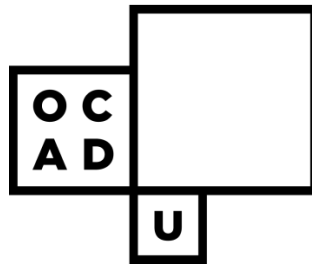


VIRTUAL URBAN GALLERY:
An immersive installation based on 3D remote experiences of
Toronto Public Art

By
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A thesis and presentation submitted to
OCAD University
in partial fulfillment to the requirements for the degree of
Master of Design in Digital Futures

Toronto, Ontario, Canada, April 2016

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Abstract

Public art is important not only for its aesthetic appearance, but also for its contribution to and reflection of the history and culture of the city it inhabits. However, given the intimate connection between public art and its social and geographical contexts, it is not possible to build a physical gallery for public art; the only way to display such artworks together is virtually. Virtual Reality technology provides new opportunities for audiences to experience public art in its social and spatial contexts. This thesis investigates the use of VR to create an interactive virtual gallery of public art in Toronto. This work is an attempt to utilize 3D modeling of public arts and the areas surrounding them, along with an immersive and exploratory interactive experience, to curate a virtual gallery that allows audiences to appreciate and interact with public artworks in an embodied way.

Keywords: Public Art, Digital Gallery, Virtual Gallery, Experience Design, VR, Oculus Rift, Technology

Acknowledgements

A huge thank you to my parents for all their love and constant support. Without their love and support I would not have been able to finish this study. Special appreciation to my love Ruiqi Zhao, she accompanied me through the tough time, and gave me a lot of help and encouragement.

I would like to express my gratitude and appreciation to my primary advisor Tom Barker, for all of his support and guidance. Thank you for all of his encouragement and advice when I faced struggles and challenges in the process.

I would also like to express my deepest appreciation and thankfulness to my secondary advisor Adam Tindale. Thank you very much for all of his patient assistance in whole process. His knowledge about multimedia and thesis writing has made my thesis coherent. It was a delightful experience under his supervision as well.

I would like to thank Judith Doyle who has a rich experience and theory in new media area. Her suggestion gave me a lot of inspiration for developing my future project. I deeply appreciate her support. Credit goes to her daughter Kaelan Doyle Myerscough as well, who gave me an excellent editing support.

I am extremely thankful to Davidson Zheng for his continuous technical support. Without his help this project would not have been the same. I truly appreciate his patience with this project's programming.

I would like to thank professor David McIntosh for pushing me forward through the final stages of my thesis.

Last but not least, thank you all my friends who helped me with this thesis from start to the end.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND AND MOTIVATION

I am an international student currently living in downtown Toronto. The downtown core is the heart of culture and the arts in the city; recently, public art has become prominent in Toronto's cityscape.

The Toronto City Plan website says of public art (2010) that, "in 2003, City Council approved the 'Culture Plan for a Creative City' which positions Toronto as an international culture capital and defines culture's role at the center of the economic and social development of this city. Public art is included in this plan as a key contributor to the quality of life in Toronto." There are many excellent public artworks throughout Toronto; these artworks are often deeply interconnected with the cultural and historical contexts of their creation and the space they occupy. Public art also enriches the spiritual life of the city and imbues in citizens a sense of belonging and pride of place. It can change the landscape of its location and encourage citizens to remember historic people or events. This is reflected in the fact that the City of Toronto views public art as a benefit for everyone: according to the City of Toronto official website, "the governing principle for the Percent for Public Art Program is that art is a public benefit to be enjoyed and experienced by residents and visitors throughout the city" (1998).

Despite geographical familiarity with the cities we live in, the locations of public artworks may be missed or overlooked, as I discovered during my preliminary research for this thesis. I took several walks around the city and recorded my experiences viewing public artworks; sometimes artworks would escape my notice entirely. Occasionally, my interest

piqued by a work's unique appearance, I would conduct research online about its author and its intended meaning. Unfortunately, for many public artworks this information is not provided in the vicinity of the installation. At that time, I began to consider ways to gather and collect these public artworks together to build an exhibition for people to view and research them more conveniently.

According to Josef Hargrave and Radha Mistry in their article *Museums in the Digital Age* (2013), “as we live increasingly mobile, digital and virtual lives — with personalised user-experiences and services at our fingertips — museums will have to find new ways to tell stories and engage their audiences”. In the contemporary moment, people can enjoy art and cultural objects easily from home by using digital virtual museums or galleries. In the summer of 2015, I worked for a company called *Synthescape*, which is concerned with the creation of virtual digital museums and art galleries. During my time there in 2015, I gained considerable knowledge about presenting virtual gallery exhibitions. Several projects at *Synthescape* involve recording physical gallery exhibitions using a 360-degree camera and reconstructing them on the website so that the camera travels through the space the way a gallery attendee might realistically do. Many institutions, museums and art galleries, including the Frick Collection, the Louvre and the National Gallery of the UK, are currently participating in similar digital museum projects. The most famous of these is *Google Art Project*. The head of *Google Art Project*, Amit Sood, said in a 2011 Google Blog entry that users of the project can “find a selection of super high-resolution images of famous works of art as well as more than a thousand other images, by more than 400 artists—all in one place. And with Street View technology, you can take a virtual tour inside 17 of the world's most acclaimed art museums.” Virtual gallery has the power which

allows people in different places to see artworks in other different places just like “in one place”.

Based on my considerations of public art and digital museum projects, I decided to design a virtual gallery installation that affords the ability to fully experience and appreciate the relevant information pertaining to public art works in Toronto. This installation is a virtual gallery that allows people access to Toronto public artworks.

1.2 STATEMENT AND PROBLEM

Unlike gallery-based art, public artworks are not shown and stored in art gallery spaces; instead, they are displayed in public spaces, often outside, across the city. They are also often very large; as such, it is impossible to physically gather public artworks together to hold an exhibition. Therefore, when people want to enjoy public art works, they must travel across the city to see them, which introduces the logistical limitations of time, weather and distance. Sometimes there is no background information about the artists next to the public artworks; even if there is, it is often placed in inconspicuous, barely visible places. The most common way to find more information about public art is to search the Internet. I list several other cities’ websites that feature public artworks in Chapter 2 (see page 17). However, I was unable to find a website that collates and distributes information on public artworks in Toronto; this information is scattered across personal blogs and local news articles. To research this, I examined popular websites that showcase Toronto’s public art, including *City of Toronto*, *Urban Toronto*, *blogTO*, *The Culture Trip*, *Living Toronto*, and *Public Art Management*, among others. Most sites displayed information separately; only one, the *Percent for Public Art Program* website, compiled information about different works. An internal page of the Toronto Municipal Government’s website,

the *Percent for Public Art Program* only presents the location of each public artwork on a map including the work's name and a single image (City of Toronto, 1998); there is no other information provided on the website. Viewers must search for information about each artwork individually, and they cannot enjoy the pieces as if they are viewing them in person.

As quoted in the previous section, Hargrave and Mistry assert that people can enjoy art and cultural relics in digital virtual museums or galleries. These digital virtual museums and galleries are often restored on the website according to the realistic order one might view the exhibition. However, public artworks are scattered across the city. As such, there is no one viewing order by which a virtual exhibition can be recorded.

1.3 HYPOTHESIS AND PURPOSE

My background is as a GUI designer for mobile applications. With consideration to the ideas mentioned above, my initial idea was to design a public art mobile phone application or a website. Currently almost all galleries in Toronto have their own websites, either traditional flat websites for introducing information or digital virtual art gallery websites for experiencing the exhibition. However, there are few websites dedicated to public arts.

As mentioned above, recording and displaying public artworks in the form of the digital virtual art gallery is difficult, as there is no one linear way to experience public artworks in Toronto. If one only uses websites to display text, picture or videos, however, it is hard to bring to audiences the experience of interacting with these artworks in their public environment. Paintings do not generally have a close relationship with their surrounding environment. As such, we can easily move paintings between galleries and use HD scans to record and present them in virtual museums; *Google Art Project* is doing this

kind of work. Conversely, the presentation of public artworks is ingrained in the contexts of their surrounding environments. They are landmarks of a city or a region; when we talk about them, we are reminded of where they are located. In our minds' eyes we see not just the public artwork itself, but also its environment. For instance, whenever we talk about the *Statue of Liberty*, the impression in our minds is that she is located next to the city of New York, she faces the sea, against the background of bustling New York City scenes. Each public artwork is entangled within the environment around it, reflecting the significance of its location. In my thesis, I discuss a public artwork in the Fashion District in Toronto titled *Uniform Measure/STACK*, made by Stephen Cruise in 1997 (see APPENDIX B). Every day I passed it on the way home, but before I commenced my thesis research, I never thoroughly considered its meaning. It looks vaguely like ice cream, but actually consists "of a giant bronze thimble, sitting atop six oversized, multi-coloured buttons, and two buttons made out of concrete that now act as planters for growing trees [;]" Cruise's work is a reminder of the neighbourhood's history as a centre for garment and cloth-making, which dates back to the early part of the 20th century" (The CDR). People unaware of this context may have trouble understanding the work's intended meaning. That historical and environmental context is so inherent to the meanings of public artworks necessitates the use of technology that can capture and properly convey public artworks within their spatial settings.

Virtual Reality technology provides new potentialities for experiencing the world. VR essentially creates an immersive user experience; this experience is appropriate for the requirements of public art presentation given the need for information about public art to integrate more effectively with public space. Therefore, In this thesis I argue that it is possible to apply the idea of the virtual urban gallery for public art to the VR platform.

RMB City is a virtual art gallery based in Second Life that depicts a pastiche of contemporary Chinese cityscapes. Created by Chinese artist Cao Fei, *RMB City* considers contemporary urbanization in China by splicing famous Chinese buildings in a virtual space. Players interact with this space in a unique way that is not physically possible in the real world (RMB City, 2008). My urban gallery includes aspects of the appearances and features of the real world of public art, while also excluding some by taking advantage of the affordances of virtual worlds. I hope that through new digital technologies, visitors can not only enjoy these public artworks, but also can observe and consider the environments around them. In virtual worlds, we don't need to stringently follow the rules of the physical world. Therefore, in this project, I create new and interesting ways to encounter artworks that would be impossible in the physical world. For example, I allow users to see the works brought together into a virtual curated space, to hover around artworks without regard for gravity, and to explore panorama photographs by swooping or flying around them. This adds to the real-world experience of visiting the works by providing new perspectives, vantage points and imaginative artistic encounters. The virtual gallery also points the user towards third-party online resources, including maps, video interviews, and events, which provide valuable information and context.

The operation process of this project is as follows. By creating a simulation of an urban 3D model, users are empowered to explore and shuttle freely and quickly through the world through the use of an Xbox 360 controller. Based on map data, the public art models are placed in the virtual city corresponding to their location in the physical world. Users can walk or fly through the virtual city to observe the distribution of urban public artworks and explore the ones they are interested in; alternatively, they can use the fast travel function to teleport to the public artwork immediately. When the user approaches an

artwork and enters a portal next to the model, the scene will switch to a panoramic image of this public art. The user then observes the panoramic image while audio introduces information about the artwork. In this way, users can more deeply understand the meaning and context of each public artwork.

The purpose of this study is to investigate how a journey through a virtual version of Toronto can provide audiences with a macroscopic perspective to examine the entire city's public art distribution. A first-person perspective simulates the experience of moving through the physical city; in addition, the immersive experience is enhanced by a 360-degree image of each artwork, while at the same time relevant information and context are conveyed to the viewer through audio and online resources.

1.4 SCOPE AND LIMITATIONS

My project's research is limited to downtown Toronto. The anticipated audience for my thesis project is people who are interested in Public Art and local culture, either local people or tourists. This project includes several important public artworks in Toronto. Due to time limitations, I limited the scope of my project to ten public works of art in the downtown core.

This project requires a 3D model of the city and the locations of the public artworks found on the government website *Open Data Toronto* (City of Toronto, 1998). Because this project requires a 3D model of the city, it is necessary to combine all the separate buildings' model together, so the file is very large; it is effectively impossible to design it as an online installation, so the project is at this stage offline.

CHAPTER 2

LITERATURE AND REFERENCE STUDY

In this chapter, I discuss the definition and purposes of public art. I present two art museum exhibition forms--physical and virtual--and discuss the differences between them. I consider how the use of new media in art museums affords new ways for audiences to experience these artworks; I use Cao Fei's *RMB City* as a case study to demonstrate new ways to view art in virtual spaces. I argue that since virtual urban galleries are a kind of exhibition, curation of spaces and artworks is an important consideration even in the virtual context. With this in mind, I examine several virtual public art gallery websites and consider them in the context of my project and what I can learn from them. I also examine the simulative installation *Placeholder* as an example of the potential of VR technology for designing a virtual art gallery. Finally, I analyze and reference several applications of VR in art museums.

2.1 PUBLIC ART

Public artworks are inextricably entangled with the spaces in which they are situated, unlike many other art forms, which can be displayed at art galleries. Public artwork is often directly informed by its environmental context; many works depict the historical figures, events and local cultures of the places they inhabit. Taking this into account, I resolved to represent the local contexts of the works I depicted. This way, as users appreciate these public artworks, they can also observe the environmental contexts and interact with them. Displaying public art within its environment in a virtual space creates a richer narrative situation for users that allows them to more deeply consider the implied meaning of the artworks. The virtual world is not held to the same physical and

spatial constraints as the physical world. In the virtual gallery, then, it is also possible to enrich the narrative experience by creating imaginative, physically impossible spaces. For example, in Cao Fei's *RMB City*, buildings that are in different places in the physical world are situated next to each other in virtual space; this enhances the experience and symbolic meaning of the project and of the buildings themselves. In the case of *RMB City*, the buildings are still given some environmental context; however, unrelated places in close proximity are removed so as to focus more on the content that the gallery wants to present.

Additionally, the virtual world affords non-human perspectives that may reveal new conceptual potentialities for public artworks; for example,, users might embody a fish in Algonquin to see Tom Thomson's canoe, a car driving through the Gardner Highway to view the Gardner Stream beside, or an eagle flying around the Rocky Mountains watching Chinese rail workers. When users interact with these environments, they can transport to a panoramic scene via a portal, which connects the virtual and physical by allowing users to virtually view what the artwork looks like in the physical world.

One of the purposes of my work is to facilitate the enjoyment of public art, and to understand the background and historical significance of particular public artworks. To achieve this goal, I first need to understand the concept, history and significance of public art.

2.1.1 DEFINITION OF PUBLIC ART

In the wake of the First and Second World Wars, America focused its efforts on expanding its cities. In order to promote the construction of cities, the United States government established a series of federal legislations, such as, the Works Progress Administration (WPA), Government Service Administrations (GSA), and National

Endowment of the Arts (NEA) (Grenier, 2009). These federal legislations adopted percent-for-the-arts projects as part of all federal capital projects. Michael Robert Grenier asserts in his dissertation, *An Analysis of Public Art on University Campuses: Policies, Procedures, and Best Practices* (2009, p.16) that “Philadelphia was the first municipality to adopt a *percent-for-public art* in 1959. The percent-for-art initiative was intended to be an antidote to increasingly industrialized urban spaces.” The main purpose of early public artworks was to enrich and beautify the city's image in the face of increasingly industrial cityscapes. As time went on and city buildings became more modern, the historical significance of public artworks began to emerge. They began to represent not only the local geography, but also the history and local culture of the cities they inhabited.

