Restoring Fort Frontenac in 3D: Effective Usage of 3D Technology for Heritage Visualization

Mitsuyoshi Yabe

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Restoring Fort Frontenac in 3D:
Effective Usage of 3D Technology for Heritage Visualization

by Mitsuyoshi Yabe

December 17, 2014

Rochester Institute of Technology
A Thesis submitted to the Faculty in the School of Design
of the College of Imaging Arts and Sciences
in candidacy for the Visual Communication Design
degree of Master of Fine Arts
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Restoring Fort Frontenac in 3D:
Effective Usage of 3D Technology for Heritage Visualization

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Abstract
My thesis is composed of three elements: 3D modeling, web design, and heritage visualization. My goal is to use computer graphics design to inform and create an interest in historical visualization by rebuilding Fort Frontenac using 3D modeling and interactive design. The final model will be integrated into an interactive website to learn more about the fort’s historic importance. It is apparent that using computer graphics can save time and money when it comes to historical visualization. Visitors do not have to travel to the actual archaeological buildings. They can simply use the Web in their own home to learn about this information virtually. Meticulously following historical records to create a sophisticated restoration of archaeological buildings will draw viewers into visualizations such as the historical world of Fort Frontenac. As a result, it allows them to effectively understand the fort’s social system, habits, and historical events.

Keywords: heritage visualization, 3D computer graphics, interactive virtual design

Thesis URL: http://mxy3663.wix.com/fortfrontenac

Figure 1. The aerial imagery of surroundings around the remnants of Fort Frontenac (provided by the City of Kingston).
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Introduction

Fort Frontenac was an important military fortress and fur trading post that was built in Kingston, Ontario, Canada in 1673 (Figs. 1 and 2). In 1758, during the Battle of Fort Frontenac, the fortress was abandoned and has deteriorated since then (“Canada’s Historic Places”). I want to reconstruct all the buildings to look like they did originally. It is applied to the field called Heritage Visualization derived from a combination of conventional archaeology and cutting-edge 3D computer graphics design. The field has been used to recreate digital models of antiquity, such as ancient Egypt and Rome, at several research institutes around the world. It would be a great opportunity to rebuild Fort Frontenac because many forts have been renovated to show historical reenactment sites.

Actual restorations of archaeological building remains require a great deal of time and money due to great involvement of architects, engineers, and lawyers for property development and land ownership. Can the use of computer graphics design inform and create an interest in historical visualization by rebuilding Fort Frontenac using 3D modeling and interaction design? Even though the remains of Fort Frontenac get restored, the fort’s location has limited transportation access for visitors. Additionally, existing templates illustrate the fortress’s outer appearance but its interior is not shown. 3D technology will help people get a better understanding of how Fort Frontenac was built. Through the use of interaction design, the user can be informed about the fort’s historic importance in a dynamic way while they are at home. In addition, they can view the fort’s interior in different perspectives and examine details.

But, this is a difficult task because there is limited information and a small amount of archaeological remains from Fort Frontenac. While the original maps and plans of Fort Frontenac are incomplete, a fertile imagination and computer graphics design skills are essential if we are to help correct false assumptions regarding historical viewpoints. For example, what was color of the building? Color may be involved with an overly subjective viewpoint. What were its social system, habits, and historical events at that time? Meticulously following the limited historical records, the sophisticated restoration of archaeological buildings draws viewers to the historical world of Fort Frontenac. This pushes them into effective understandings of its social system, habits, and historical events that occurred at that time.

I have a strong background of art and design and have an enthusiastic interest in geography and history. I have been trained in different design methods that range from traditional page layout and illustration to new 3D computer graphics. I devote myself to doing research on the field of Ethnology on weekends. For my thesis, I have chosen the virtual restoration of Fort Frontenac, one of the known designated French forts, because of the
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resources available to do historical and archaeological research and to easily envision the restoration using 3D modeling.

My target audiences are those interested in history and archaeology. For those who are not able to visit Fort Frontenac because it is too far away from their residence, this thesis is designed to expand their knowledge while saving money and time. Multimedia in 3D computer graphics design for Historical Visualization is essential for the future of society. Today, people often prefer searching the Internet because it provides clickable hyperlinks. Future audience interaction is the main focus of the evident convenience of graphical user interface in computing.

My goal is to virtually restore an archaeological building, Fort Frontenac, which in turn will draw viewers into the historical world of Fort Frontenac. It will also allow them to effectively understand the fort’s social system and historical events. Digital Visualization is a vital field by means of Internet access to view not only the fort, but also many other forts and traditional and architectural features, such as castles, all over the world. The method is important to distribute my thesis for educational purpose and economy.

To contribute to the thesis, I will make good use of my wide range of skills in traditional art methods and 3D computer graphics design. I will transform historical features that are done in traditional 2D illustrations, into 3D models. Additionally, the idea of the fusion of traditional and digital art methods would be recognized as an innovative artistic expression for archaeological illustration. Hence, I want to study 3D graphic design in order to contribute to archaeological illustration which will need resources in the future because of a lack of archaeological illustrators who are skilled in 3D graphics technology. Therefore, in order to hone the advanced 3D techniques, I believe that this thesis will push me to improve my theoretical skills in preparation for my future job that will help me to develop wisdom and creativity.
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Figure 2: The remnants of Fort Frontenac (taken in late September of 2014)

Figure 3: The current map showing the former location of Front Frontenac (cited from carf.info)
Figure 4: The plan of Fort Frontenac in 1685 (cited from lessignets.com)
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**Review of Literature**

**Online Documentation**

**Fort Frontenac**
Cataractaari Archaeological Research foundation
September 2013
[http://www.carf.info/kingston-past/fort-frontenac](http://www.carf.info/kingston-past/fort-frontenac)

This webpage is sponsored by an archaeological research foundation and provides a detailed history of Fort Frontenac. The Foundation stresses effective research on archaeological and historical details of buildings and events in the past. It is beneficial to not only archaeological experts, but also prospective students who wish to become archaeologists. This research supports accuracy of building restoration in 3D computer graphics.

**Hypostyle Hall of King Raneferef Ancient Egypt**
Corinth
September 2013
[http://www.ecorinth.com/projekty/#4](http://www.ecorinth.com/projekty/#4)

For archaeological practice, this video shows the interactive reconstruction of Raneferef's Hypostyle Hall from Ancient Egypt in 3D computing. It illustrates the virtual reconstruction of the inside hall in 3D graphic design. It obviously exemplifies my thesis plan to use a 3D video and an interactive webpage.

