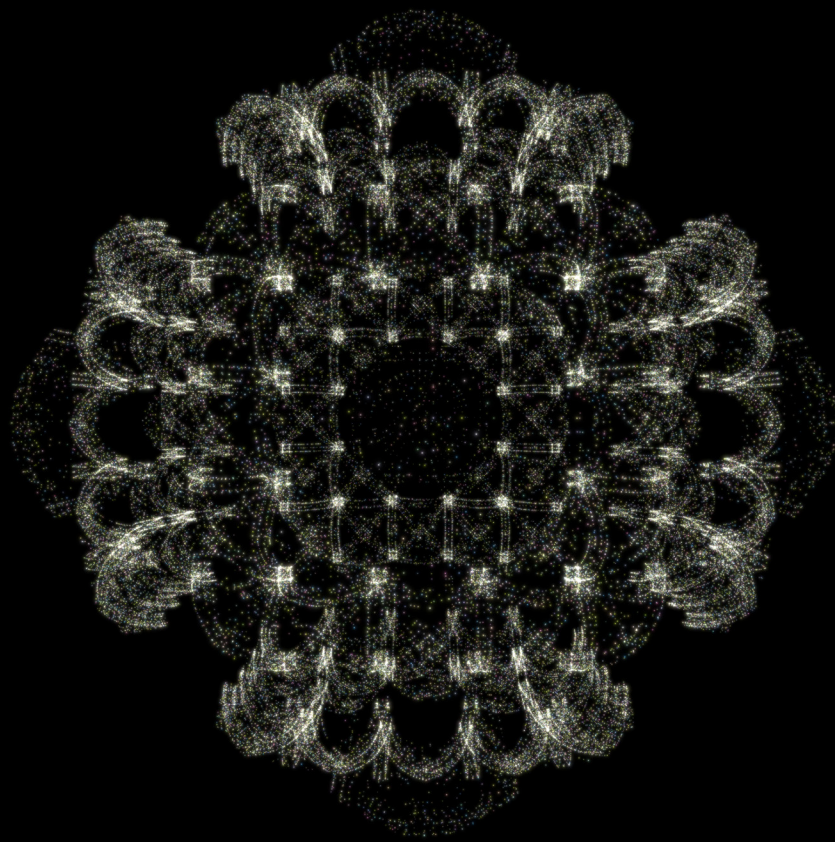
Figure 26.
The fusion of individual prayer spaces
- Digital Mosque Concept

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Image Source

All figures not listed are of authors own work

Figure 5.
The Prophets Mosque (Present)
*Retrieved from: researchgate.net/figure/Shows-the-current-Image-of-the-Prophets-Mosque_*
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pbuh.html, (3) kisspng.com/png-al-masjid-an-nabawi-green-dome-mosque-clip-art-isl-677333/
(4) britishmuseum.org/explore/themes/hajj/medina_the_illuminated.aspx

Figure 6.
Diagram showcasing expansions and alterations of the Prophets Mosque
Diagram consists of images retrieved from: (1) researchgate.net/figure/Shows-the-current-Image-
of-the-Prophets-Mosque_fig9_305041390

Figure 7.
Namaz Khaneh - the 'Prayer Room' - Tehran, Iran
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Figure 8.
'Ground-Zero' Mosque - Park 51 - New York, America
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Figure 10.
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Figure 11.
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Figure 12.
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Figure 13.
Inclusive and Exclusive Multifaith Spaces - Professor Andrew Crompton
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Figure 14.
Adaptive Multifaith Spaces
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Figure 15.
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