The United States’ first private, non-profit civic organization, the *Association for Public Art*, was established in 1872, dedicated to creating a “museum without walls” by integrating public art and urban design. On their website, they define public art as follows:

Its size can be huge or small. It can tower fifty feet high or call attention to the paving beneath your feet. Its shape can be abstract or realistic (or both), and it may be cast, carved, built, assembled, or painted. It can be site-specific or stand in contrast to its surroundings. What distinguishes public art is the unique association of how it is made, where it is, and what it means. Public art can express community values, enhance our environment, transform a landscape, heighten our awareness, or question our assumptions. Placed in public sites, this art is there for everyone, a form of collective community expression. Public art is a reflection of how we see the world – the artist’s response to our time and place combined with our own sense of who we are (Association for Public Art, 2016).

The audience’s aesthetic experience of a piece of public art can widely vary; it largely depends on the piece’s locative context. The way that the design of a public artwork interacts with its environment through its materials, shape and content can convey meaningful information to the audience or arouse an emotional response. For instance, once

artwork I examined in this project is titled *Memorial to Commemorate the Chinese Railroad Workers in Canada* (see APPENDIX B), created by Eldon Garnet and Francis LeBouthillier in 1989. Its primary materials are wood and metals, which represent the materials of the railway construction. It is located downtown near the corner of Blue Jays Way and Navy Warf Ct, beside the Go Train railway. The monument is a railroad trestle made out of dark brown wood beams with the rails installed along the top. There are two workers on the trestle who represent the danger of working on such a structure. The features compose a large image that commemorates Chinese railroad workers who faced great hardship constructing the Canadian Pacific Railway, which linked and united Eastern and Western Canada during the 19th century. To build this railway, labourers had to brave the treacherous terrain of the Canadian Rockies. Between 1880 and 1885, over 4,000 workers died in the process of construction; they remained nameless in Canadian history. This monument is erected to remember them (The Blue Quasar, 2011). Nowadays, “it is not uncommon to find new wreaths laying at the foot of this memorial, as many Chinese associations continue to pay their respects” (Meritt, 2009). The stately-looking boulders standing like sentinels near the base of the work were directly extracted from the Rocky Mountains. These unique materials poignantly convey the work's theme and information to audiences. This memorial exemplifies the materiality of public art. Through this form, people can intuit the event this work commemorates; it is easy to understand its historical significance.



Figure 1 Eldon Garnet and Francis LeBouthillier, *Memorial to Commemorate the Chinese Railroad Workers in Canada*, 1989

Cher Krause Knight defines Public Art in his book *Public Art: Theory, Practice and Populism*, stating, “If we define ‘public art’ by its most basic precepts, then its roots reach far back in history. Its works are conceived for larger audiences, and placed to garner their attention; meant to provide an edifying, commemorative, or entertaining experience; and convey messages through generally comprehensible content” (Knight, 2008, p.1). In contrast to private or chamber art works, these works were created for the public; they are free and open. This form of art provides the opportunity for more people to interact with art works. In addition, public art works reflect the environment they inhabit.

My thesis focuses on public artworks in the downtown core of Toronto. The City of Toronto defines public art as follows:

The City of Toronto has a broad definition of public art that provides artists with a variety of opportunities to enrich the urban environment. Public art can be unexpected moments of beauty, amusement, reflection or intrigue. These works of art might serve as monuments or memorials or represent other creative, innovative and exploratory ideas or expressions for the area. It is widely recognized that public art has the ability to boost economic development and tourism by making destinations for visitors and local residents (Toronto City Plan, 2010).

The Toronto Government's stated desire is to beautify the urban environment through public art and commemorate important historical events. They want more people to understand and enjoy the city through public art. My work is intended to provide an opportunity for more people to appreciate and understand public art in Toronto.

2.1.2 INTENTIONS OF PUBLIC ART

In *Art for public places: Critical essays* (1989), Malcolm Miles writes that, "the history of art has sometimes been presented as a history of styles. The history of public art will more likely be seen as a history of intentions." The purpose of public art involves historical memory; in the process of spreading local culture, public art has become a part of it. According to Hilde Hein, "public art aims both to express and to effect its culture" (2006, p.53).

Public art represents and embodies the history and local culture of the site where it is located. Public art is thus important for the design and culture of cities; artworks also provide useful historical context and knowledge for those who observe them. Penny Balkin Bach answered the question "why public art?" in her book *Public Art in Philadelphia* (1992), saying, "Public art is a part of our public history, part of our evolving culture and our collective memory. It reflects and reveals our society and adds meaning to our cities. As artists respond to our times, they reflect their inner vision to the outside world, and they

create a chronicle of our public experience.” Public art contributes greatly to the character and atmosphere of urban spaces. The City of Toronto notes this, saying:

Public art can reaffirm or reveal a sense of place in a symbolic and visually stimulating way by evoking some aspect of the social, natural, cultural, physical, political, economic or historical context of the site and its locale. Typically, public artists produce site-specific sculptures and prominent installations that add character and distinction to a development and the surrounding neighborhood. Other public art opportunities include inviting artists to collaborate with design teams to create integrated built form and open space schemes (Toronto City Plan, 2010).

One City of Toronto official document considers public art in the context of city planning and development:

Public art installations, both publicly and privately owned, make walking through the City’s streets, open spaces and parks a delight for residents, workers and visitors alike. Public art has broad appeal and can contribute to the identity and character of a place by telling a story about the site’s history. It creates a landmark and celebrates the cultural diversity and creativity of our communities. A partnership between the public and private sectors is to be nurtured to transform Toronto into a large public art gallery with installations throughout the City (Toronto official plan, 2010).

The Toronto municipal government’s stated intention in funding public artworks is to transform the city into a great beautiful gallery; but even having built this “large public art gallery”, it may be difficult to motivate audiences to actively engage in the process of learning the meaning of these artworks: when people pass by a public artwork, they may be shocked or attracted by its appearance, but this doesn’t necessarily mean that they will make an effort to understand the historical story and meaning of the piece. To assess this level of engagement, I conducted an online survey of OCAD students and Toronto residents, asking respondents about the degree to which they understand public artworks in the urban areas of Toronto (see APPENDIX D). Out of over thirty respondents, 72% were not familiar with the background stories of public artworks in the city. I describe the survey in

more detail in the fourth chapter. I hope that my work can provide a new way for audiences to access, appreciate and understand the history and local culture behind these public artworks.

2.2 ART MUSEUM/GALLERY

I call my work virtual art gallery, but my work also takes inspiration from several museum exhibitions; the ways that galleries and museums exhibit their work is often very similar, and the concepts of “art galleries” and “art museums” are almost the same. In the introduction of the *Art Gallery of Ontario (AGO)* website, they describe themselves as follows: “With a collection of more than 90,000 works of art, the Art Gallery of Ontario is among the most distinguished art museums in North America.” (AGO) In their name, they define themselves as an art gallery, but in this description they refer to themselves as an art museum; in this way, they consider art galleries and art museums as the same thing. Therefore, in this thesis, I do not distinguish between these two terms.

2.2.1 EXHIBITION: FROM PHYSICAL TO DIGITAL

In order to design a virtual museum or gallery, it is first necessary to consider its function and purpose. Therefore, before studying virtual museums and galleries, I need to understand traditional physical galleries. James Cuno states that, “an art museum’s fundamental purpose is to collect, preserve, and exhibit works of art as a vital part of our nation’s cultural patrimony” (McClellan, 2003, p.36). The traditional art museum is a physical storage room that can store and preserve a collection of art works, but can also exhibit these works to the public in exhibitions curated by theme. Digital technologies have the potential to revitalize art galleries by allowing for new ways to exhibit work; this has

led to the transformation of the duties of art gallery workers. Marie Bourke wrote in her book, "IT is influencing the outcome of the long debate between those curators who believe that their prime duty is to preserve and maintain the artefacts in their care and others whose priority is to instruct the public" (2001, p.50). For the duty of virtual gallery in my thesis, I want to do both of them. I think the virtual urban gallery in VR can not only record the image data of these public art and their surrounding environment, but also can create a new way to interact with them and convey their information to public. With the development of new technologies, the primary mission of museums has gradually shifted; George F. MacDonald and Stephen Alsford consider this notion in *Museums in a Digital Age*:

Traditionally, museums have focused their attentions on the past. Their preoccupation with the material remains of the past has made them object-orientated. This is reflected in the list of key functions of museums: to collect, preserve, study, exhibit, interpret; all are activities preformed on museums' artifacts or specimens.... Today there is a growing appreciation in the museum world that museums do not exist primarily to service their collection s of material heritage, but rather to serve society by helping provide the knowledge it members need to survive and progress (Parry, 2010, p.72).

Google art project is a good example of the application of new technology to art galleries. This project collects images of a massive number of paintings and presents them to the public for free. Its priority is to inform and engage with the public about the artworks they display. It is in the context of this shift in the cultural role of museums and the development of new technologies that virtual museums have emerged. My project is also focused on the provision of information about art.

In museums or galleries, the use of media is very wide and has several advantages. Selma Thomas & Ann Mintz describe these advantages in their book *The Virtual and the Real: Media in the Museum* (1998, p.81). Virtual museums offer an opportunity for those

who cannot appreciate artifacts on-site to experience them in a virtual site: “art museums are both users of new technology and repositories of content. Increasingly, museums are using interactive systems containing high-quality images and extensive information about their collections to offer the public expanded opportunities to learn about art both on- and off-site.” Public artworks are scattered across cities; in the physical world, it is difficult for people to view them all in one day. Virtual art museums are a good solution to this problem.

Thomas and Mintz also state that, “media also can place objects in their appropriate historical and/or cultural context. This helps visitors to better understand objects and to transcend their concrete characteristics.” (p.61) VR technology is uniquely suited to placing objects “in their appropriate historical and/or cultural context,” in that it can locate viewers in a virtual space. In my work, I combine the virtual art gallery with VR technology in order to display panoramic images of public artworks and provide relevant historical information to audiences, providing them a convenient way to appreciate and learn about these pieces. Thomas and Mintz also note that “media, with its power to juxtapose and visually and aurally connect ideas, is an excellent vehicle for presenting abstractions. Because of its inherently powerful visual and aural characteristics, media can support and complement presentation and interpretation in ways that the objects and phenomena alone may not be able to do.” (p.59) In my project, I combine visual panoramic images and auditory information to provide an immersive and informative environment for the audience.

2.2.2 ART IN VIRTUAL SPACES

RMB City is an example of an experimental and innovative approach to art making in virtual space. It is a virtual art community in the online world of Second Life planned

The RMB City website notes that “RMB City is not a city of magical mirror, it doesn’t restore the full present, nor does it recall our reminiscence of the past. It’s a mirror that partially reflects; we see where we were coming from, discover some of the ‘connections’ that fill the pale zone between the real and the virtual, the clues of which get disturbed, enriched, and polished. New orders are born, so are new, strange wisdom” (RMB City, 2008). In my thesis, these “connections” can be the public art models in physical or their historical scenes, or they can be the videos, interviews, and events about public art. These “connections” also reflects the people’s perspective to these public arts. In my project, users can view and interact with these artworks as some embodiments. All embodiments in Second Life have the ability to fly and instantly move, allowing players to have a bird’s eye perspective of RMB City as they explore it; this constitutes an exaggerated sort of splicing in the virtual world. This artistic splicing method, in which, for example, Tiananmen Square is placed next to a swimming pool inspired by the Three Gorges Dam, directly reflects the contradictions inherent in these places in the real world. This exaggerated splicing satirizes the phenomenon of Chinese contemporary social development. Players can interact with the virtual environment of *RMB City* in ways they are not allowed to in the physical world. For example, they can fly on the back of a swan above the city, or play in front of Tiananmen Square in the swimming pool. In reality, people are not free to play near the people's palace, but the virtual space grants them that freedom. Players can also interact socially with other players in RMB City, share their contact information and buy copies of the locations and items. There are also frequent social events in RMB City. For example, at the opening of RMB City in 2008, its author and sponsor held a virtual city opening ceremony. Cao Fei’s avatar, China Tracy, gave a

speech and announced the first mayor of *RMB City*, UliSigg Cisse, the avatar of the Swiss collector Uli Sigg.



Figure 3 China Tracy (Cao Fei) and UliSigg Cisse (Uli Sigg) in RMB City, 2008

From *RMB City* I learned that in the virtual world, we do not necessarily follow the rules of the real world. *RMB City* also reveals the importance of the virtual environment in contextualizing spaces transposed from physical spaces to virtual ones. There is a close relationship between public art and its surrounding environment, and *RMB City* provided me with inspiration for how to depict this relationship on a virtual plane. Users are not limited to viewing public art on the land, but can also see it from the air, the water or the highway. *RMB City* also proved inspirational as an example of virtual curation; in *RMB City*, the artist juxtaposes unrelated buildings by placing them together, and in doing so creates a new city with a unique spatiality. In my project, I combine public art models from the physical world and my imagination of their historical environments together, and curate them in a virtual museum based on geographic location.

2.2.3 CURATION IN VIRTUAL SPACE

The goal of this project is to create an exhibition in a virtual urban art gallery. Curation in virtual space is different from that in physical places. Exhibitions in the virtual world are not subject to the limits of time and space. However, users can only watch and listen, and cannot engage in a tactile way with the artworks.

The traditional way of displaying art in virtual space is on web platforms. This we can call Web-based Art or Net Art. However, the curation of web art galleries presents a series of problems. As Olia Lialina, the founder of one of the first Net art galleries online, has commented (Graham & Cook, 2010, p.71), “On-line galleries only store facts and demonstrate that a phenomenon exists. They neither create a space, nor really serve it.” Those who don’t have a clear target when searching for virtual artworks on the website or who are not familiar with the art scene might not be able to distinguish them from other cultural productions found on the internet. Another problem faced by web art galleries is that of seamlessly connecting the virtual gallery to physical exhibitions. According to Graham & Cook (2010) “In exhibitions of Net art, museums have to consider not only the computer and connection settings, but also the space of the gallery where the installation is sited” (p.73). Curating Net Art in physical gallery will deliver an experience similar to watching TV in that only one person holds the controller and other people watching the background (p.71).

Net art not only presents challenges in the physical world, but in virtual space as well. “Works of simulation-based art, such as immersive video games, are a challenge to present because they are premised on the idea that the awareness of the mediation should be the viewer’s primary experience” (Graham & Cook, 2010, p.79). Based on viewer’s previous experiences, they can make choices, thus affecting the developing narrative in the

simulative landscape. Virtual space also problematizes the role of the curator in managing exhibitions; Graham & Cook point out that “the curatorial role in the presentation of this kind of immersive installation may simply be in the entering and exiting of the mediated space” (p.79). For example, for the immersive installation *Ephémère*, designed by Char Davies at the National Gallery of Canada, users must sign disclaimer forms and listen to instructions about physical actions and controls before they can navigate the installation.