**Iron Age House 3D Reconstruction – Virtual Archaeology**
Corinth
September 2013
[http://www.youtube.com/watch?v=GRyv34HVRuw](http://www.youtube.com/watch?v=GRyv34HVRuw)

This video advises researchers on how to work on a virtual Archaeology reconstruction project about Early Iron age house. It describes the development of graphical user interface through the iPad based on the architectural context of real reconstruction of the ancient villages. It is a helpful resource on my thesis plan for the restoration.

**Kingston, Ontario – the Founding of Fort Frontenac**
YodelOut
September 2013

This is an educational online page for learners of Canadian history. It discusses the background of Fort Frontenac, its surrounding area, and Canada according to cultural methods and social events that occurred at that time. It is a convenient way to integrate the content into 3D technology so as to restore the background.

**Rome Reborn**
Bernard Frischer
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Institute of Advanced Technology in the humanities
September 2013
http://romereborn.frischerconsulting.com

This organization is developing the creation of 3D modeling on the basis of making urban reconstruction of ancient Rome. The team encourages users to understand the urban topography of ancient Rome through online resources. It publishes many articles that help give me tips of how to work on my thesis plan for 3D modeling and multimedia.

**Books**

**Battles of the French and Indian War**
By Diane Smolinski
Heinemann Library 2003
This book is for the education of children and is designed to take a quick look at the outlines of the French and Indian War, in which colonists of North America fought together for control of the North American continent. The context of historical importance plays a role in developing basic understandings of Virtual Archaeology.

**Royal Fort Frontenac**
By Richard Arthur Preston
The Champlain Society 1958
This is the best book for those with a strong interest in Fort Frontenac. It contains a storehouse of information connected to the fort and proves an assemblage of old French forts leading up to the spot of Kingston, Ontario in which Fort Frontenac is located. It is the essential tool to conduct research on my thesis work.

**Virtual Archaeology**
By Maurizio Forte
Thames & Hudson Ltd 1997
This book is a good match for those who want to learn Virtual Archaeology. It offers that basic computerized reconstruction is seen through wide-ranging contents of worldwide ancient sites and buildings. This abundant information is fundamental to research on a combination of 3D graphics design and Virtual Archaeology.

**Print Documentation**

**Archaeological Monitoring at the Kingston Coal Gasification Plant Site BbGe-78**
By Jonathan Moore and Susan Bazely
Cataraqui Archaeological Research Foundation 2000
This print documentation reports the archaeological records on excavated sites around Fort Frontenac. The records discuss historical information about geological compositions from the sites. It will be helpful in developing archaeological knowledge for potential archaeologists in terms of investigation and excavation.
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Fort Frontenac, Result of the 1982 Test Excavations
By W. Bruce Stewart
Cataraqui Archaeological Research Foundation 1982
This documentation asserts essential and abundant information about the first exposition of the long-term buried remnants of Fort Frontenac. It observes the assessment of historical components. It asserts those with a strong interest in Fort Frontenac. It concurs with crucial materials to archaeologists’ future investigation, development of site conservation, and my thesis research.

Kingston Inner Harbour Historical and Archaeological Overview
By Susan M. Bazely
Cataraqui Archaeological Research Foundation 2005
This archaeological research project provides the results from the particular lots excavated by archaeologists on the Kingston Inner Harbour where Fort Frontenac was situated. It presents historical sequences of the lots. It is geared towards prospective archaeologists and historians and is a useful study of what Kingston has developed for many years.

Stages 2 & 3, Archaeological Assessment Place D’Armes Re-Alignment
By Susan M. Bazely, Helen Sheldon, and Jonas Fernandes
Cataraqui Archaeological Research Foundation 2007
This project is one of archaeological reports resulting from consecutive test investigations. It interprets the success of archaeological investigation and excavation into the particular sites near Fort Frontenac in 2006. It demonstrates historical and geological components recognized as a result. It contributes to the next generation who will preserve historical assessments of Kingston.
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**Process**

**I. Design Approach**

First, in order to approach a true picture of Fort Frontenac and its surroundings as they existed in the past, I had a method to meticulously conduct research on historical maps, plans, and architectural styles of the fort at that time using the Internet and libraries. I needed to refer to architectural styles of restored forts similar to Fort Frontenac and its surroundings, so I was in touch with the City of Kingston by email and she offered an enormous quantity of valuable print documentations through accessible Dropbox. When I discover something helpful to research, I underlined points, such as old and limited records, maps, plans, and architectural styles of the fort.

The print and online documentations as well as books are good resources. However, a physical visit and an archeologist’s opinion are more advantageous to developing exceptional research. I moved on to the next step, which is to visit forts and to meet with a local archaeologist who is very familiar with Fort Frontenac. Utilizing the Thanksgiving break, I visited Fort Ontario and Old Fort Niagara on November 30, 2013. I planned to visit Kingston, Canada on December 3rd in order to photograph and glean information about the target fort. Furthermore, I succeeded in consulting with a local archaeologist, and I was glad that she shared her knowledge, experience in archaeological research, and insights with me. At her suggestion, I visited Fort Chambly on December 24 and Fort Crown Point on December 25 (Fig. 8). Filtering the collected information and photographs, I sketched out my designs on paper for envisioning the fort’s restoration. I set up and scanned my drawings and blueprints as a good guide for my 3D modeling using Maya software (Fig. 5).

After the design research was completed, in order to build models, I used the following practical software: Adobe Photoshop for refining textures, CrazyBumps for collecting normal maps and displacement maps, and Autodesk Maya for modeling on the basis of my drawn plans. I had an initial plan to model the interior of the buildings, but I needed to drop the plan because it was lacking credible information regarding the 17th-century. I constructed the exterior of the fortress in five steps: 1673, 1675, 1680, 1685, and 1688. The 3D modeling techniques included polygon modeling, shading, and lighting. I shaded the textures of the building and added the background of the building and its surrounding environment by lighting adjustment. I rendered the completed models to produce video clips and interactive animations through camera movements, which set in motion a placed 3D camera to create a bird’s eye-view and a 360-degree view from the fort (Fig. 7).
After the modeling was complete, interactive sceneries in Adobe Flash were devised to provide an effective way to implement visual communications and learning through the use of a mouse. The interactivity was integrated into the 3D models of the fort with unseen clickable buttons to learn more about the fort’s structure and historical importance. For example, users would be able to navigate over to a wall of the building that informed them of how the wall was constructed using stones. Also, users would be able to rotate the building for a 360-degree view in order to give an archaeological atmosphere to viewers (Fig. 6). My designed website was assisted by Wix for a novice. The video clips and interactive sceneries were integrated into the website in order to inform the user of the fort’s social systems and historical events. Also, the purpose for this is that people prefer to stay at home without visiting a location that is far from their residence. The uploaded website’s goal is to excite the user’s curiosity about the fort.