My work is an exhibition about public art in a virtual environment. The curation of this exhibition involves combining a model of the city at large with spatial information about the environment surrounding each public artwork. My intention is to allow viewers not only to see the public art themselves but also to see and interact with their environment. For example, for the Gardiner Stream (see Appendix B), the artwork will be presented together with a piece of the Gardiner highway, but without the other meaningless buildings around it. I will also make a map of Downtown Toronto and mark the location of the public artworks on the map. I chose not to use Google Maps because I felt that the complicated interface of Google Maps might impede users from properly observing the works and navigating the map. Figure 3, for example, shows the location of a public artwork. When the user selects one of these locations from the map, his/her view will transfer to the related public art model in the virtual world.

2.2.4 REFERENCE STUDY OF PUBLIC ART VIRTUAL GALLERIES

In this section, I will discuss several public art virtual galleries and evaluate their strong and weak points as pertaining to my project.

Association for Public Art

This is a website for public art in Philadelphia, developed by the Association for

Public Art. The interface is well-designed, and its content is also very substantial. This website offers two modes of navigation: Explore and Tours. Explore mode has three functions: map, gallery and list. Each function can be filtered according to specific themes. The Tours mode is very interesting; if Explore mode is a fully online browsing experience, Tours is a combination of online and offline. Users can choose their favorite tour to visit the city's public artworks on-site; the website provides routes that users can take to best appreciate the public artworks. On the introduction page, the information is very detailed; most artworks have audio introductions and video documentary footage.

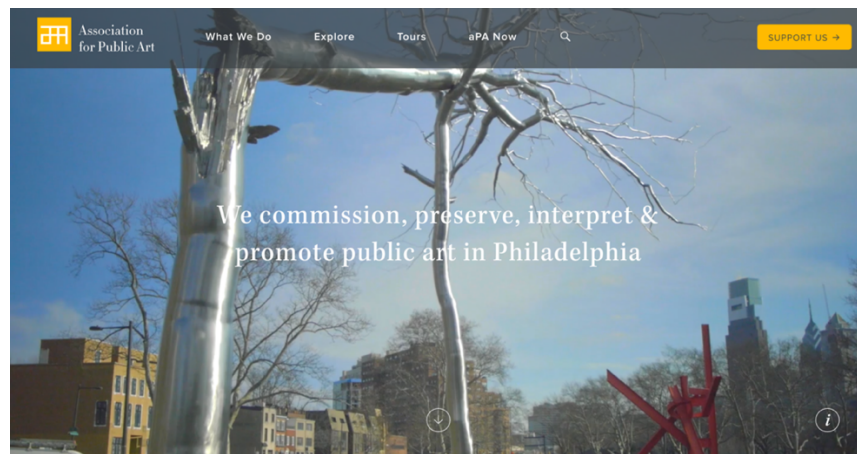


Figure 4 Screenshot of *Association for Public Art* website – Home page, from: <http://www.associationforpublicart.org>

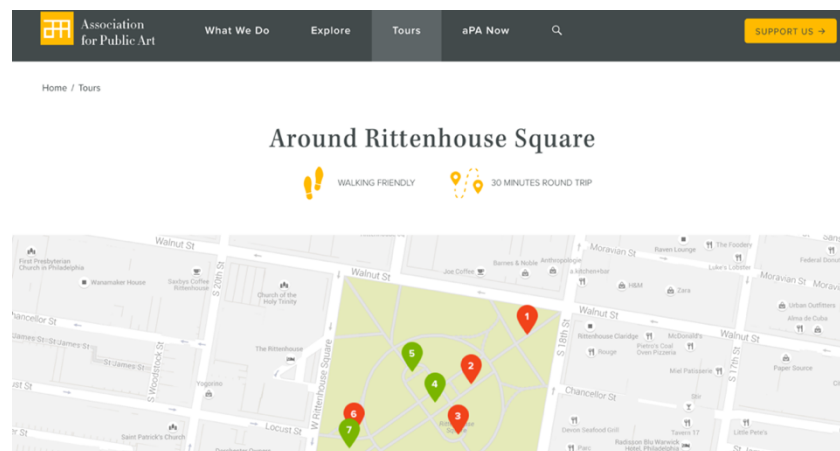


Figure 5 Screenshot of *Association for Public Art* website – Tours function page, from: <http://www.associationforpublicart.org/tours/around-rittenhouse-square/>

Winnipeg's Public Art program

On the website of the Winnipeg Art Council, there is a page dedicated to public art that features all of the public artworks in Winnipeg. Users can select an artwork by clicking on it; this will open a detailed page that describes specific information about this public artwork, in addition to the artist's biography, a gallery of images and videos of the work, and the work's location on Google Maps. This is a very convenient way for people to understand Winnipeg's public artworks. The website also features a downloadable *free public art guidebook*. The interface design of this website is not very intuitive, however.

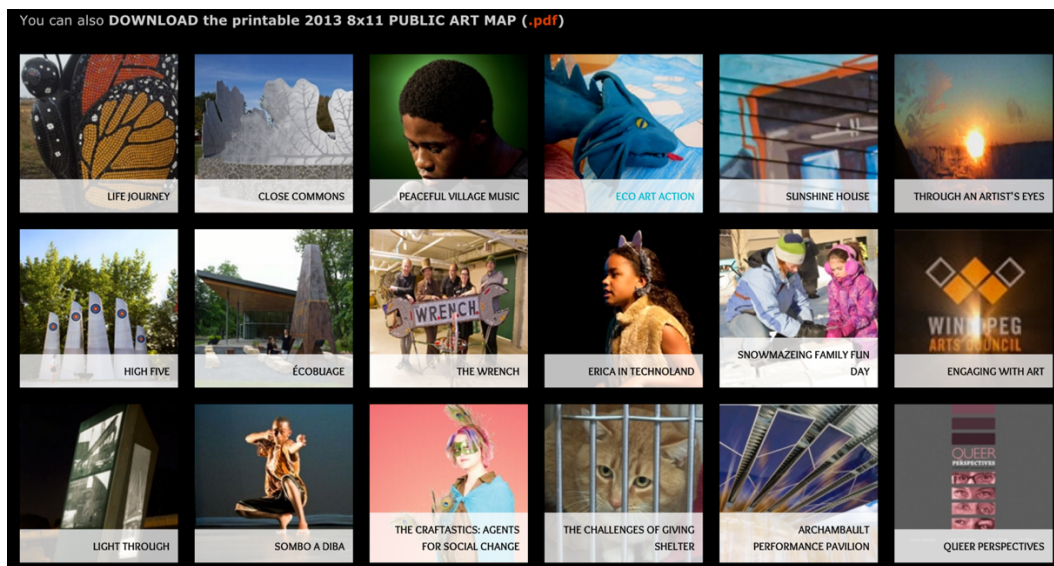


Figure 6 Screenshot of *Winnipeg arts council* website – Gallery of Public Artwork page from: <http://winnipegarts.ca/pubart-gal>

City of Edmonton Public art collection

This website features a large collection of public artworks in Edmonton. The interface design of this website is very simple; it is easy for users to focus on important

information. One of the most interesting and practical features of this website is the “Timeline filter” function, which allows users to view the artworks by the dates they were created. The introduction page is also very detailed. However, the website suffers from a lack of audiovisual information.

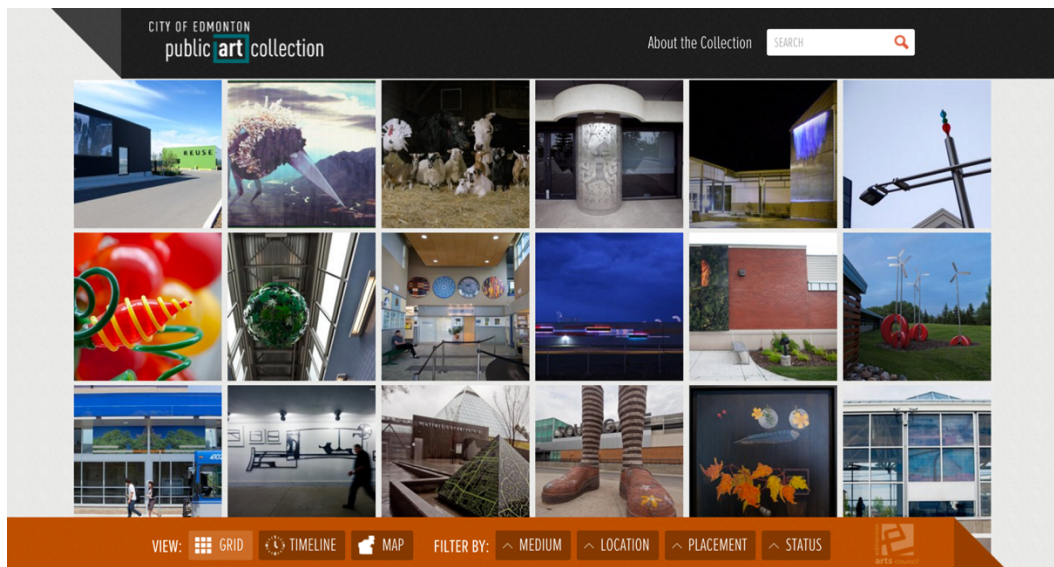


Figure 7 Screenshot of *Edmonton Public art collection* website, from: <http://edmontonpublicart.ca/#!/grid/>

Percent for Public Art Program in Toronto

The City of Toronto does not have its own website for public art; it has only a branch page in the government’s website that displays a map of public artworks in Toronto. Users can click the red pins to see a small single image about that artwork and its name, artist and location. No more information is provided; if people want to see the details about the artworks, they have to search for them online individually.

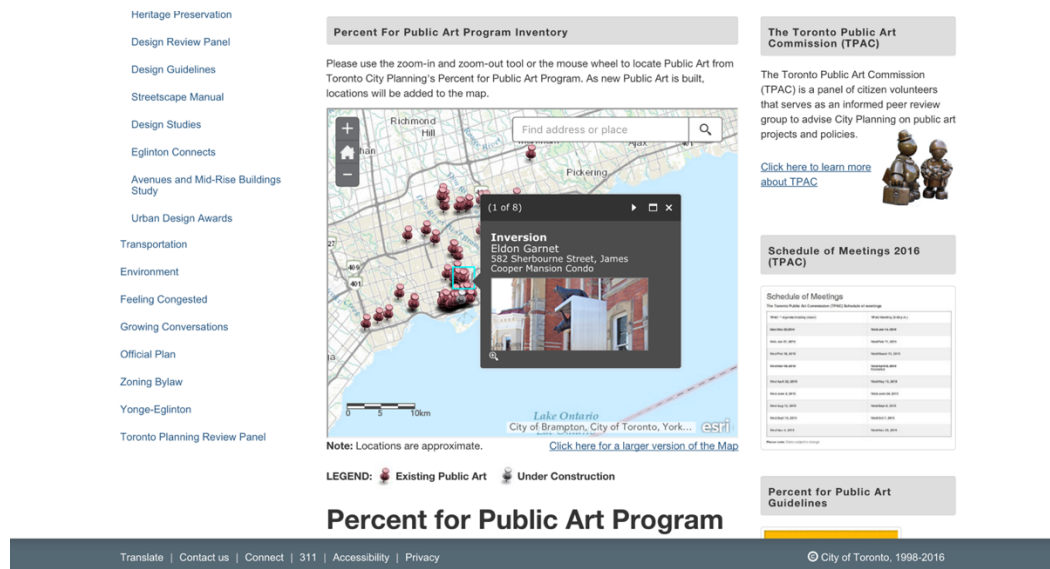


Figure 8 Screenshot of *City of Toronto* website – Percent for Public Art Program page, from:
<http://www1.toronto.ca/wps/portal/contentonly?vgnextoid=fcf65297faa58410VgnVCM10000071d60f89RCRD>

The Toronto City Plan describes the history of Canadian Public art, and evidently The Canadian government emphasizes the importance of the construction of public art:

In Canada, the first public art program began in the 1950s when the Province of Quebec introduced its Art in Architecture program. In 1986, the former City of Toronto was the first Canadian municipality to endorse policies to encourage public art in major developments. The former Municipality of Metropolitan Toronto, the former cities of North York, Etobicoke, Scarborough and York and the former Borough of East York, also supported a diverse range of public art policies, advisory committees and programs. Today, over 50 Canadian municipalities have public art policies and programs including Vancouver, Edmonton, Calgary, Richmond, Winnipeg, Montreal, Ottawa and Thunder Bay (2010).

Several other Canadian cities have public art collection programs on their government website; these websites often discuss the importance of public art to local culture and history. However, many of these sites are simple lists; it is difficult to find more information on the artworks. Only a few cities have websites dedicated specifically to their

public art scenes. Edmonton's collection is good, but it is still not detailed enough; using VR technology to display public art might create a better result. *Association for Public Art* uses audio guides on their website. But the problem on *Association for Public Art* website is it separates these audios from their visual information. In my project, I combine audio and visual information together, allowing users to appreciate the public artworks visually while learning information about them from the audio guide.

2.3 VR TECHNOLOGY

Before I discuss the creation of my virtual space, I want to delineate the possibilities in the virtual and real worlds. The physical world offers an embodied sensory experience not possible as of yet in virtual worlds: we can touch, smell and taste objects, sense temperature and pain, and feel the air pressure and atmosphere of a space. However, some tasks in the physical world are limited by our bodies. In the virtual world, our movement is not limited to our bodies; we can run without tiring, swim as deep as we want to and even fly or teleport. In the physical world time is uncontrollable, but in virtual space, it is possible to alter the season, weather, light conditions and other visual factors. For example, in *RMB City*, players can fly around the city to view, observe and interact with it from any angle. They can also teleport to notable locations or explore the city on foot. According to Ceren Erdem (2012), "The exploration of virtual spaces is achieved through a natural propensity for movement; users wander anonymously within the boundaries of virtual space, developing a virtual identity while connected. These explorations are limitless, without boundaries in space or time." Therefore, in virtual space, we can create new ways for players to interact with each other or with their environment that are not possible in the physical world.

My thesis considers the potential for digital technologies to help audiences appreciate public artworks in downtown Toronto. By combining the aesthetic and exploratory possibilities of virtual worlds with auditory guides that provide relevant information and context, this project aims to allow audiences to watch and experience these artworks and at the same time understand the cultural and historical stories behind them.

The development of VR Technology provides new possibilities for us to appreciate art in virtual art galleries. The Point of View (POV) perspective afforded by VR technology can bring the audience a more immersive experience. Given the local and cultural importance of public artworks, in order for audiences to understand them properly, it is necessary to situate the works in their surrounding environments. One advantage of VR Technology is the ability to create a realistic virtual environment; in addition, VR Technology is a great way to solve the problem of how to create a convenient tool that allows audiences to appreciate art in a virtual world and at the same time understand the meaning behind it. That is why I chose to use VR Technology to achieve the purpose of my thesis. In the following sub-sections, I introduce the history and advantages of VR technology and a case analysis of VR Technology.

2.3.1 HISTORICAL DEVELOPMENT

Morton Heilig was the first person to design an immersive machine that we might consider a form of Virtual Reality, a machine he called *Sensorama* (Packer & Jordan, 2002, p.261). In his 1955 essay, *The Cinema of the Future*, Heilig wrote that, “If an artist controlled the multisensory stimulation of the audience, he could provide them with the illusion and sensation of a first person experience, of actually ‘being there’” (p.240). Providing my audiences a simulative environment that gives them the illusion “of actually

‘being there’” affords them a new way to appreciate public art. As we know, public artworks are best viewed in the context of their location; as such, the best way to appreciate them is in the field. VR technology provides the opportunity for us to enjoy these public artworks in a virtual field and give us the feeling of “being there” without the inconvenience of traversing the city.