Figure 5: My sketch illustrating the plan for the passage of time through Fort Frontenac
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Figure 6: My sketch illustrating the plan for my website design interface

Figure 7: My sketch illustrating the ideal overview of modeling the exterior fort in Maya
II. Visit five fortresses

Figure 8: The Google map showing the spots where I visited the forts

A. Visit Fort Ontario and Old Fort Niagara

To conduct research on comparing textures and sizes of two fortresses to those of the Fort Frontenac, I visited the Fort Ontario and Old Fort Niagara on November 30th, 2013. In spite of the heavy snowfall, I was fortunate to collect proper information about buildings, textures, locations, and values.

Fort Ontario is a historical fort located on the City of Oswego in north-central New York. It is designated as Fort Ontario State Historic Site (Fig. 9). There were originally three forts, Fort Ontario, Fort Oswego, and Fort George, situated by the shores of Lake Ontario in the City of Oswego in the 18th century. The forts were constructed by British traders for trading posts and called “The Fort of the Six Nations.” They were damaged and ruined by the French during the French and Indian War in May of 1756. Only Fort Ontario was rebuilt again but later destroyed during the Revolutionary War and the War of 1812. It was reconstructed in the early 1840’s. It opened as a historical site in 1953 (“Fort Ontario State Historic Site”).

Fort Ontario is mainly a masonry construction in a star shape with an en glacis counterscarp encircled by an 18 x 8 foot ditch. It is 800 feet in circumference, 20 to 30 inches wide in limestone, and 9 feet high (“Fort Ontario” 2006). There are quarters, guardhouses, and a powder magazine, a storehouse, barracks, and windswept ramparts inside the fort. It is open
from May to October for visitors. Unfortunately, it was closed during my visit. The gate was closed with dark-olive, grill wood door. I did, however, have the opportunity to walk around the fort. The wall textures were slightly brownish with tints of gray and beige with dull white grids in a lower part and dark gray grout in an upper part. There were various kinds of dispersed casements on the walls. There were also three embrasures on the flanks near the entrance and six rectangular embrasures on other flanks on the opposite walls. There were a few very thinned-rectangular loopholes on the curtain walls, a few loopholes on another walls, and a mixture of two aligned congregational kinds on other walls (Fig. 10). The roof was covered by snow; therefore, I was unable to describe its textures. The fortress features gave views of Lake Ontario. The curtain walls helped me to conduct research.

Figure 9: Fort Ontario

Figure 10: Two loopholes on the curtain wall

There are no remains of Fort Oswego. A monument is a big piece of stone and solitarily stands squarely surrounded by an iron fence. The monument is located on the northwest side of
the mouth of the Oswego River and surrounded by the shipping lines. I was unable to read the explanation because snow filled the monument and could not reach it because of the fence (Fig. 11).

Moreover, there are no remains of Fort George a half mile to the southwest of Fort Oswego, and it is currently surrounded by Montcalm Park, a series of residential streets. There is only a big stone monument erected at the head of the park (Fig. 12).
I visited Old Fort Niagara in the afternoon. The fort is located at the mouth of the Niagara River and has a beautiful view of Lake Ontario (Fig. 13). It was constructed by the French in 1679 for a trading post as well as a military fort in order to control access to the Great Lakes. The fort renovated a strong frontier fortification and added the great “French Castle” in 1726. The British began capturing the fort during the French and Indian War. It still stands strongly without oppression and demolition. The fort consists of the South and North Redoubts, the Dauphin Battery, the Provisions Storehouse, the Powder Magazine, the Log Cabin, defenses, the Bakehouse, and the French Castle (“History of Old Fort Niagara”). This was only one of the forts I was able to enter because most are closed during the winter months.

I walked along the outside curtain walls that held the inner gates. The walls were erected on a ravelin and were encircled by ditches. The walls are composed of 3-foot wide stones and looked new because they were reinforced in the 1930s (“Old Fort Erie Tours). They have two colors: one was originally stone color that is beige and ochre, and the another color is crimson because it was artificially reinforced with brick.
I entered the interior of the French Castle, the storehouse, the powder magazine, the log cabin, and the bakehouse (Fig. 14). The rooms are good examples to model buildings inside Fort Frontenac despite the different backgrounds of Fort Niagara and Fort Frontenac. The French constructed the French Castle to use as a large trading house for high-standard officers. The building held furnishings. In the interior, the first floor is mainly the Trade Room to trade furs for manufactured goods with Natives (Fig. 15). The vestibule provided water for castle residents. French troops lived mainly in the chapel and barracks rooms on the second floor (Fig. 16). The powder magazine was built for the storage of gun powder. It was composed of a thick layer of earth and was designed to avoid accidents caused by wars. Similar to the composition, the redoubts played a major role in fortifying and protecting the castle from all sides. The buildings were connected to the gates where I passed ditches covered by a wooden trestle bridge. The first floor was the fortified gateway. I entered the interior and found very tinned-rectangular casement on the second floor (Welcome to Old Fort Niagara Your Guide to the Fort). The external appearance of the buildings inside the fort was useful to me for good tips as research the modeling of old buildings.
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Figure 14: The French Castle

Figure 15: The Trade Room in the French Castle
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Figure 16: The Dining Room in the French Castle

B. Visit Fort Frontenac and Fort Henry

My visit to Fort Frontenac is one of the most essential parts of my thesis research. I visited the crucial site of the fort on December 3, 2014. The target fort is located in Kingston, Ontario, Canada and it would take three and a half hours to drive from Rochester.

Fort Frontenac was situated on the low level shore of the mouth of the Cataraqui River near St. Lawrence and Lake Ontario in Kingston, Ontario (Bazely, e-mail). The fortification was originally known as Fort Cataraqui and was constructed of a rough, log palisade. One log palisade was 46 feet in length and others were 20 feet in length (Stewart, “The Kingston,” 5). It was established by the French for a trading post and military fort in 1673. There might be two inside store houses that supplied food, drink, and bullets. It was rebuilt with additions of four limestone square bastions in 1675. All wooden walls were replaced with limestone to become a great and strong masonry fort in 1688 in order to develop lucrative fur trade and reinforce a French outpost for military defense and exploration of the interior (Cataraqui Archaeological Research foundation, “Fort Frontenac”). The walls were 3 feet thick and 12 feet high and approximately 800 yards in circumference and might be larger than the original wooden palisade. Inside the fort was a powder magazine, a well, a bakery store, forges, guardhouses, trade stores, and commanders’, officers’, and traders’ quarters including a chapel. Outside the
fort were the 15-foot wide defensive ditches. Around the fort were French houses, a barn, a cowshed, a garden area, a Recollect church, and an Iroquois village (Fig. 4). A storage tower was also erected for the purpose of storing goods to serve as a lookout post in 1687 (Stewart, “The Kingston,” 7). However, Fort Frontenac was embroiled in occasional outbreaks of fighting between the Iroquois and the British. The fort became weak. The French abandoned and destroyed the bulwark in 1689 but reconstructed it in 1695 to strengthen their military activity and accommodation.

For the course of 50 years, fur trade gradually became more unprofitable. Their reputation dwindled. It was relinquished to British forces with curtain walls, tower, and at least one barrack building along the west curtain wall during the Seven Year’s War, a part of the French and Indian War in 1758 who mostly devastated it (Bazely, email). The French never rebuilt the fort because the fortification was no longer needed. Inevitably, supplies and means of communications and transportation were moved to other French outposts in Western Canada. The French were left on the American mainland. 25 years later, the British buried its ruins with new streets and buildings, the former Tete du Pont Barracks in 1789 that would be known as the National Defence College today. Archaeological research was conducted between 1982 and 1986. The excavations finally revealed only a small portion of the fort, the northwest bastion in 1983. It was designated as a National Historic Site of Canada and a part of the northwest bastion was reconstructed in 1984. It is located in the center of the new compound (Cataraqui Archaeological Research foundation, “Fort Frontenac”).

Currently, the reconstruction stands beneath the intersection of Ontario Street and Place D’Armes (“Fort Frontenac National Historic Site of Canada”). It is a crude limestone construction and shabbily lies on the ground in front of the military college called the National Defence College. It is found on the left side of the residential streets and on the backside of the Rogers K-Rock Centre (Fig. 3). I walked around the remains that are only 100ft in circumstance and 30 inches thick (Fig. 17). The height of the top corner is, at its peak, lower than my shoulders, gradually becoming less than 10 inches at the end of both edges. For lengths, these remnants were aerially measured. The measurements are as follows: West curtain is 70.23 feet long; Southwest face as long part of bastion is 53.64 feet long; Northwest face is 31.23 feet long, North curtain is 31.23 feet long; South flank as short part of bastion is 18.58 feet long; North flank is 19 feet long. For height, it is about less than 6 feet high at the highest point at the top corner of the bastion and steps down to an average wall height of around 3 feet high (Bazely, email). Their textures were drably and somberly greyish on the slightly brownish and ochreish sandy grout (Fig. 18). Mrs. Bazely told me the original textures were probably tinged with yellowish multiple limestone in crude piles.
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Figure 17: The remnants of Fort Frontenac

Figure 18: The detailed masonry texture of the destroyed Northwest bastion of Fort Frontenac
On the other hand, Fort Henry was restored well in 1938 so that it entirely has a splendid figuration (Fig. 19). It is a half-mile west of Fort Frontenac and stands on the top of the hill. It is on the higher ground overlooking Lake Ontario and the City of Kingston. However, there is no research material available because of the strikingly different historical background. The British began construction of Fort Henry during the War of 1812 and the second fort was built in 1832. The fort was renovated with the addition of ditch towers in 1840 and still stands today (Fig. 20). Its purpose was to protect the city of Kingston. There are fine-looking features; Advanced battery, Dry ditch, Reverse fire galleries, Redoubt, Branch towers, Curtain wall (Fig. 21), Demi-bastions, Commissariat stores, and Caponier in the fort ("Fort Henry National Historic Site of Canada").
Figure 20: The dry ditch of Fort Henry

Figure 21: The detailed texture of the curtain wall of Fort Henry
C. **Meet with an Archaeologist and a Manager for Heritage and Urban Design**

Consulting an archaeologist and a manager for heritage and urban design is also one of the most important factors of my thesis research to collect valuable information. I contacted Canada’s Historic Places in order to consult an archaeologist regarding my inquiries. I was introduced to Shirley Bailey, the Manager for Heritage and Urban Design for the City of Kingston. She was willing to send me many research articles and a chronological series of diagrammatic maps done by the City of Kingston and the Cataraqui Archaeological Research Foundation. She set an appointment to meet with me and made a referral as Sue Bazely, an archaeologist. She had a worthwhile experience in digging up the remnants of Fort Frontenac. We met at the conference room in the City Hall of Kingston on the 3rd of December at 2pm (Fig. 22). Mrs. Bazely brought her published books, brochures, and articles on her archaeological records about the fort. She presented her experience and the history of Fort Frontenac for 2 hours. Mrs. Bailey gave me a permission form to get an aerial imagery of Fort Frontenac. I gleaned from information through Mrs. Bazely’s presentation. She told me the Kingston Archaeological Centre operated until last year. They had a 3D model of Fort Frontenac made in expanded polystyrene. A few days after the conference, she sent me two sample pictures of the exhibit of the model and the scanned pages of the brochures, and the City of Kingston sent me the aerial imagery. All those resources supportively encourage me to conduct extensive research in the future.

![Figure22: The City Hall of Kingston](image-url)
D. Visit Fort Chambly and Fort Crown Point

Mrs. Bazely made great suggestions about how to find good resources to compare my target with other old forts that are more similar to the target regarding buildings, textures, sizes, backgrounds, and periods. I visited Fort Chambly and Fort Crown Point on December 23rd and 24th, 2014. Despite severe cold weather and most of the buildings being covered by ice and snow, I was able to collect sufficient information to help develop my thesis research.

Fort Chambly is located on the banks of the Richelieu River in the city of Chambly, 16 miles southeast of Montreal (Fig. 23). The wooden fortress was initially constructed by the French in 1655 and became an impressive square stone structure in 1711. It was used as a fortifying post to protect New France from British invasions. Due to the loss of the French during the Seven Year’s War, the fortress was ceded to the British in 1760. The fort was recaptured by the British only one year before being lost to the American in 1775. The fort was totally abandoned in the mid-19th century and was restored by Parks Canada in 1983. It was designated as a National Historic Site of Canada in 1920 ("Fort Chambly National Historic Site of Canada").