Morton Heilig proposed a framework of human consciousness in which “the consciousness is a composite of all the sense impressions conveyed to the brain by the sensory part of the nervous system which can be divided into the great receiving organs—the eyes, ears, nose, mouth and skin” (Packer & Jordan, 2002, p.247). His study deals with which of each of the five senses are being used at any given point in an experience. He concluded that people’s senses are monopolized in the following proportions:

Sight	70%
Hearing	20%
Smell	5%
Touch	4%
Taste	1%

We can see that sight monopolizes human attention, so the more “sight” senses are presented, the more information will be clearly conveyed. However large the traditional screens are, the two-dimensional display still has a border. But in VR environment, we can view the perspective from any angle. Ivan Sutherland states in his article *The Ultimate Display* that, “the two-dimensional nature of pictures makes it impossible to order the parts of a picture by neighborhood” (Packer & Jordan, 2002, p.256). Based on 3D virtual environments and the POV perspective, VR technology expands this feature and makes the viewing experience more immersive.



Figure 9 Morton Heilig, *Sensorama*, 1962, from:
<http://www.mortonheilig.com/InventorVR.html>

Sutherland invented the first Head Mounted Display (HMD), which surrounds the user with 3D information, in 1965. The head mounted device created a precedent for the portability of VR technology; it created the potential for people to more conveniently experience virtual worlds. Sutherland says that “there is no reason why the objects displayed by a computer have to follow the ordinary rules of physical reality with which we are familiar” (Packer & Jordan, 2002, p.256). In my project, the user can fly and experience a bird’s eye view to see the distribution of public art works in Toronto. This simulation gives people the chance to visit virtual public artworks as if they are in a huge art gallery. Sutherland states that “a display connected to a digital computer gives us a chance to gain familiarity with concepts not realizable in the physical world. It is a looking

glass into a mathematical wonderland.” (p.256) By allowing users to experience physically impossible concepts in virtual spaces, the POV perspective in VR devices gives them a chance to experience public art works in new ways.



Figure 10 Ivan Sutherland, *Head-Mounted Display*, 1965, from:
http://amturing.acm.org/photo/sutherland_3467412.cfm

According to *RMB City* creator Cao Fei (2008), “A reason that the virtual world appeals to me is that it transcends obstacles in reality, despite being hyper-real. It offers a virtual platform for human beings to experiment with a possible utopia, such as building an individualistic heaven, drafting laws and systems, generating new discussions and thoughts, etc.” In virtual space, we can break the rules of the physical world and create new modes of experiencing space. In *RMB City*, players can see famous buildings from different

parts of China together in an eclectic way; this creates an interesting visual representation of contemporary conditions in China. Familiarity with these buildings allows for a more immersive experience of the virtual city. As Ceren Erdem mentioned:

Cyberspace is immersive and yet highly-constructed. Second Life enforces this effect: “The very term ‘immersion’ implies that one is drawn into an intimate and embodied relationship with a virtual and physical architecture, whether this immersive affect is generated by a VR [Virtual Reality] system, the cinema, a panorama or another medium. It suggests that one is enclosed and embraced by the audio-visual space of the work, and transported into another realm or state of perception. One cannot be immersed without being affected by the environment on perceptual, sensory, psychological and emotional levels” (2012).

Another similar immersive simulative VR project called *Placeholder*, directed by Brenda Laurel and Rachel Strickland, explores a new paradigm for multi-person narrative action in virtual environments. According to N. Katherine Hayles in her essay *Embodied Virtuality: Or How to Put Bodies Back into the Picture* (1996), “[Laurel and Strickland] envisioned a simulation that would situate embodied actions within an interactive environment. They wanted the aesthetic choices to grow out of a respect for the complex interactions that take place between embodied creatures and the world they inhabit.” In order to create a suitable simulation model, they chose three locations in Banff: Hoodoos, a vertical rock revered by local Aboriginal people as the home of spirits; a natural cave; and a mountain waterfall. They used panoramic videotapes taken from four different times of day to create the landscape for the simulation.

This project has another function: The Voiceholder, which can record the voices of participants. When participants experience the project, they can touch face icons; these faces will open their eyes and play messages recorded by the previous participants. Perhaps the most important feature, however, is the Smart Costume feature; Hayles notes that

“embodiment in Placeholder is enacted through Smart Costumes.” Participants can choose from one of four costumes--spider, crow, snake, or fish--to interact with the simulation; they will appear as this animal when moving through the simulation. Moreover, their voices will be filtered through the voice type of their animal. Their choice of form also determines their ability to move through the simulation. For example, the crow can fly and the fish can swim while the other forms cannot. Hayles (1996) notes that “the simulation does not restore a ‘natural’ connection between the user’s pov and the body, most obviously because human being do not naturally have sensoriums that process information in these ways. The person who experience this simulation is a techno-bio-subject whose body has been resurfaced and reconfigured by its interface with the technology.”. The project gave me a lot of inspiration. Within virtual spaces, participants can embody any form or state. People can choose a unique perspective and form to feel and interact with this world in a way that is impossible in the real world. VR technology therefore has the potential to create immersive, unique embodied experiences for participants that allow them to re-examine virtual and physical worlds and the ways they engage with them. Inspired by *Voiceholder*, I plan to add a recording function in my project. In this way, users can refer to insights and information from previous users, and can also provide more information for future audiences.

Laurel and Strickland also invited a number of actors to perform improvisation at the physical opening site. The actors performed as if they were shouting by the Hoodoos, splashing in the waterfall, or exploring the caves. The interaction between actors and environments has the potential to create new forms of narrative and embodiment. *Placeholder* also encourages interaction between participants, who can see and hear each other's filtered voice. Temporary cues provided by the environment and other participants

can create a sort of immanent narrative. In addition to this, a role known as the Goddess can watch the simulation on monitors and interject with suggestions or commands that enrich the simulation's narrative. The Goddess's voice is heard from inside the simulation rather than from the physical world; this creates a more immersive and atmospheric feel for participants. In this project, participants can not only interact with the environment and other participants in the virtual world, but can also listen to or follow the advice and orders of the external Goddess in the physical world. I also intend to allow participants to experience my project simultaneously, allowing for immanent encounters and experiences to emerge. The Goddess character also inspired me to consider the connection between the virtual and physical worlds. I intend for users to experience my project in the company of friends and observers watching via a monitor, who might provide suggestions and insight for the user as they traverse the virtual world.



Figure 11 Brenda Laurel and Rachel Strickland, *Placeholder*, 1993

2.3.2 REFERENCE STUDY OF VR

Webvr-cities

Webvr-cities is a data visualization based on a virtual reality platform. It is a new paradigm for creating immersive experiences in virtual reality by combining real cities with geographic data. Creator Brian Chirls (2015) states that “The biggest difference between virtual reality and flat, map-based data visualizations is that you can be placed “inside” the data, rather than above it. We’ve experienced an unexpected intimacy from these visualizations, along with a sense of scale... The subjective point of view is also more cinematic than a map, making it potentially more powerful for storytelling.” In this project, users can use their mobile phone as a remote controller after scanning a QR code on the website. Then, the website loads into a 3D environment. When the user types in a location and selects one kind of data, a data visualization appears. Users can touch and drag in any direction on their phone to move around and observe the data-altered space. I found this project inspiring: it is very effective that people can walk or fly through the simulated space and see a data visualization of the city.



Figure 12 Screenshot of *docubase* website, Data Visualization for Virtual Reality Cities website, from: <http://docubase.mit.edu/tools/data-visualization-for-virtual-reality-cities/>

Woofbert

WoofbertVR is an app for the Oculus-powered Samsung Gear VR that displays collections from art galleries. Currently, it is exhibiting work from the Wolfson Room at the *Courtauld Gallery*. Co-founder Elizabeth L. Reede says that new content will take users on a tour of several museums with some of the best collections of art and artifacts in the world. Currently in the physical world, people have to fly around the world to visit places like The Louvre and wait in long lines to get stuffed into a packed room for a short visit with famous artworks. If someone wants to visit an art museum like The Louvre, they might spend more time in line than they do viewing art. Their viewing processes might also be interrupted by other visitors, especially in crowded conditions. VR offers the opportunity for anyone to have a private viewing experience, a personal tour with no time limitations and the freedom to get up close to the artworks. Jonathan Shieber describes the details of this project, saying that “Several paintings are dotted around the walls, which you can view by simply looking and tapping on the on-board touchpad. The camera will then slowly walk over towards the given artwork, and you’re left with a number of options from here. Double tapping the touchpad when looking at any painting will start up an impressively detailed explanation of the work concerning its artist.” (2015) The purposes of this project are to allow for art education and appreciation and to offer open access to the world’s greatest museums for people who may never otherwise see these treasures of the art world. According to Shieber, “the company’s value proposition is more than just guided gallery tours. Woofbert is developing a full suite of educational products that it will offer to schools and to casual users who want to learn more about the world’s great works of art” (Shieber, 2015).



Figure 13 Screenshot of *Woofbert* VR App for *Courtauld Gallery*, from <http://techcrunch.com/2015/11/17/museum-collections-enter-vr-with-the-launch-of-the-woofbert-vr-app-for-samsung-gear/>

The Museum of Stolen Art

According to its website, “the Museum of Stolen art is a virtual space for art that has been stolen or looted, lost to greed or conflict. It is an Oculus Rift experience where one can enjoy artwork that is otherwise hidden. We are dedicated to engaging the public in culturally significant items that are in danger and aim to assist in the recovery of stolen art.” (Schneider, 2014) Given that it displays works that have been stolen, this project is a museum only possible in virtual reality. My works are also concerned with the creation of a museum that cannot be achieved in reality through the use of simulated space. The Museum of Stolen Art’s purpose isn’t only to create a simulated space that allows people to appreciate artworks they can’t see anywhere else, but to familiarize the public with stolen pieces in order to help recover them.

If public art is destroyed, it cannot easily be repaired; This would be a loss of culture. Digital data, such as image and video, is a good way to preserve these public artworks and the culture they reflect. My project provides a new way to preserve public art works in addition to the graphic image or video. It not only can save visual information about public art works, but also record the environment around them. And in this way, the experience of viewing them..



Figure 14 Screenshot of *The Museum of Stolen Art VR* App, from:
<https://play.google.com/store/apps/details?id=com.zivschneider.mosa.cardboard&hl=en>

CHAPTER 3

RESEARCH APPROACH

This chapter considers my research question and methodologies.

3.1 RESEARCH QUESTION

Based on the problematics I encountered when researching public artworks in Toronto and my research of VR technology and virtual art galleries, my research question is: can a virtual urban gallery allow audiences to view public artworks more conveniently, while allowing them to achieve a deep understanding of the work through supporting information, combining map-based data and 3D remote experiences of VR technology?

3.2 RESEARCH METHODS

Data collection

At the beginning of this research, I conducted an online survey about public art in Toronto (See Appendix D). The purpose of this was to gather data about the general level of understanding of and interest in public artworks in Toronto by those living in the city; I also asked whether participants would be interested in experiencing public artworks in a virtual environment.

Field research

First, in the early stages of this project, I investigated and researched public artworks in Toronto and created a list of ten works to be included in the scope of this project. I then conducted field research and information collection for those specific works (see Appendix B).

In order to better represent these public artworks and convey their messages in this project, I firstly conducted research on the artists, their intentions, and the historical and social contexts involved in their lives and works. After this, I physically went to the sites to experience and understand the pieces. I also observed other people's responses to them on-site, to analyze which specific point of view is most desirable for appreciating the piece.

Prototyping and Usability Testing

In order to answer the research question, I developed and tested three prototypes. The process of this prototyping is as follows:

1. The first prototype was based on my initial ideas and mainly functioned as a design objective, to address critical technical difficulties. Through technical testing, I effectively assessed which technologies best serviced my goals. After testing this prototype, I began to simplify the project's technical processes.
2. The second prototype aimed to fix the technical problems found in the first prototype. I also created more detailed designs and developments from the first prototype, extended some gameplay features and added more graphic materials.
3. In the third prototype, I focused on making the interface and material more aesthetically pleasing and thus more likely to be accepted by users.
4. I conducted continued iterative testing in order to improve user experience.

I also conducted extensive usability testing on prototypes in order to evaluate the experiences of test users. Some user test tasks were developed for the second and third prototype. According to the feedback from this user testing, I discovered areas requiring improvement and considered new solutions suggested by users for future prototypes.

CHAPTER 4

DATA COLLECTION AND FIELD RESEARCH

4.1 ONLINE SURVEY

Prior to this research, I conducted an online survey about public art in Toronto. The purpose of this survey is to gauge interest in and knowledge of public art, as well as interest in the idea of appreciating public art in a virtual environment. I proposed 10 questions about public art using a survey website called *SurveyMonkey*; I shared the survey with my friends on my social media networks, and received thirty responses.

Seventy percent of respondents said that they've heard about public art before; 73.33% know a little bit about public art work; just 6.67% know a lot of them. Sixty percent of people are interested in knowing more about public art, thirty percent feel "so-so," and just ten percent said that they are not very interested. The percentage of people who always pay attention to public art is 23.33%. 46.67% of people don't pay much attention to public art; thirty percent never pay attention to it. 73.33% said that they want to understand the expressions of public artworks in the city, but just 6.67% have done research on public artworks in the past. 65.52% said that they have favorite public artworks, but only 13.79% can remember them. Most people (76.67%) are not familiar with the history or background story about these public artworks; finally, 56.67% of respondents expressed a desire to experience these public artworks in a virtual environment.

The results in this survey show that most of the respondents have an interest in public art, but they are not familiar with the historical meaning and background of public artworks in the city. Additionally, most of them are interested in experiencing public art in a virtual environment.

4.2 INVESTIGATION AND SELECTION

Toronto is a hub for arts and culture in Canada. There are many famous public art installations in the downtown area. By searching online for *Top 10 Public Art Works in Toronto* (Egan, 2016) and *Percent for Public Art Program Guidelines* (City of Toronto, 1998) I found significant information about some of Toronto's most famous public artworks. I limited the scope of my project to a square of the city bordered by Bathurst Street on the West, University Avenue on the East, Queen Street on the North, and Lake Ontario on the South. I live within this section; therefore, I have had more opportunities to experience and observe public artworks in this area in my daily life. The place where I live is a new community that was established by *Concord Cityplace*. In order to comply with the *One Percent Program* promulgated by the City of Toronto, the developer must use at least one percent of the revenue for building public art. There are many complexes like *Concord Cityplace* throughout the downtown core; as such, there are dozens of Canadian and international public artworks installed in this area. The 10 public art works I chose in the list below are based on the frequency they appear on the website.

I conducted thorough research of these artworks in order to glean information about them, including the contexts of their creation, their historical significance, implicit local culture and the sources of inspiration for the artists. However, the traditional flat image online has several limitations. It is difficult to understand the size of public art works from images alone. The viewer can see their colors, shapes or materials, but cannot get close to experience them. Most of the time, traditional plane photography is shot from a long distance. This is the only way to capture the whole work; a shot from a closer angle would have to exclude part of it. Therefore, viewing images of the works online only

increased my desire to experience them on-site, and prompted me to consider how my project could solve these problems for people who cannot go to the field.

According to the geographical distribution of these art works in Toronto on the *Percent for Public Art Program* website (City of Toronto, 1998), I separated them into several sections and carried out my on-site research one geographical section at a time. Table 1 shows a list of selected Public Art Projects with their titles, artist's name, date and location. Based on these collected art works, I experienced and observed these public art works on-site and considered the feelings I got from them and the best angle from which to capture panoramic images of them.

TITLE	ARTIST	DATE	LOCATION
Barca Volante	Francisco Gazitua	2007	Parade Condons, Spadina Ave & Front St. W
Bobber Plaza	Douglas Coupland	2008	Canoe Landing Park, 95 Fort York Blvd
Flower Power	Mark di Suvero	2008	175 Dan Leckie Way
Gardiner Streams	Kathrine Harvey	2013	75 Queen's Wharf Rd
Memorial to Commemorate the Chinese Railroad Workers in Canada	Eldon Garnet & Francis LeBouthillier	1989	Blue Jays Way and Navy Warf Ct
Rising	Zhang Huan	2012	Shangri La, 180 University Ave
Search Light, Star Light, Spot Light	John McEwen	1998	Air Canada Centre

The Audience	Michael Snow	1989	Rogers Centre
Tom Thomson's Canoe	Douglas Coupland	2008	Canoe Landing Park, 95 Fort York Blvd
Uniform Measure/ STACK	Stephen Cruise	1997	Richmond St. & Spadina Ave

Table 1 Collection List of Toronto Public Artworks

4.3 ON-SITE EXPERIENCE AND OBSERVATION

Personal Experiences and Feelings

After investigating and studying these public artworks online, I went out into the field to physically experience them. I observed the artworks from different locations and angles to observe how they blend with the surrounding environment. I experienced and felt how they promoted the overall atmosphere of the living environment of their community and changed the local landscape. After having physically and emotionally experienced them, I tried to find the most suitable position and viewing perspective for users to view these art works, and utilized this viewpoint in my VR project by capturing it with a panoramic camera.

Observation

I also observed other people on-site and considered which viewpoints they chose from which to view the artworks. Specifically, I observed people taking photographs of the works and noted which angles they chose to use. I incorporated this information into my analysis of the most ideal viewing angle and position for each artwork.

Analysis

Different viewing positions give viewers different experiences. For example, standing outside of *Tom Thomson's Canoe* (Appendix B) gives a completely different experience from standing inside. (Figure 12 and Figure 13) From outside, one sees a third person perspective of a red canoe dock on the edge of the cliff facing the lake and the Gardiner Expressway. Standing inside, it feels like one is paddling the canoe. Compared to plane picture representation, VR technology is more capable of reproducing the feeling the viewer gets from standing inside the canoe. Viewers can use VR technology by wearing the headset to watch the surrounding environment: the busy highway at the front, the park behind and the modern architecture on either side of the canoe. Beatrice Paze states that public artworks require people to approach and interact with them in order to understand the meaning of their communication. She posits that “the interactive art invites attention and wants to be touched; it stretches the imagination and allows one to stop, linger for a bit, and discover that it is possible to get away from it all, even in the big city.” (Paze, 2016) Based on my experience and my observations of other people's attitudes towards *Tom Thomson's Canoe*, we all seemed to prefer to stand inside the red canoe and watch the busy city. Therefore, I chose to represent this artwork in my project from this vantage point.

Panorama collection

Based on my selected perspectives of each public artwork, I conducted on-site shooting tests. I used a RICOH THETA S Panorama Camera (See Appendix C) to capture the immersive images. During the shooting process, I tested different perspectives; for example, Figure 12 and Figure 13 show different angles for the Tom Thomson's Canoe shooting test.

I also encountered some environmental issues during the shooting process, including bad light levels and bad weather. As such, I returned to the scenes several times to take the best possible array of panorama photos.



Figure 15 Outside perspective view of Tom Thomson's Canoe

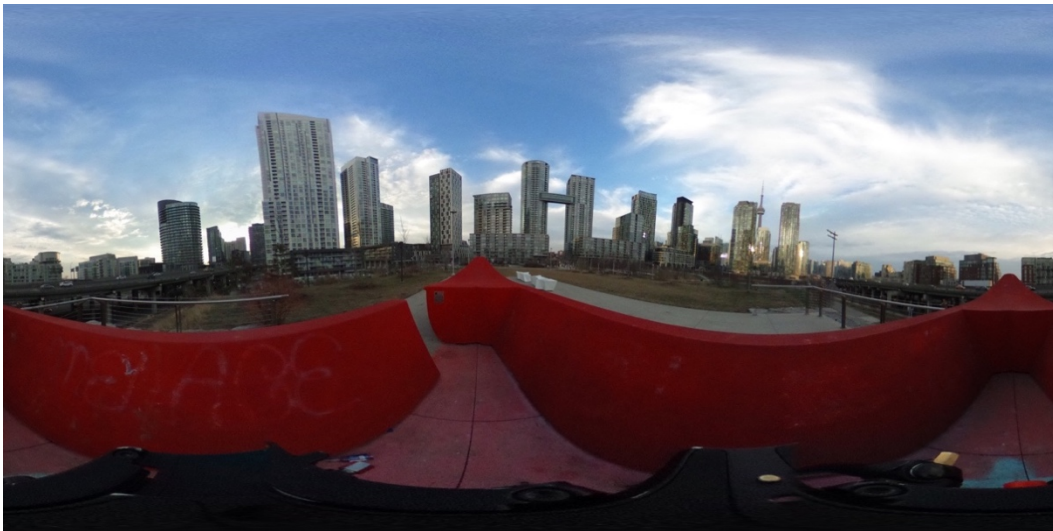


Figure 16 Inside perspective view of Tom Thomson's Canoe

CHAPTER 5

DESIGN DEVELOPMENT

5.1 CONCEPT AND EVALUATION

The design development is based on a synthesis of the knowledge from the literature reviews, precedents of inspirational work in the field, and also on the foundation of the thesis's three processes: accumulation, identification, and meaningful outputs. The core research approach and method is a combination of Field Approach, Prototyping and User Testing. In the early collection phase, I conducted Field research and short interviews. Prototype testing and analysis were conducted as components of the development. The following prototypes demonstrate the challenges and struggles faced before the current design was attained.

My initial idea was a visualization based on urban map data in a VR platform. Because traditional data visualization is two-dimensional, I wanted to use a 3D perspective to observe the visualization of the data and evaluate whether this new form could create a unique viewing experience for the audience. My initial idea was to create a virtual city where users could fly and observe the changes of the dataset. However, issues began to emerge when I did the specific design work. This initial concept didn't focus on a specific domain. I just focused on the technology, but I didn't find a specific thing to do with the research.

When I conducted research about urban visualization, I found a program supported by the Toronto government: *Percent for Public Art Program (City of Toronto, 1998)*. This program collected all of the public art works in Toronto and presented them on the website

based on the map data. Viewers can see the distribution of these public artworks by zooming in or out.

As I mentioned in Chapter 1, I was interested in public artworks and their culture and history. During my online survey about public art in Toronto, I discovered that most people were also interested in public art, but they tended not to understand the meanings and stories behind them. I hope that through my project, audiences might enjoy viewing these artworks and learning about them in a virtual and immersive environment.

In order to facilitate clear thinking and design frameworks, I used paper prototypes to model the processes of the project.

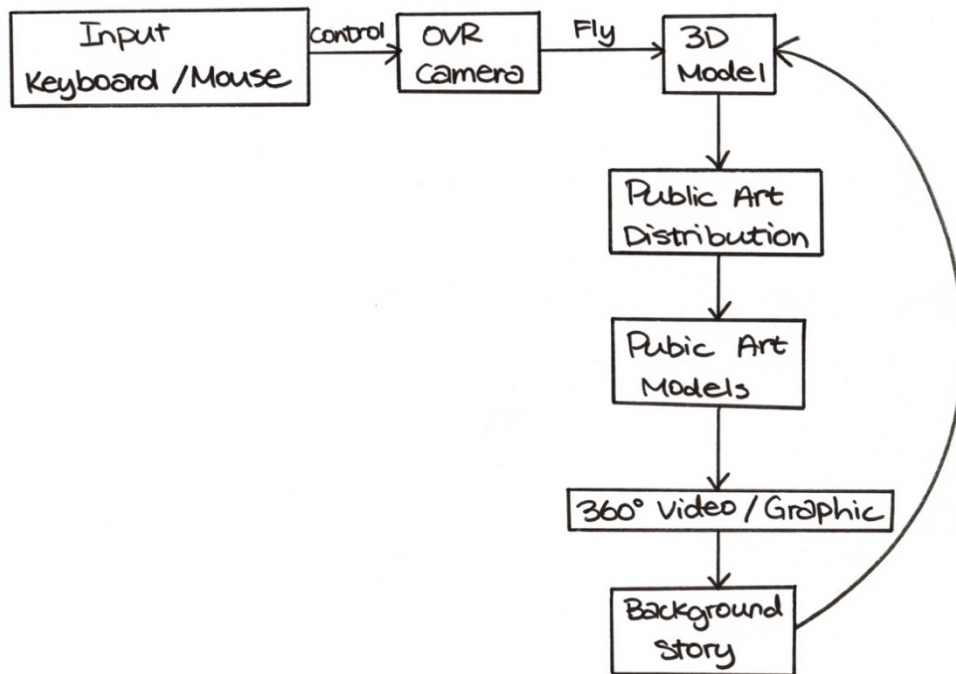


Figure 17 Paper prototype

5.2 TECHNOLOGY REVIEW

Technologies such as Oculus Rift 2, Xbox 360 Controller, and Unity3D (See Appendix C) were explored to understand how to best experience a simulated exhibition in a virtual immersive environment.

5.2.1 HARDWARE TESTING

The following hardware devices were used for this project, following their evaluation for suitability:

Oculus Rift2

My project design was developed on Windows 10 Operating System. To use Oculus Rift 2, I first installed *Oculus Runtime for Windows* and *Oculus SDK for Windows*. Then I tested the demo in Runtime in order to check if Oculus Rift 2 could be used correctly in this system.

Xbox 360 Controller

Windows 10 supports the Xbox 360 Controller's input very well, with no driver installation required. If the project were developed on any other version of Windows, however, a driver would be required to support the Xbox 360 Controller.

5.2.2 CAMERA CONTROL

Oculus with Unity3D

The new Unity3D 5.3 supports VR development very well. In order to control the camera with Oculus in Unity3D, I downloaded and imported "ENGINE INTEGRATION — Oculus Utilities for Unity 5" from Oculus's official website. Contained in this package is an OVR camera customized for Oculus in Unity3D. Putting the camera in the scene allowed us to rotate Oculus to control the view and simultaneously use keyboard to move the camera horizontal or vertical.

Xbox 360 Controller with Unity3D

Unity3D allowed me to map commands to different keys on the keyboard. For example, one might give the command to “switch to scene1” when the space bar is pressed; when one presses “space”, the scene switches to scene1. In order to map commands to the buttons on the Xbox 360 controller, I gave the order to the key name that corresponds to the key on Xbox 360 Controller. Figure 4 and 5 shows the comparison between the Xbox360 Controller keys and Unity3D input settings.



Figure 18 Xbox 360 Controller Picture Reference, from:
<http://wiki.unity3d.com/index.php?title=Xbox360Controller>

Microsoft Xbox 360 Controller

Buttons (Key or Mouse Button)	Axis (Joystick Axis)
joystick button 0 = A	X axis = Left analog X
joystick button 1 = B	Y axis = Left analog Y
joystick button 2 = X	3rd axis = LT/RT
joystick button 3 = Y	4th axis = Right analog X
joystick button 4 = L	5th axis = Right analog Y
joystick button 5 = R	6th axis = Dpad X
joystick button 6 = Back	7th axis = Dpad Y
joystick button 7 = Home	
joystick button 8 = Left analog press	
joystick button 9 = Right analog press	

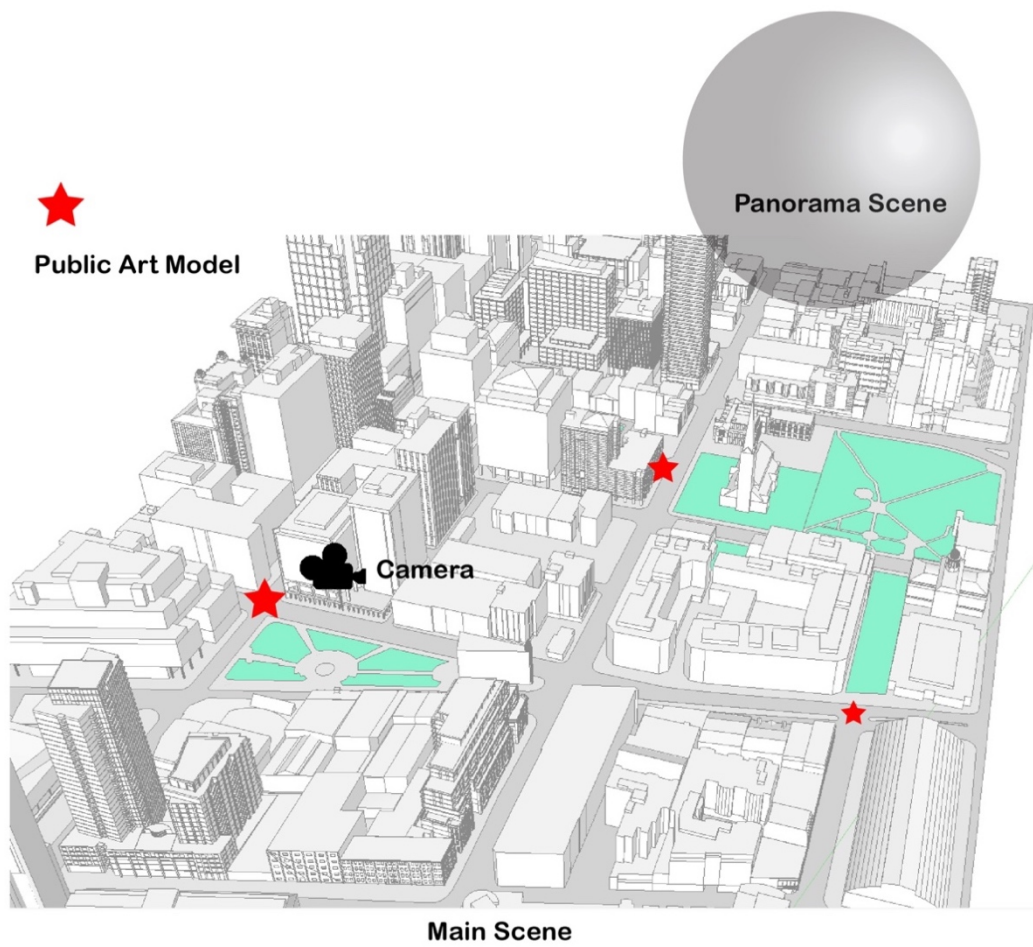
Table 2 Xbox 360 Controller input setting in Unity3D

Analysis

According to the description above, I decided to use Oculus to control the view perspective, and the X360 Controller to control the horizontal, vertical and Z-axis motion, as well as some functional orders for operations such as switching scenes and calling up and canceling the information interface.