The interior of Fort Chambly has traditional guardhouses, barracks, and administrative buildings, and a museum that enables visitors to enter in the spring to fall seasons. During my visit, it was closed but I walked around the circumference of the fort. It has been grandly and neatly preserved. The distinct stone textures and external figures are grave. The exterior distinctly features bartizans. There are embrasures and musket loopholes mounted on the machicoulis galleries, curtain walls and bartizans. There are two layers of curtain walls and three layers of bartizans. The lowest layer of both is a base in huge stone structure. The textures are yellowish in all tints of red, orange, blue, and grey (Fig. 24). The roof was covered with icy snow. The location features a clear view of the Richelieu River and a clean sidewalk leading into a wooded park. The river was totally frozen.
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Figure 23: Fort Chambly

Figure 24: The detailed texture of the curtain wall of Fort Chambly
The next day, I visited Fort Crown Point situated by the narrows of Lake Champlain near the town of Crown Point, New York (Fig. 26). The first fortress called Fort St. Frederic was built by the French in the 1730s for protection from British invasions during the French and Indian War. It was composed of with thick limestone square walls six bastions. The French broke down and left the fortifications in 1759 (Fig. 25), and then the second fortress called Fort Crown Point was rebuilt by the British troops. It was a large pentagon with five bastions. However, it was entirely destroyed during the Battle of Valcour Island, a part of the American Revolutionary War, and was abandoned in 1783. Both fortresses are registered as a National Historic Landmarks (Millard 2012).
Both were totally ruined. They looked quite ghostly and shabby. I felt that they were solitary in an impressively desolate and forlorn scene in the harsh cold weather. Fort St. Frederic was almost buried in the icy snow. I very carefully walked around Fort Crown Point because the ground consisted of one-inch soft snow and a sheet of very thick ice. It was extremely slippery and dangerous. I went back and forth around its interior because there were no entrances and exits. The wall was greyish and was tinged with blue due to climate influences (Fig. 28). Fort Crown Point was too devastated to be compared to Fort Frontenac for thesis research (Fig. 27).
Figure 28: The detailed texture of the curtain wall of Fort Crown Point
III. **Modeling Buildings in Maya**

A. **Constructing Buildings and Environment**

Maya 2014 is a considerably professional tool that has a means of modeling physical objects and rendering sequences to create animations. To exactly envision a real, overall picture of Fort Frontenac, I visited five forts and entered two forts where old buildings were preserved: Old Fort Niagara and Fort Henry. While complying with my notes of the archaeological and historical consequences of the research, such as photos taken during my visit to the forts, online documentation, and historical plans and print documentation provided by the City of Kingston, and Mrs. Bazely’s evidence, to which I devoted myself even though extremely restricted information about Fort Frontenac in the 17th century, I had to meticulously elaborate archaeological features of the building constructions and the exterior. I carefully needed to fathom the length, height, and size of each building, log palisades, curtain walls, and moats in Maya.

In addition, Crazybump is convenient software for shading textural materials where I simultaneously turned photos into displacement maps and normal maps. The software is the most effective, easiest, simple way of creating displacement maps and normal maps. It is beneficial to the enhancement of aesthetics and contrast. I made four, six, or eight images with two or four of each image by flipping vertically and horizontally and stitched the original whole images together with as much repetition in Photoshop as I could. I offset the images and used the clone tool to make seamless repeating patterns (Fig. 29). The more images put on the one large image in Photoshop, the more realistic textures of the buildings when the images were transformed to displacement maps (Fig. 31) and normal maps (Fig. 30) adjusted by Crazybump according to intensity, sharpen, detail, shade, and highlight and were imported into Maya. The normal maps were placed along with the displacement maps onto a Blinn bump map for particular buildings. Most texture images were provided by the website referenced as Cgtextures. They have abundant and wide resources of textures from ancient to modern. There are quite limited textures generated from my photographs because snow covered the target buildings.
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Figure 29: A classic sample of stitched textures for the fort’s curtain wall done in Photoshop

Figure 30: Normal Map
For the imagery of 1673, the constructed buildings are the following: two storehouses for provisions and ammunitions storage, log palisades, which north and south sides were forty-six feet and other sides were twenty feet in length, and a well (Stewart, 5). Their textures were taken from online images. For the restoration of wooden palisades, I asked Mrs. Bazely about the real appearance of the log structures, but she did not have any references (Bazely, e-mail). As a sequel to researching their detailed textures among old forts in America that were built in the 17th century, their average colors were shabby and gray with a few knots. They were possibly attributed to a kind of oak, beech, or cedar. To reconstruct the textures of old traditional palisades, the image was found in Cgtexture, and I strived to adjust them in a realistic style. I needed to stitch six similar, repeated images together with offset in Photoshop and to respectively adjust the surfaces of each pole on the UV texture editor in Maya. For the roofs and wooden walls of two storehouses, their textures were also found in Cgtexture, created by the same means of Photoshop and Crazybump, and placed onto bump maps in Maya (Fig. 32).
For the imagery of 1675, the log palisades had additions of four limestone square bastions and their area was 800 yards in circumference (Stewart 7). The masonry textures of the bastions were originally made from remnants of Fort Frontenac because Mrs. Bazely mentioned that the surfaces looked yellowish, rough, and blunt. I got six similar, repeated images together and offset them. I blended both together to appear more realistic in Photoshop. The blended textures were imported into CrazyMap to produce displacement maps and normal maps. They were placed on Bump map in Maya (Fig. 33).
For the imagery of 1680, the constructed buildings are the following: a one-hundred-foot-long quarter, a blacksmith shop, a guardhouse, a cow house, a well, and wooden platforms and scaffolds, log palisades on the North, East, and South sides, and masonry curtain walls on the West sides, and additions of four limestone square bastions. Around the fort were 15-foot-wide ditches (Stewart 7). The masonry curtain walls included many casements and loopholes. It took a lot of time to meticulously embed the casements and loopholes with the wall (Stewart, 7). The log textures were from Cgtexture and the limestone textures were from the remnants of Fort Frontenac. I put textures on each building by following those methods (Figs. 34 and 35).
For the imagery of 1685, the fort was enlarged in a square with each of four bastions, which was approximately 96 feet from curtain wall to curtain wall. The South Side had a combination of a 4-foot-high masonry foundation wall and log palisade that stood on the foundation wall. The inside included a masonry quarter or barrack, a guardhouse, a forge, mills, a powder
magazine, a bakery, trade house, a well, a sentry-box, and moats that are fifteen feet deep (Stewart 8). I put textures on each building by following those methods (Fig. 36).

Figure 36: The completed model of the construction process of the third fort.

For the imagery of 1688, the additional constructed buildings are the following: a big tower, four small towers, wooden platforms and scaffolds, a wooden bridge, a masonry gate, and full limestone curtain walls with many casements and loopholes (Stewart 8). The flag with the pole on the big tower was added. Most of buildings were completely transformed from wooden surfaces to limestone surfaces. Some buildings still remained with wooden textures. Both textures were replaced because they had to be reinforced strongly due to the improvement of the military services and the interior exploration. I made the 1673, 1675, 1680, and 1685 structures following the same steps (Figs. 37 - 39).
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Figure 37: The wireframe model of the third fortress

Figure 38: The fundamental model of the third fortress
I created geographic landscapes in Maya by tracing curves over the outline of the plans of 1685 and 1720 provided by the City of Kingston. The outline became a planar surface and the surface was converted into a polygon surface with numerous quarter geometries. I created the landscape for 1673, 1675, 1680, 1685, and 1688. The geometric maps were shot by the UV Snapshot of the UV texture editor in Maya and were imported into Photoshop to color geographic topography. I also gained a displacement map and a normal map in Crazybump, and then they were imported back into Maya to get placed onto a bump map for the landscapes. Moreover, I created the sea by using an Ocean Shader and Ocean and I made minor revisions until the color was very similar to the color of the sea around Kingston that was dully emerald or bluish.

Three lights were set up: Key Light, Fill Light, and Back Light. The key light was like sunlight set as a directional light to turn towards the north and its color was slightly bright yellowish. The Fill light was a secondary light set as a spot light facing southwestward and its color is slightly bluish. The back light was a third light set as an additional spot light in the southern direction and its color was dimly, warm orange. Originally, the fort’s gate turned northeast so that the entrance was in shadow. The shadows were in the northeastern direction. Three lights were crucial materials to heighten an aesthetic sense of natural imagery.

To create the dynamic moving sky, the sky image was distorted to polar coordinators in Photoshop and the hemisphere modeling was mapped with the image onto the UV texture editor.
under the spherical mapping to eliminate seams of the top sky. The hemisphere modeling was placed to entirely hide the forts and geographical landscapes. It was designed for camera application to further an appreciation of natural aesthetics.

B. Rendering Sequences to Create Videos and Interactive Design

Regarding the camera animation, I wanted to render PNG sequences featuring an overview of the forts for a series of all construction dates and the forts inside for 1675, 1680, and 1685, and 1688 in video clips. The 1673 version was not included because the inside was too narrow to create a video. I set “Two Node” camera – camera body and an aim constraint. This allows the camera to focus on one object while you move the body. I created different circular curves for a motion path attached to each camera in order to make the cameras move very smoothly. I had to set nine hundred frames for an overview of the exterior 1688 fort in sequence. I already set nine hundred frames for a series of all the forts and three hundred sixty frames for a close-up of the entrance in sequence. However, these settings were removed due to the effective properties of collecting information on the web. It took an average of six to nine hours to get it smooth for the videos.

The completed sequences were imported into Adobe After Effects software and rendered for videos. The preferable time length for videos was twenty-four seconds for an overview of the exterior. These setups needed to make viewers visually comfortable according to motion and timing. Also, I created videos for thirty-six seconds for an overview of the interior, and twelve seconds for the close-up of the gate, but I removed them to develop effective visual communication with viewers on the web.

I created two videos for a chronological series of two kinds of the whole exterior forts. The images of them were simply taken from Maya. It was a simple and easy way that each image was ordered chronologically and the following chronological date texts were aesthetically put on each of the images in After Effects.

Furthermore, in the aspect of interactive design, only thirty-six frames were required to render an overview of the exterior and interior forts. It took thirty minutes to set all the frames for installing historical sequences: respectively for 1673, 1675, 1680, 1685, and 1688 (Figs. 40 - 42).
IV. Creating Interactive Imagery in Flash

Flash CC is reliable software to play a major role in interactivity (Fig. 43). An SWF format generated from Flash was designed for interactive application and was equipped to get integrated with the website. From a technical view, playing interactive animation was to set up only thirty-six frames. I typed and fixed coding on the action scripts to fit the interactive scenery while following the example created by Professor Jackson (Fig. 44). I added the names and descriptions of each building in panels. Descriptions were brought by the research result from trustworthy online and print documentations. These panels were placed around each building, their colors were transparent black with high opacity, and their fonts were Palatino Linotype in white texts on the basis of visual effects. Once SWFs were published, the interactive system enabled users to hover a certain building with a mouse, the panels of its name and description popped out. I explored users’ comfort, their effective applications of learning the fort by interactivity, and animation principles. This idea will be a useful educational tool to let users learn the fort’s historical importance and to acquire new knowledge. It will assist in developing educational and study materials.

Figure 40: The interactive scenery of the 1675 interior fortress
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Figure 41: The interactive scenery of the 1680 interior fortress  

Figure 42: The interactive scenery of the 1688 interior fortress
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Figure 43: Working in Flash

```actionscript
// set the number of frames in the scene movie clip
var totalNumFrames:Number = scene_mc.totalFrames;
var movel: Number = 0;

// cw arrow - set up for clockwise arrows
backward_btn.addEventListener( MouseEvent.MOUSE_DOWN, setClockWise);
backward_btn.addEventListener( MouseEvent.MOUSE_UP, stopRotation);
forward_btn.addEventListener( MouseEvent.MOUSE_DOWN, setCounterClockWise);
forward_btn.addEventListener( MouseEvent.MOUSE_UP, stopRotation);

// set up event listeners
function setClockWise(e:MouseEvent){
    moveTo = -1;
}
function setCounterClockWise(e:MouseEvent){
    moveTo = 1;
}
function stopRotation(e:MouseEvent){
    moveTo = 0;
}

// rotate the scene
scene_mc.addEventListener( Event.ENTER_FRAME, spinScene);
function spinScene(e:Event){
    if (thisFrame >= totalNumFrames) { thisFrame = 1; }
    if (thisFrame <= 1) { thisFrame = totalNumFrames; }
    // display the scene
    scene_mc.gotoAndStop(thisFrame);
}
```

Figure 44: Codes in action scripts
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V. Designing My Website

Wix has indispensable web assistance, which is helpful to a beginner for designing attractive websites without coding for a short while. Wix is able to convey more effectively within limited time rather than multimedia (Fig. 46), which took a lot of time for a novice to design a website with numerous entangled codes. In terms of layout design, the color of the top bar was a slight crimson. The main background is slightly yellowish beige or grey with high opacity under the old map. The reason for the color choice was that the outline and background of the old fort’s map plan had color in common with the roof and the wall of the National Defence College built on the front of the fort’s remnants. The classic font is chosen as *Palatino Linotype*, used as a sort of old, traditional French fonts. It reanimates time reenactments of French settlements in Canada (Fig. 45).