5.3 CONCEPT SKETCH

Figure 6 is a simple concept sketch to describe the process of this project.



Xbox 360 Controller
Control Motion / Switch Scene



Oculus Rift 2
Control Rotation

Figure 19 Concept Sketch

5.4 PROTOTPYE 1

5.4.1 TECHNICAL DESIGN

According to this concept sketch, there are several problems to be solved and a few functions to consider:

1. Model stitching and import;
2. Moving through the virtual city;
3. Creating a panorama scene and switching into it; and
4. Calling up and canceling the information interface.

Model stitching and import

3D Massing is an Open Data project created by City Planning. There are two downloadable formats for this: SketchUp and AutoCAD. The AutoCAD format is smaller, but it can't be imported into Unity3D, so I chose the SketchUp format and modified it in SketchUp before importing it into Unity3D.

First, I needed to join all the separate models, as the models on the website were separated into different files; one file would have been far too large to download. Next, the models needed to be screened. Each model building is very large, and there are over five hundred building models in total; this meant that it is simply too difficult to use every full-sized model in Unity3D. These models needed to be modified in SketchUp; the work included deleting buildings, reducing the volume and deleting some less important environmental details, such as pools, lakes, and grass.

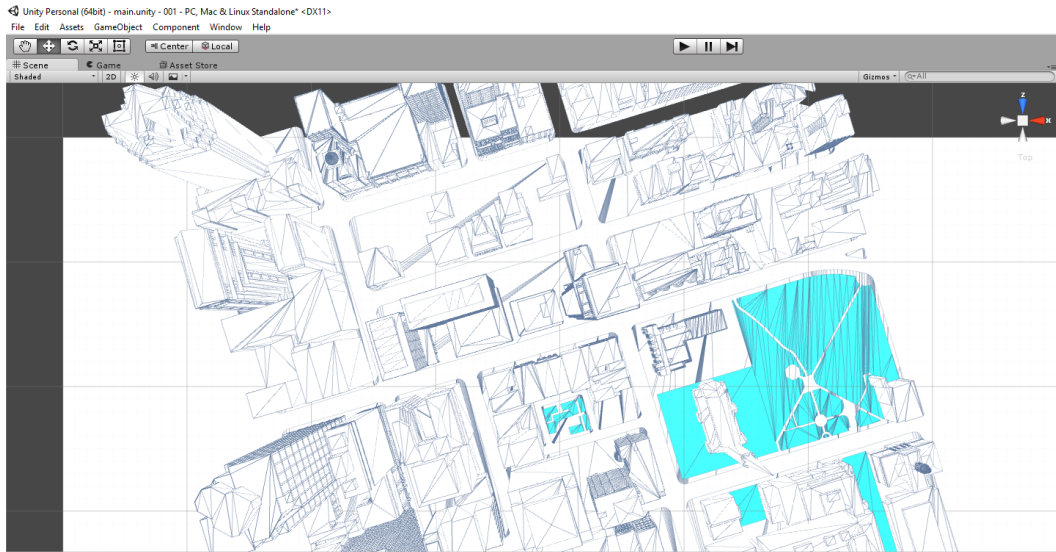


Figure 20 Urban Model in Unity3D

Test and Analysis

The downloaded model size from the Open Data Website is the same size as in the real world. After importing it into the software, the file size became really large, and the computer's operating efficiency slowed down. Therefore, in order to optimize the operating efficiency, I needed to shrink the size of the model without changing its overall effect. In this case, I chose to reduce its size by half. Due to the problem of shadow rendering, some parts of the model flash randomly; this problem will be fixed in later prototypes.

Moving through the virtual city

In the virtual city, there are two ways to move around and observe public art works: walking around and flying in the sky.

Walking

Users can use the X360 Controller to control movement direction (forwards, backwards, left and right) and speed, while the OVR controls the direction the player is facing. This is a highly intuitive and accessible control scheme.

Flying

In order to allow users to observe the distribution of public art in Toronto from a higher angle, I decided to add a flying mode in my project.

To create this mode, I added directional controls to move up and down and bound this operation mode to the Right analog stick of the Xbox 360 controller. Adding a flying mode meant adding programming to take into account the physics of gravity, movement speeds while flying, and cancellation of gravity in the OVR camera's settings (there is a check box in the OVR camera setting for gravity control).



Figure 21 Control Testing

Test and Analysis

From my initial control testing, the overall combination of walking and flying was smooth, but there were two obvious problems:

1. Input controls: Handle input controls were a bit inconvenient. First-time users found it difficult to use the right analog stick to control forward, backwards and turning movement. In future prototypes, I planned to reconsider the controls and conduct more user testing.
2. Speed: Running speed on the ground should be the appropriate speed for most users. But while flying, the user's movement becomes much slower; this feeling is more obvious at higher altitudes. In future prototypes, I planned to make the overall speed faster. However, if the speed is too fast, then when the user moves towards the ground, the perspective will change so quickly that it might cause dizziness. Therefore, it became necessary to find a balance so as not to let the speed become so slow that it breaks immersion, but to make it slow enough that users don't become uncomfortable and dizzy. To this end, more research and user testing was required. In addition, when flying at high altitudes, the light becomes brighter. I planned to adjust my design to take this into account in future prototypes.

Creating a panorama scene and switching into it

This function involves creating scenes to host panoramic photos of the public artworks; during testing, I considered the most fluid way to switch in and out of this panorama mode.

Spherical Scene

I captured panoramic photographs of the public artworks using the panoramic Camera RICOH THETA S. The next step was to create scenes to store these images.

The panoramic images are spherical; therefore, the scene that stores the image also needed to be spherical. After creating the panoramic scenes, I attached the panoramic images to the panoramic scenes and reversed the image to make a mirror image inside the scene. This way, the user can observe the whole spherical panorama image by controlling the camera. Since the scene is spherical, it needs light from different angles; I added light from six different directions so that the entire scene is lit evenly.

Switch Scenes

While traveling through the virtual city, users can explore public art within a model of the city. When they get closer to the model, the virtual 3D city scene switches to a real urban panoramic scene. I designed two control schemes for switching scenes.

Plan 1

When the user gets to a certain distance from a public artwork in the virtual city, a ray appears in the center of the screen of the Oculus. If the user points the light towards the model of the public artwork, the model will glow; then, if the user presses a button on the controller, the scene will switch to the panorama mode. When the user is done browsing, they press the same button to return to the virtual city.

Plan 2

Light apertures that work as transfer portals are located near each public art model. The user simply walks into the aperture to switch into the panorama mode, and presses a button to return to the virtual city when they are finished.

Analysis

Plan 1 is a more detailed process for users; this means that it is more difficult to mistakenly enter into the panorama mode, but may be difficult to control. Plan 2 is simpler, but it is not perfect.

When the user uses the transfer portal to switch to the panorama, the coordinates of the portal are recorded; when the user returns to the virtual 3D city, they will return to the same coordinates. This forms an infinite loop. Additionally, in this plan the user enters into the panorama mode through movement, but must press a button to exit. This violates the principle of consistency in user interface design. (Shneiderman, 2013)

After analyzing and comparing the two plans, I decided to combine the advantages of the two plans and remove their disadvantages: the result was Plan 3.

Plan3

The user enters the panorama mode by pressing a button on the Xbox 360 controller when they are at a certain distance from the public art in the virtual city. After exploring the contents of the panorama, the user presses the same button to return to the main scene. In addition, there are boundary limitations for users to move within the panorama mode, to prevent users from walking out of the spherical scene.

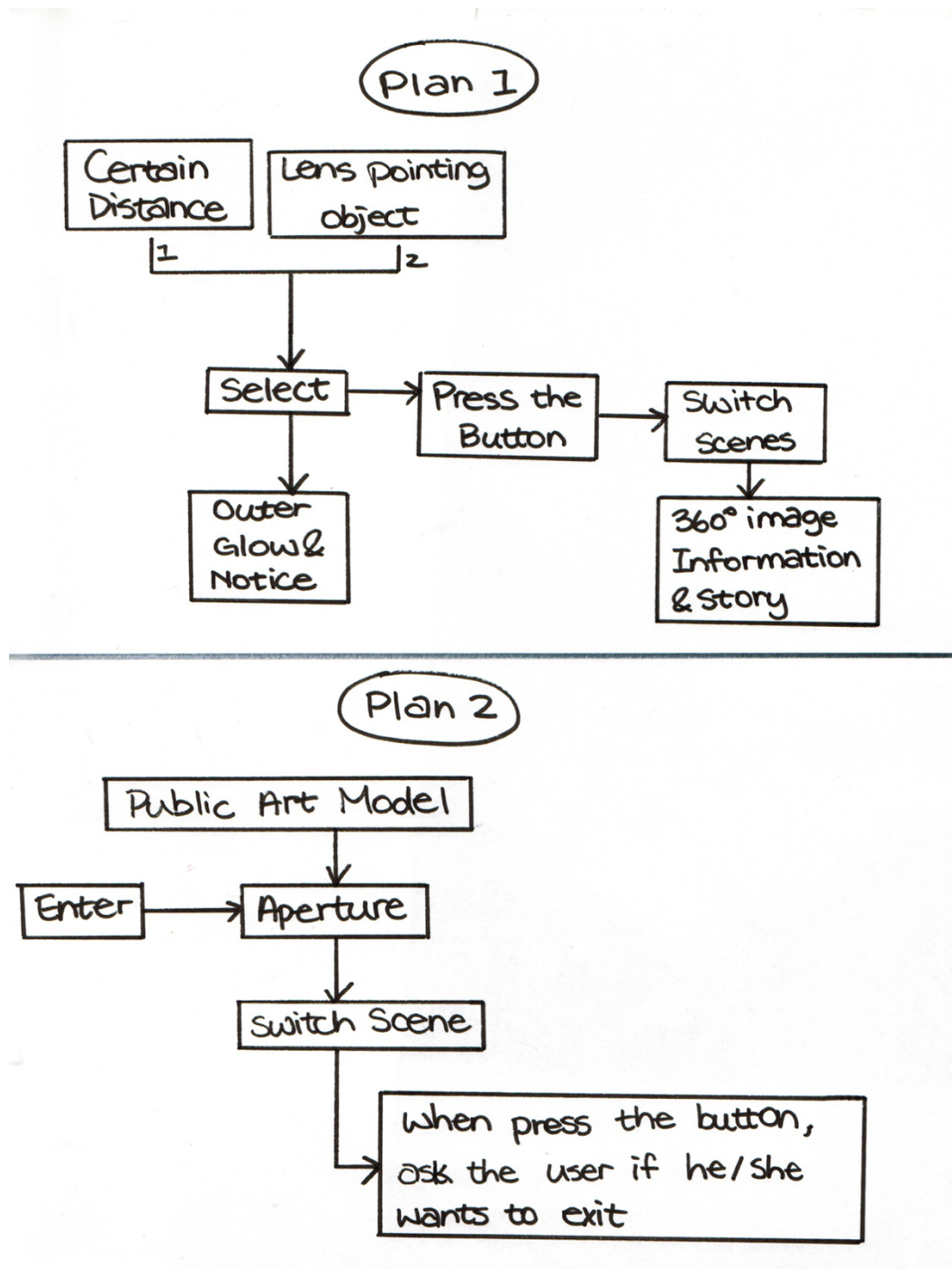


Figure 22 Switch Scenes Plans

Bring up and cancel the information menu

When users enter the Spherical Scene, they can turn their head or use the controller to rotate to view the panoramic images. However, my work does not intend for users to only view these public artworks and their surrounding environment. More importantly, I want users to view these art works and let my work do the storytelling at the same time, in order to impart information about these public artworks to my audiences. In order to accomplish this, I created a menu for users to access information. While viewing the artworks, the user can press a button on the controller; this will call up an information menu. In this menu, there will be detailed information about this piece of public art. Users can watch the panoramic images and read their background stories; this allows users to have a better understanding of these artworks and the historical and cultural purposes they embody. In the design process, I experimented with two methods of viewing information.

In the first method, the static information menu stays in the user's field of view while they explore the city. The advantage of this approach is that it doesn't leave the user's field of view.

In the second method, the information menu is bound to an OVR camera that moves as the user's perspective changes. When the user presses a button on the controller, an information menu comes up; pressing it again cancels the display. The disadvantage of this is that it can obstruct the user's sight; furthermore, more users are needed to control it. One advantage is that when users access this information, they can make it appear again in front of them rather than moving their perspective to look for it. Through user testing, I planned to get more feedback from other users in regards to the most effective way to present the information menu.

5.4.2 USER TESTING AND ANALYSIS 1

After the first prototype, I conducted user testing. I then analyzed users' reflections in order to assist in the development of next prototype.

REFLECTIONS

I collated the data from the user testing and summarized the reflections as follows:

Control:

1. The controls are too complex; too many buttons are required. As a result, it takes too much time to learn;
2. The control scheme is not the same as traditional game controls; users want to use a more familiar control scheme;
3. When users manipulate the analog stick to control turning around, they feel dizzy.

Scene:

1. There are shadows in the panorama scenes;
2. The camera's initial position needs to be adjusted.

Menu:

1. The virtual world is too large; it is time-consuming to go to a faraway public art work;
2. It is easy for players to lose themselves in the virtual city; a mini-map is required.

Interface:

1. Street names need to be added to the virtual world's streets;
2. Some faraway public art models are blocked by building models;
3. There is a glitch that involves flashing on building models.

Information :

1. An audio introduction to the spherical scenes would provide a more seamless way

for users to get information.

ANALYSIS

Based on these reflections from user testing, I concluded that there is a lot that can be adjusted to improve user experience. According to my research, I divided the functions of my project into two categories: one category is to facilitate enjoyment of public artworks; the other category is to offer users access to relevant background information about the artworks while viewing them. In the current prototype, there are several issues that impede the viewing and enjoyment of the public artworks: the control mode is complex; users become lost in the Virtual City; and sometimes there are long distances between artworks. There are also problems in accessing relevant information: there are issues with the most efficient way to display the information menu, whether to add audio information, and so on. In the next prototype, I planned to address these problems in the following ways:

1. Adding an audio introduction function in the spherical scene;
2. Adding a fast travel function and menu in the main scene;
3. Adding a mini map on the bottom left corner of the main scene;
4. Integrating control buttons: except for the “start” button, which is used to bring up the fast travel menu, the other functions will be integrated into the A and B buttons.
I will use "A" for interaction, "B" for returning or cancelling;
5. Adjusting the maximum speed of turning around in order to reduce dizziness;
6. Adding effects to emphasize the locations of the public art works and visualize their distribution in the virtual city, in order to make it more convenient for users to find distant targets;
7. Organizing all the assets and fixing some small details.

5.5 PROTOTYPE 2

The previous prototype was very basic; I focused on making all of the key technologies work properly. Based on the feedback from user testing, I planned to continue to adjust and improve the functions to allow users to access it in a more streamlined way, and to get a more seamless user experience. Also in this prototype, I planned to organize and fix the assets and add new ones based on recommendations from user testing; these assets include the City Model, Public Art Model, Panoramic images, Text information, Audio information of Public Arts and the mini map.