Figure 45: The website of the 3D restoration of Fort Frontenac
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Figure 46: An example of the Wix assisting in the web design

I designed a logo in Adobe Illustrator. A logo should be related to the 3D restoration of Fort Frontenac and followed the exemplary plan of the representative old map. Also, the logo color followed the color of the plan. I traced lines over the plan with different width and expanded the lines. There were many kinds of logos produced from my design. I thought a logo in 3D would have been appropriate and, fortunately, Adobe Illustrator has a unique system of rendering from two dimensions to three dimensions with different perspectives: X, Y, and Z. The 2D design became 3D design logos (Fig. 47). However, as a result of feedback from professors and students, a 2D logo was very favorable due to high aesthetics and design without extra values. The favorable font adjacent to the logo is Palatino Linotype (Fig. 48).
The logo samples, the videos, the SWFs, and photos of the fort’s remnants, were imported into the designed website and were categorized as the different sections: “Home,” “About,” “Restoration,” and “Learning.” There are no subtopics on “Home,” two subtopics on “About” that were categorized as “History” and “Gallery,” two subtopics on “Restoration” that were categorized as “Restoration 2” and “Completion,” and nine subtopics on “Learning” that were
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categorized as “1673,” “1675 Inside,” “1675 Outside,” “1680 Inside,” “1680 Outside,” “1685 Inside,” “1685 Outside,” “1688 Inside,” and “1688 Outside.” It was designed for educational purposes for those with a strong interest in history and archaeology.

Completed videos have a good balance between light and shadow. Importing them to YouTube and Vimeo to post the videos on the website represented a new issue with the light and the shadow. The importing process of YouTube and Vimeo darkened the videos. I had to get the rendered frames lighted in After Effect and then imported renewed videos back to YouTube and Vimeo.

Thus, these processes of my thesis project are being completed according to my visit to those forts, modeling and shading buildings in Maya, creating interactivity in Flash, and designing a website in Wix. It is apparent that my thesis wants to lay emphasis on the restoration of Fort Frontenac for Virtual Archaeology in 3D on the basis of educational materials. The finished website fosters new knowledge for those who are interested in archaeological and historical concerns. It will encourage them to correctly acknowledge the archaeological and historical importance of Fort Frontenac. This fort, as well as other forts all over the world, will be restored for these purposes by developing interactivity with 3D technology in a versatile website.
VI. Critical Analysis and Troubleshooting

There are three main issues and struggles I encountered with my thesis. Each struggle greatly affected the process of how my thesis is critiqued and improved. The following is a critical analysis and troubleshooting of what went right and/or wrong and how I solved the issues.

1. Meticulously reading articles and records about Fort Frontenac was an important means of exactly building historical structures in Maya. However, I entirely misunderstand historical viewpoints because my native language is not English. I had to fix most of the structures in Maya, which I had built. The following structures I fixed were the outward appearance of palisades, curtain walls, and some buildings inside the forts. I needed to change the textures of the curtain walls that did not match historical occurrences of the limestone masonry. The logs of palisade were too wide and high, so I needed to scale down them. Lastly, they needed to look natural through the adjustment of textures and lighting.

2. Visiting five fortresses was important to my research as these sources for inspiration. I was only able to make visits during winter. The winter months are not an ideal time to do researches and photography because most of the fortresses were closed. Many are just open from May to October to visit their interior. Most buildings were covered by heavy snowfall. In addition, the sky was not clear and dull, so it would degrade photographic details and overall visual look. The textures of the roofs and buildings’ walls displayed in 3D were used from the website called cgtextures.com. Obviously, visiting the forts during the summer periods would be more advantageous to conduct research and to photograph the natural textures, such as the vivid roofs and textures of the buildings’ walls illuminated by the direct ray of the sunlight. It is the best way to update the roofs and buildings’ walls in 3D and photographs in the website.

3. My first plan was to create three kinds of videos, an outside overview of the forts, an inside overview of the forts, and a close-up of the gate for each of 1673, 1675, and 1688. I had to set nine hundred frames to produce a 36-second video for the outside overview, six hundred frames to produce a 24-second video for the inside overview, and three hundred sixty frames to produce a 12-second video for the close-up of the grate. Rendering nine hundred frames greatly impacted my lifestyle on a daily basis. It took one day to complete one video. To create all sets of nine videos required a week. On the
other hand, to create an interactive sceneries for the outside and inside forts in Flash CC, it took only 30 minutes to render all twenty-four frames necessary to build a 360-degree interaction in Flash. I could create more than 10 interactions on a day. However, designing a website was influenced by the video file formats and interactive sceneries for each page. User-centered design determined the best method to incorporate the videos. Consequently, most videos were removed due to their memory-intensive usage and time management required. Only videos for the completed exterior fort in 1688 were uploaded for the webpage. The website featured nine interactive sceneries, the interior for 1673, 1675, 1680, 1685, and 1688 and the exterior respectively, except for 1673. It looked innovative and comfortable for users to deal with the website and enhance their knowledge in an effective way. Watching videos was not innovative and banal. To sum up, this design could assert that interactive applications are attractive to users and usefully economize time creating them, but featuring videos is relatively conventional and spend considerable time effort.
VII. Usability Testing

I made questionnaires for usability testing according to the effectiveness of knowledge acquisition and the enhancement of user interface, navigation, orientation, visual effect, and physical convenience. The questionnaires focused on my designed website, videos on an overview of the fort outside and an approach of the gate, and effective usage of interactive learning (Fig. 50). Figure 49 represents the survey results.

When the Imagine RIT took place on May 3rd, 2014, I was fortunate in having the opportunity to collect attendants’ feedback through the questionnaires enough to resolve my thesis project. I was successful in gaining thirteen attendants’ answers to my questions. According to the statistics, I asked them about their ages and visit to Canada. See pie charts as follows below (Fig. 49).

![Pie Chart 1: Age Distribution](image1)

![Pie Chart 2: Have you ever been to Canada?](image2)

Figure 49: Pie Charts according to two questions

For age, most attendants are in their twenties. There were no Canadians from attendants but three visited Canada. There is a learning point although the U.S. is adjacent to Canada. I thought that feedback might be involved with the different views of American or Canadian according to cultural values, but I should have been in contact with Canadians to gain their feedback, except for the Imagine RIT. I also asked the attendants about their professions. The answers are various: college student, teacher, American Sign Language interpreter, user interface designer, graphic designer, software engineer, and physical therapist. One answer is omitted as N/A. In spite of what to say that people had various kinds of professions, the fact is that students
installed their own booths and events of the Imagine RIT, so it is proper that college students are more than any other attendant, such as professors, employees with other kinds of occupations, and K-12 students. I believe that thirteen respondents are sufficient to improve my thesis work because their answers have a lot in common with attentive revisions but might be insufficient to gain people’s practical viewpoints on cultural values. Overall, the target audience is those with a strong interest in history and archaeology without distinction of age and sex.