5.5.1 ADJUSTING AND IMPROVING FUNCTIONS

Audio introduction

Many users from the first round of user testing wanted easier access to information about the public artworks. These users found text information inconvenient, as reading text requires more attention than listening, and it affects users as they look at visual information. Audio explanations are far more convenient and improve the overall user experience. In exhibitions, many museums already use app-based audio tour guides to disseminate information. For example, AGO numbered each artwork when they held a major exhibition. A viewer could download the AGO app and find this exhibition, click on the corresponding number and listen to the voice explanation of the specific artwork while looking at it.

In my work, I collected public artwork's text information from different ways and made them to some audio files. I added these audio files to the corresponding Public Art in the spherical scenes. Pressing the "A" button in the Xbox 360 Controller plays and pauses the operation.

Fast travel menu

Because of the size of the virtual world, there are large distances between artworks. In the first prototype, users could “fly” to explore the city and find these public artworks. However, some users wanted a quicker way to get to the next artwork. I took inspiration from fast travel mechanics in mainstream video games and created a similar mechanic to allow users to teleport across space. In mainstream games, the menu can be brought up using the Start button. I decided to use this button to bring up a menu with a list of public artwork titles. The user presses the controller’s up and down arrow keys to select a public artwork and then presses the A button; the camera will quickly switch to the next selected public art.

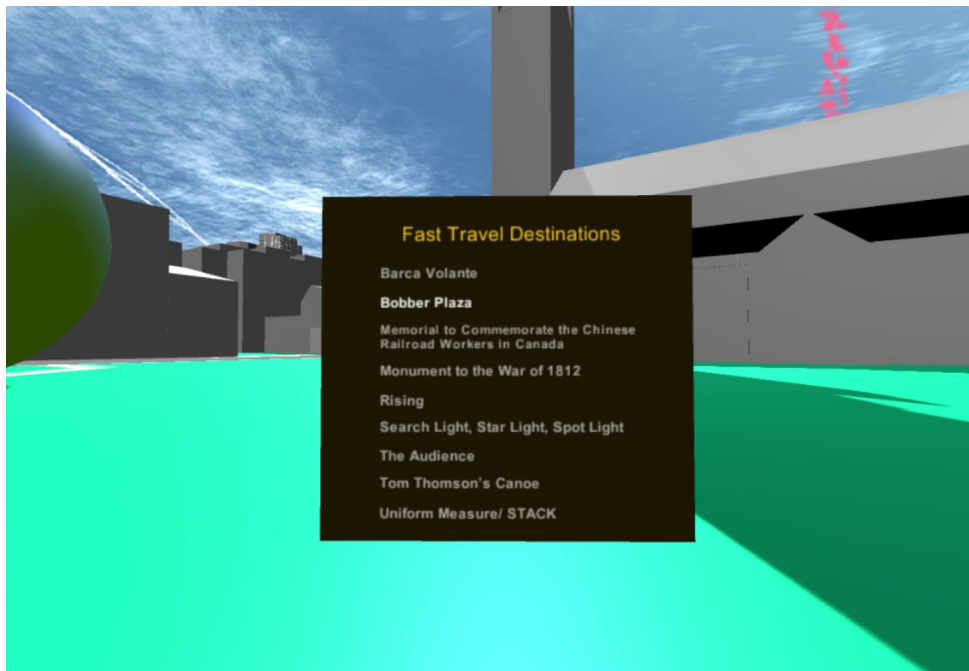


Figure 23 Fast Travel Menu

Analysis

Currently, the fast travel menu is bound to the viewing perspective. It remains in the central area of the sight and follows as the user's sight rotates. When the user wants to fast travel, they can click on the Start key to bring up the menu; clicking again cancels the menu. From my personal testing, the problem at the moment is that the menu blocks other objects in the scene. When the user's sight moves to an object, such as a building, this building model overlaps with the fast travel menu. In the later development process, I hope to fix this problem. The current solution is that when the menu is brought up, users must move their sight to an open area, such as a street or the sky, to avoid the overlapping of objects and menu.

5.5.2 INTERFACE DESIGN

Mini map

According to my user testers, when they explored my virtual world, sometimes they became lost. In order to evoke the memory of the real places, I accurately simulated the geography of Toronto; however, this made the map rather large. In future prototypes I planned to add a mini map feature. In the lower left corner, a real-time mini map shows the location of the street with street names. When users find a public art model, they may recall the memories of that public artwork in real life. In this way, the mini map will increase users' interest about public art.

Light effect

Due to the high concentration of buildings in downtown Toronto, in my project, public art models can easily be blocked by building models. This makes it difficult for users

to find the surrounding public art works while they explore the city model. Based on the feedback I got from user testing, I plan to add a light effect, such as a glowing pillar on top of every public art model. Using this light effect will prompt the users towards the distributed location of the public art works, making them easier to locate on foot.

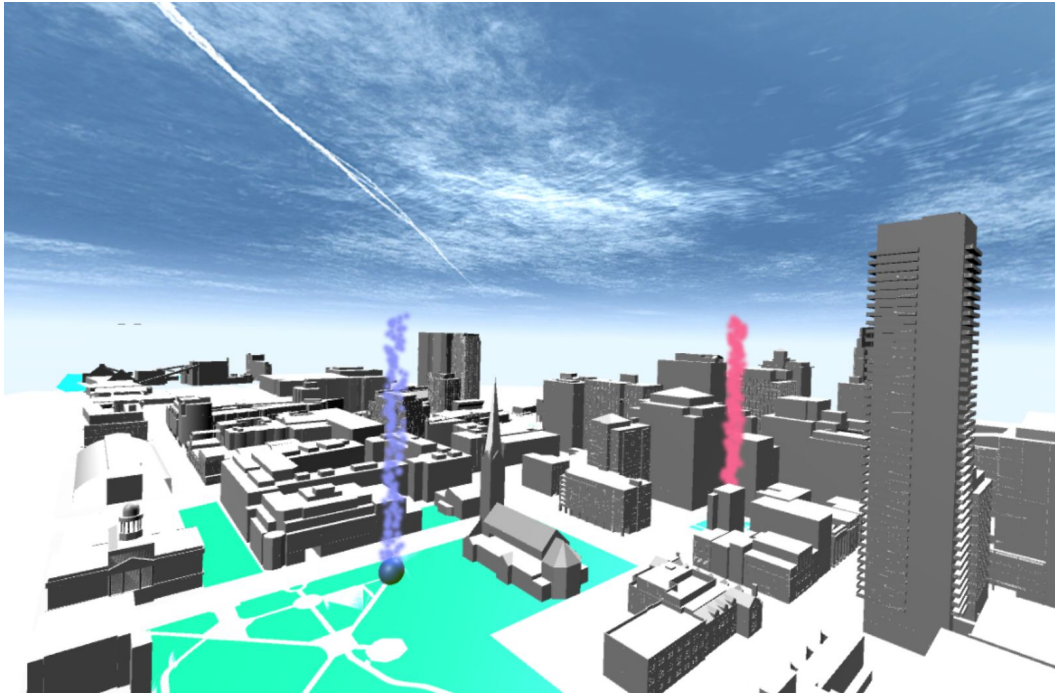


Figure 24 Light Effect

5.5.3 USER TESTING AND ANALYSIS 2

After the second prototype, I conducted user testing. I then analyzed users' reflections in order to analyze whether the new functions improved the user experience and whether the prototype answered the research question.

REFLECTIONS

I collated the data from the user testing and summarized the reflections as follows:

Control:

Almost all participants like the fast travel function, but there is a minor interface issue with this function: after using this function, the menu should close itself automatically so as to make the experience of fast travelling simpler and easier.

The windows should have a controller intro to tell user the functions of buttons.

Interface:

The public art models should feature titles.

Information intro:

Users prefer the audio introduction. The text introduction menu is useful, but sometimes, users may lose focus due to the large amount of text.

ANALYSIS:

Based on these general reflections from user testing and the answers from questionnaires given after user testing, eighty percent of participants think that this project provides them with a convenient way to see public art around the city. One participant wrote in the questionnaire that it is a “really nice way to explore art around the city much faster than walking to all of these places”. Ninety percent of participants think that it is a good way to learn information about the public artworks featured in this project. Participants also noted interface and technical issues, however. Some participants felt that the virtual world was too large, making walking arduous and time-consuming. Some other participants questioned the choice of VR, which they felt was undeveloped in this work. This project is intended as an exploration to establish a virtual urban gallery; even VR has some limitations, but it provides people with different viewing experiences of public art works; responses to the first two prototypes have been positive. I hope to continue to

develop this project in the future.

FUTURE PROTOTYPE

Due to time constraints, a third prototype has not yet been recorded. Through continuous testing and modifying to solve my research question, in my next prototype, I intend to optimize the visual details. For example, some of the public art models are still in geometric shapes. I hope to design similar 3D models closer to the original artwork in the future, which will allow users to have a more intuitive understanding of these public arts.

CHAPTER 6

CONCLUSION

This chapter summarizes the insights and outcomes discovered through this research. The research question was addressed through a series of research methods. This work was carried out through online surveys, field research, followed by the formation of prototypes and reflections received from user testing. In this section, I discuss possible directions for future research.

6.1 SUMMARY

Public artworks are scattered in every corner of the city; as such, it is not possible to build a physical gallery for public art works. The only way to display them together is virtually. Public art has an intimate relationship with the environment surrounding it: artworks reflect local culture and urban history. This thesis investigates whether a virtual urban gallery can be used for audiences to view public artwork more conveniently while allowing them to gain a deep understanding of the work through supporting information. This question was analyzed by breaking it down to smaller components: how to create a virtual urban gallery for public art works in a VR platform that allows audiences to have a more realistic visiting experience; how to combine public art works and their environment together for audiences to enjoy them and get a better understanding of their meaning; how to filter and collect information pertaining to these public artworks; how to tell the stories of these public art works in a simulative environment; lastly, the most appropriate way for audiences to manipulate and explore the 3D virtual world. To tackle these research questions and analyze the outcomes for this project, I applied a field-based approach and created three phases of prototypes. By testing these prototypes with participants and

analyzing user feedback, I tried to create a more user-friendly and efficient interface through which I might address the research questions.

In this thesis, I determined that virtual art galleries are increasingly relevant in the worlds of curation and art exhibition. I also concluded that contemporary technologies such as VR, panoramic photography and 3D gameplay controls can be used to create a virtual museum of public art and allow audiences a convenient way to appreciate and understand public art works.

I prototyped a virtual gallery of Toronto to determine whether the physical visiting experience of public art can be simulated in a virtual world. I situated the artworks in a virtual environment in order to evoke the experience of moving through a city and remind users of the physical spaces where the public artworks are located. I also wanted to help users to better understand the history and culture behind these artworks by locating them in the neighborhoods they represent. In addition, I highlighted the models with light effects in order to allow audiences to view the regional distribution of public art in the city from a bird's eye perspective. The fast travel function allows audiences to teleport quickly and easily to the locations of works they are interested in. The audio introductions afford the audiences the ability to view the artworks while learning about them and hearing their stories. Acting on the recommendations from user testing has made this project more direct, clear and simple.

6.2 REFLECTIONS

This thesis shows that virtual urban galleries can give audiences a different viewing experience for public art works.

My research question asks: can a virtual urban gallery allow audiences to view public artworks more conveniently, while allowing them to achieve a deep understanding of the work through supporting information, combining map-based data and 3D remote experiences of VR technology? Based on the research in this thesis, I conclude that this question has mostly been addressed. The online survey clarifies that most people are interested in public art, but they are not familiar with the historical contexts pertaining to these public artworks. The result of the recent user testing shows that eighty percent of participants found my project a convenient way to view and learn about public art in Toronto. The perspectives afforded by VR technology can bring the audiences a more realistic, immersive experience in which the artworks are situated in their surrounding environments. By combining panoramic images, supporting information and audio introductions, this project provides the audience an immersive narrative experience of the world they engage in. However, a few participants felt that the control scheme of this project was too complicated and difficult to use; for some new users, it can have a steep learning curve. These issues with gameplay impede the goal of providing a convenient way for audiences to view public artworks. However, this research addresses the question of distribution, information collection and public art presentation. Therefore, based on the answer of most participants, I think this project was successful, though further development is necessary to fine-tune the controls and improve user experience.

From this research, I learned that public art enriches the environment of our daily life. Public artworks have historical significance or interesting stories that many people are interested in. The development of digital media provides new potential for the functions and forms of art museums. The application of VR technology in virtual art museums can bring not only visual stimulation to the audience but also an immersive viewing experience.

In this thesis, most of the participants in the user testing are my classmates, therefore, the results are limited by the user category. If there is an opportunity in the future, I will conduct larger-scale user testing.

6.3 FUTURE DIRECTIONS

At present, the city model in the virtual gallery is too large, and contains too many meaningless building models. In the future, I will cut out these useless models, and keep those related to public art. Otherwise, I will improve the precision of these models and enrich their materials.

As a virtual work about public art, I will consider how to curate these artworks in it as the main body. Based on the research question, I will focus on creating a virtual gallery that allows users to appreciate and enjoy the narrative about public art conveniently, in order to bring audiences a more interesting and vivid viewing experience. Inspired by *RMB City*, I curated public artworks and depicted them in the context of their related environments in a virtual space; I considered this curation itself as an artistic form. These environments can be the ones that surround the public artworks in the physical world, or imagined environments. The goal is to create a virtual space that allows for engagement with the environments in which the public artworks are situated, and in the future, I plan to use the affordances of virtual spaces to create new and more interesting modes of engagement. For example, I might set up Tom Thomson's canoe in the lake of Algonquin Park beside a small island, select a part of the Gardner Highway and split it with the Gardner Stream, or place the Chinese railway workers' sculpture on the Rocky Mountains. Using *Placeholder* as a reference, I might implement a system in which users can embody different avatars to view and interact with public artworks and their environments in

different ways; for example, users might choose to play as an eagle, fish, car or human, with each embodiment providing a different mode of engagement with the virtual city. I also plan to add sound effects for these different embodiments, thereby enriching the soundscape of the simulation and allowing users to imagine themselves and imagine narratives in this virtual gallery while interacting with public artworks.

More specifically, I plan to integrate the fast travel and mini map functions so that users can use the mini map to select and teleport to public artworks. I will add a portal that can connect the “real” world and the virtual gallery around each of these public arts. Users can choose different embodiments to look for these portals and switch into another scene that contains a panoramic image to view what it looks like in the real world. I also plan to change the audio introduction tracks. Presently, the audio track is generated by a text reader software; in the future, I plan to replace it with a real voice. Additionally, due to the timing of this thesis project, the scenes of this work are limited to the winter; in the future, I plan to include photographs of the public artworks from other seasons. In the essay *The Future of the Novel* (2002), William Burroughs writes: “A Russian scientist has said ‘We will travel not only in space but in time as well—’ That is to travel in space is to travel in time.” We can’t experience public artworks in every season in the same viewing in the physical world, but this is possible in the virtual world. I also plan to add different weather effects to the virtual gallery, and have the panoramic scenes reflect these effects.

At present, the project only allows one person to experience it at a time; in future versions, I hope to add a multiplayer function so that more users can participate simultaneously. Users will be able to interact not only with the environments, but also with each other. Based on the different embodiments in the virtual world, this will create interesting experiences of encounter between users. Finally, I plan to add more meaningful

connections to other online resources, such as video, interviews and upcoming events, rather than simply providing a fixed text or voice, so that users can easily find relevant and current information in this virtual gallery. I look forward to further exploring the potentialities of virtual reality for public art.

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APPENDIX A COLLECTION LIST OF TORONTO PUBLIC ARTWORKS

Title: Rising

Artist: Zhang Huan

Time: 2012

Location: Shangri La, 180 University Ave



Zhang Huan conceived *Rising* as a philosophical reflection of the world around us. The polished stainless-steel sculpture is comprised of countless doves, the international symbol of world peace, and a twisted tree branch that resembles the body of a dragon. The sculpture draws an analogy to the fragile conditions facing our planet. Zhang Huan seeks to convey the message that humans can exist in harmony with nature, and that, if this delicate balance is struck, our cities will become better places to live. Zhang Huan says that "through the monster-shaped tree, I would like to advocate the protection of ecology, and the harmonious relationship between humans and nature. The doves in the tree symbolize the peace of the world and my wish is for beautiful city life to be shared by mankind and nature." Matthew Teitelbaum, the Director and CEO of the Art Gallery of Ontario said that "Publicly accessible art is good for everyone, and this exceptional installation is a significant contribution to the urban landscape and the cultural fabric of Toronto." (Zhang)

Title: Tom Thomson's Canoe

Artist: Douglas Coupland

Time: 2008

Location: Canoe Landing Park, 95 Fort York Blvd



No Torontonians would have seriously considered the Gardiner Expressway sightworthy. But that changed when Vancouver-based artist Douglas Coupland strategically placed an oversized red canoe overlooking the busy highway by the edge of the bluff at Canoe Landing Park. The canoe is large enough for people to stand in, and the perspective offers an unusual vista of cars streaming past the city, with the CN Tower closeby and Lake Ontario a bit farther away. The canoe pays homage to Tom Thomson, Canada's foremost landscape artist who died in mysterious circumstances in his beloved Algonquin Park. His empty canoe was found floating in a lake. The red canoe is never without visitors who fancy themselves urban explorers and take selfies to prove that they have been in Thomson's canoe. The interactive art invites attention and wants to be touched; it stretches the imagination and allows one to stop, linger for a bit, and discover that it is possible to get away from it all, even in the big city. "Thomson's canoe" is smack in the centre of what used to be railway yards, now an eight-acre park fenced in by condos. It's a stark contrast to the bucolic landscape of Algonquin Park where Thomson canoed and painted in solitude to capture the quiet beauty of nature with dramatic effect. (Paze, 2016)

Title: Float Forms

Artist: Douglas Coupland

Time: 2008

Location: Canoe Landing Park, 95 Fort York Blvd



Float Forms, erected in 2008, is just one of Canadian author Douglas Coupland's variegated public-art pieces that dots Canoe Landing Park by Concord Adex's CityPlace development. The eclectic piece, made of steel and resin, is comprised of multiple colorful bobber — fishing gear used to maintain the hook at the target depth — sculptures of varying sizes and patterns. (Bombales & Sherman, 2015)

These Float Forms liven up the urban park with a bright pop of color, and expertly integrate public art with the city's imposing downtown skyline. Just one of several large-scale art pieces in the park, these oversized fishing bobbers denote a lakefront theme. (Chestnut Park Real Estate, 2013)

Title: Flower Power

Artist: Mark di Suvero

Time: 2008

Location: 175 Dan Leckie Way



The large scale steel sculpture Flower Power, created by internationally known artist Mark di Suvero in 1967. He was part of a group of artists invited to participate in the Toronto International Sculpture Symposium - an event held to celebrate Canada's centennial. He created two sculptures in High Park: No Shoes, situated by the woods at the bottom of a hill; and the towering Flower Power, which rested at the top of the same hill. Their titles reflected the ideals of the time: "It was a moment when in 1967, I was then, as I am now, very dedicated to an idea that the world can exist in peace," said the artist. The art works didn't fare well over time - they were allowed to rust and were eventually cut apart. No Shoes lost its free-swinging logs: the top section of Flower Power was cut down due to safety concerns. Both of their original colors, bright orange and bright red, faded. It was removed by City of Toronto Cultural Services and sent to the United States to be restored by the artist. In 2008, the Flower Power restoration is complete and the piece has been installed in a new location, in Concord's CityPlace community. Flower Power has bloomed again. Now, the Flower Power sculptural work is estimated to be worth more than \$2 million. (City of Toronto, 2010)

Title: Uniform Measure/ STACK

Artist: Stephen Cruise

Time: 1997

Location: Richmond St. & Spadina Ave



The distinctive art piece was created in 1997 by artist Stephen Cruise. “Consisting of a giant bronze thimble, sitting atop six oversized, multi-coloured buttons, and two buttons made out of concrete that now act as planters for growing trees, Cruise’s work is a reminder of the neighbourhood’s history as a centre for garment and cloth-making, which dates back to the early part of the 20th century.” (The CDR, 2016)

Local artist Victor Fraser added colour and numbering to the tape measure element of the installation in 2006. Fraser’s addition remained intact for 8 years until removal by the City in November 2014. Reports at the time indicated that Cruise had complained to the City and forced the removal. Undeterred, Fraser repainted the area in May 2015, with the alphabet in place of the numbers. The City removed the piece the following November, again reportedly at the request of Cruise. (Egan, 2016)

Title: The Audience

Artist: Michael Snow

Time: 1989

Location: Rogers Centre



The Audience is a set of two original sculptural art installations placed on the northeast and northwest corners of the venue designed to extend the fan experience to both inside and outside the venue. Michael Snow became interested in the idea of involving spectators, in a certain sense, into the art installation for Rogers Centre. He came up with the idea of The Audience that would judge the oncoming guests as the guests would ultimately be judging the players on the field. "The Audience uses a repertoire of many fan signs as they appraise the guests just as they will appraise the players themselves," shared Snow. Each member of The Audience is involved in a directed action toward the oncoming spectator. Depending on how one approaches the building, you may be caught in a fan's photograph, be waved at by a young child or even be sneered at if you are a fan of the opposing team. As a result of the animated nature of the characters that make up The Audience, Snow hopes that guests take the time to walk around and inspect the art pieces. As a three-dimensional creation, The Audience cannot be treated like a picture. Stand beside it. Stand underneath it. Stand in front of it. Stand far away from it. Depending on where you are standing the overall experience will be different. (Rogers Centre, 2009)

Title: Memorial to Commemorate the Chinese Railroad Workers in Canada

Artist: Eldon Garnet and Francis LeBouthillier

Time: 1989

Location: Blue Jays Way and Navy Warf Ct.



This is a very large monument in downtown Toronto which is dedicated to the thousands of Chinese workers who died while working on the building of the railroad that went through the Rocky Mountains in Canada. The monument is a railroad trestle made out of dark brown wood beams with the rails being installed along the top. There are two workers on the trestle who depict the danger of working on such a structure. Memorial to Commemorate the Chinese Railway Workers in Canada is an unusual monument in that it was created not for the regular purpose of acknowledging some heroic or popular individual but to honour a group of labourers. These are the Chinese workers who toiled hard to build the Canadian Pacific Railroad through the Rocky Mountains of western Canada during the 19th century. Between 1880 and 1885 over 4,000 of these workers were killed in the process of construction. The massive trestle is an impressive presence, appropriately located near Toronto's main rail line. Two muscular figures in typical work clothes and perched precariously, are depicted as if they are maneuvering a huge beam into place, effectively demonstrating the dangerous and challenging nature of the risky and raw physical labour they were expected to perform. The stately looking boulders standing like sentinels near the base were directly extracted from the Rocky Mountains, near Crowsnest Pass, one of the most geographically inaccessible areas that had to be built upon for the railroad to link and unite eastern and western Canada." (The Blue Quasar, 2011)

Title: Barca Volante

Artist: Francisco Gazitua

Time: 2005

Location: Parade Condons, Spadina Ave & Front St. W



Barca Volante is a 20 m-high black steel sculpture, made by a Chilean sculptor Francisco Gazitua installed in 2005 above a reflecting pool. Barca Volante, a lofty, seemingly airborne skeleton of a schooner in the act of tilting over, actually represents a capsized boat settling to the bottom of Lake Ontario. The ambiguity of either rising up or going down is inherent in this sculpture. Drawing on an early nineteenth century historical maritime event, Gazitua took his inspiration from the capsizing of two U.S. warships, the Hamilton and the Scourge, in Lake Ontario in 1813 during the War of 1812-14. Two thick dark steel beams hold high the toppling hull of a boat, tall mast and spars tilt way over, long oars point skywards, and it appears as if everything is crazily flying apart. Two slender bounding arcs of thin black steel, with the help of cables, hold the pieces in place and give a seeming rotary motion to the sculpture. This could be an abstract di Suvero, except this sculpture has a story to tell and seems to fly free in its imaginary watery element. The inscription on a plaque reads:

Suspended in flight, this “flying canoe” draws its origins from the story of two ships overturned by the wind in Lake Ontario in 1813. It draws on traditional canoe construction and subtly refers to the role of the canoe in shaping Canada (Warkentin, King & Volovics, 2010, p.84).

Title: Search Light, Star Light, Spotlight

Artist: John McEwen

Time: 1998

Location: Air Canada Centre



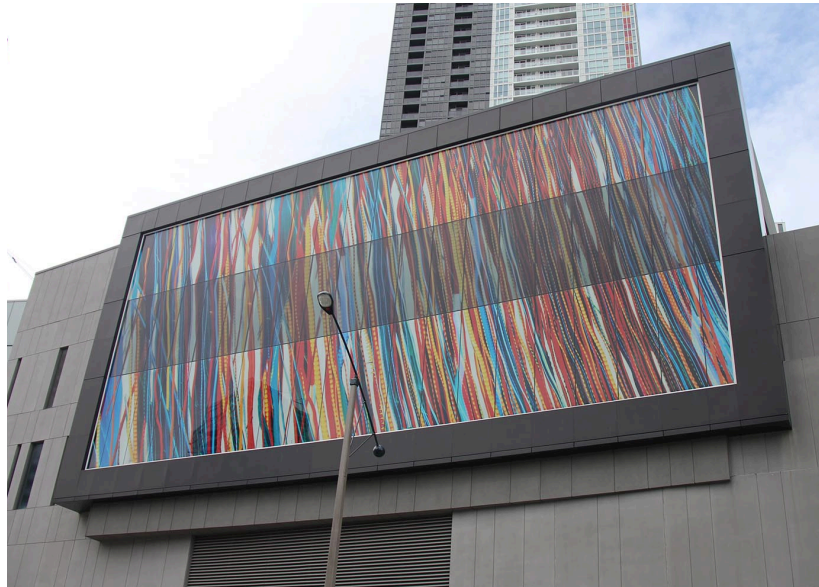
The three-column steel sculpture Search Light, Star Light, Spot Light, is inspired by a quote from author Louis Untermeyer, (1885-1977): “God, if you wish for our love, Fling us a handful of stars.” The surface of each column has been extensively perforated with holes in the shape of five-pointed stars that glow when lit from within like celestial search beacons in the night. The effect is most immediately associated with the search beams that call attention to entertainment spectacles such as those that take place in the adjacent Air Canada Centre. Further, the telescopic shape of the columns and the starry lights suggest a connection between the earth and sky; between the infinite cosmos and the depth of the human imagination. (Outspoken1, 2010)

Title: Gardiner Streams

Artist: Katharine Harvey

Time: 2013

Location: 75 Queen's Wharf Rd



This colourful billboard window seen from the Gardiner Expressway was commissioned by Concord Adex for the façade of Quartz Condominium Towers at 75 Queens Wharf Road and Dan Leckie Way in downtown Toronto. The artist photographed blurred car headlights on the highway and collaged these images together to create dramatic red, yellow, and blue vertical bands. The design was enlarged to 35 by 74 feet onto transparent Dupont window film and embedded in between layers of glass. (Harvey, 2013)

At nighttime even more movement will be imparted to the piece: the middle tier of the work is see-through. The entire piece is made up of 60 sealed panels, all sandwiching the work on a Dupont film—guaranteed not to fade—between two layers of glass. The top and bottom tiers have opaque white backs, but the middle tier are windows, opening up the view from the Prisma Club's pool to the city beyond. At night, dappled light from under the pool's surface will dance on the windows. Those using the facility and walking by on the pool deck will show as silhouettes passing behind Gardiner Streams. (White, 2014)

APPENDIX B LIST OF SOFTWARE AND HARDWARE USED

Oculus Rift	https://www.oculus.com/en-us/
Xbox 360 Controller	https://support.xbox.com/en-CA/browse/xbox-360/accessories
Window 10	https://www.microsoft.com/en-ca/windows/features
Unity 3D 5.3	https://unity3d.com/
SketchUp	http://www.sketchup.com/
Oculus Runtime for Windows	https://developer.oculus.com/downloads/pc/0.8.0.0-beta/Oculus_Runtime_for_Windows/
Oculus SDK for Windows	https://developer.oculus.com/downloads/pc/0.8.0.0-beta/Oculus_SDK_for_Windows/
Oculus Utilities for Unity 5	https://developer.oculus.com/downloads/game-engines/0.1.3.0-beta/Oculus_Uilities_for_Unity_5/
ReadSpeaker TextAid	http://www.readspeaker.com/

Table 3 List of Software and Hardware used

APPENDIX C ONLINE SURVEY ABOUT PUBLIC ART IN TORONTO

A survey about Public Art in Toronto

1. Have you heard about Public Art?

Yes

No

2. How much do you know about Public Art?

Knows a lot about it

A little bit

No, not at all

3. Are you interested in knowing more about Public Art?

Yes, of course!

So so

Nah, not very interested.

4. Have you ever paid attention to the Public Art works in Toronto?

Yes, all the time

So so

No, never

5. Have you ever wanted to understand the expression of these Public Art?

Yes, also done some research

Yes, but have not done research

No, not really

6. Do you have any favorite Public Art works in Toronto ?

Yes

Yes, but can't remember exactly which one

No, have not seen one I like yet

7. Are you familiar with the history or the background story of some Public Art works in Toronto ?

Yes, I know a lot about them!

Knows a little bit

Not really

8. If there's a convenient way to enjoy and understand these Public Art works, are you willing to try and experience it?

Yes

Maybe

No

9. Have you experienced some artwork in a virtual environment (website or other form)?

Yes

No

APPENDIX D QUESTIONNAIRE FOR THE UESR TESTING

User Testing Questionnaire

Questions:

1. Have you experienced virtual gallery on a VR platform or some other immersive form before?
Yes ☐ No ☐
2. Do you think this form of virtual gallery makes you easier to appreciate public artwork?
Yes ☐ No ☐
3. Do you think this form of virtual gallery makes you easier to understand public artwork's meaning and background?
Yes ☐ No ☐
4. What is your impression of this virtual gallery?
5. What kind of feelings do you get from the project?
6. What limitations does this project have?
7. What elements do you think could be improved?
8. Do you have any additional feedback?

Please attach your E-mail below, I will send you an invitation for the final Exhibition of this project.

E-mail: _____