Following and analyzing attendants’ feedback gave me a meaningful opportunity to reform my website. On the basis of their responses, I fixed the page transitions and the navigation menu on the top bar of the website. The menu system has a dropdown style, but most people inclined to click the dropdown menu more than the firm menu on the bar. I needed to redesign the menu bar style to pay further attention to the firm menu. I changed the size of the unseen clickable buttons on buildings and added big arrows in the interactive pages. The webpages were enlarged. These renewed evaluations will give me advantages when the website is published in public. If the website is implemented in public, I will set up online statistics of how many people visit the website per day. I want to carry out new work of the restoration of other models, such as remains of castles and historical sites all over the world.
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My thesis focuses on effective usage of 3D technology for virtual Archaeology, especially restoring Fort Frontenac in 3D. The remnants of Fort Frontenac are located in Canada and have been never rebuilt since it was demolished in the 18th century. I have restored the fort in 3D now.

I want to get feedback on my thesis project from users. I want you to answer to the following questions 1-7 for my testing.

1. What is your age?
   • 0 – 18
   • 18 – 30
   • 31 – 60
   • 61 -

2. Are you Canadian? Have you even been there?
   • Yes
   • No

3. What is your profession?

4. Please rate how much you agree or disagree with each statement about my work
   1 = strongly disagree >>>>>>>>>>>>>>>>> 5 = strongly agree
   • Is something I’d consider doing again
   • Was a quality experience
   • Was something my family enjoyed

5. Please rate what is the thing I could use most improvement on?
   1 = Don’t need to improve >>>>>>>>>>>>>>>>> 5 = Must improve!
   • Website design (visual, layout, forts, etc.)
   • Camera movement in films
   • Fort design (visual, light, texture, etc)
   • Effective usage (easy, comfortable, visible, etc.)

6. Overall, are you satisfied?
   1 = strongly disagree >>>>>>>>>>>>>>>>> 5 = strongly agree
   1 2 3 4 5

7. Please give me any advice or questions on my thesis work

Figure 50: A sample of the survey
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**Conclusion**

To create an ideal learning tool that gives users profitable advantages, I needed to elaborate every step in this process: storyboarding, building constructions in Maya that are modeling, shading, lighting, camera movement, rendering, and animation, interactive design in Flash, and web design in Wix that is made of layout design and logo design.

Modeling buildings and the environment challenged me with many difficulties because there was very little information about the 17th-century Fort Frontenac. Figuring out how to glean from such information, I needed to compare it with other forts that were relatively similar to the target fort according to the veracious sizes, such as height, length, and width of buildings and environment and trustful textures of the buildings. To make visual motion very smooth and slow, nine hundred frames in rendering sequences were required to create video clips. Needless to say, the average rendering time length was nine hours, and several defections from the rendering occurred occasionally, so I had to constantly supervise the rendering a few times in each hour. When professors and an archaeologist pointed out that some minor revisions met in Maya according to design and archaeological issues, any additional renderings were required. My successful website can be issued in public; however, for the past few years, there have been further issues with some functions that have consistently upgrading versions of several software, such as Flash. In a few years after the website is published, the website may not be useful due to the expiration of a version of a certain software that may not match a particular browser or a computer that requires a newer version. This requires me to upgrade versions to determine users’ needs. In addition, annually hosting the website may prove too costly.

Nevertheless, the achievement of my 3D virtual model and interactive website will enable users to effectively learn about the historical importance of Fort Frontenac. In addition, users can quickly view its exterior from different perspectives. The development of an interactive website is essential to, and entirely prevalent in, our current world. I want to develop a many-sided website that enhances digital visualization. My goal is to take the content and make it a more beneficial experience through the vivid screen rather than studying textbooks. This encourages users to understand the fort’s social system and historical events that occurred at that time of the fort’s operation.

When we change our understanding in an archaeological viewpoint, the field continues to evolve step-by-step. Simultaneously, 3D techniques and web design gradually support this evolution, even though their technology is still developing in areas such as comfort and convenience for modeling, importing colors and sounds, lighting, shading, setting items in motion in 3D, visually communicating a 3D screen, and interactively using a mouse in a website.
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The more the technology improves, the more heritage visualization can develop. Historical sites in repair and abolished cultural methods can be resuscitated through the use of the latest technology.
References & Bibliography


Bazely, Susan M., email message to Mitsuyoshi Yabe, February 26, 2014.


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http://romereborn.frischerconsulting.com


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http://dmna.ny.gov/forts/fortsM_P/oswegoFort.htm

http://dmna.ny.gov/forts/fortsM_P/ontarioFort.htm

http://dmna.ny.gov/forts/fortsM_P/oswegoFort.htm


http://www.oldfortniagara.org/history


http://mayaarch3d.unm.edu/documents/MayaArch3D_NEHPhaseII_WhitePaper.pdf


http://en.wikipedia.org/wiki/Fort_Frontenac

### Appendix I: Data Table

<table>
<thead>
<tr>
<th>Date</th>
<th>Methodology</th>
<th>Material</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stewart/6</td>
<td>2007/8</td>
<td>Wood/Masonry/Wood</td>
<td>Base of the fort</td>
</tr>
</tbody>
</table>

**Notes:**
- The construction of the fort was undertaken in 1667.
- The fort was 120 ft. across the front, 152 ft. wide at the base, and 42 ft. high.
- The fort was made of three layers of materials: a wooden outer shell, a masonry core, and a wooden inner core.
- The fort was designed to withstand cannon fire.

**Table:**

<table>
<thead>
<tr>
<th>Layer</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer</td>
<td>120 ft</td>
<td>42 ft</td>
</tr>
<tr>
<td>Core</td>
<td>152 ft</td>
<td>42 ft</td>
</tr>
<tr>
<td>Inner</td>
<td>48 ft</td>
<td>42 ft</td>
</tr>
</tbody>
</table>

**Calculations:**
- The total width of the fort is 314 ft.
- The total height of the fort is 132 ft.
- The total area of the fort is 19,584 sq ft.
<table>
<thead>
<tr>
<th>Layer/10</th>
<th>Depicted</th>
<th>Masonry</th>
<th>Masonry</th>
<th>Masonry</th>
<th>Masonry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stewart/5</td>
<td>Post 10 to 20 years &amp; lookout for soldiers &amp; goods &amp; food</td>
<td>post</td>
<td>post</td>
<td>post</td>
<td>post</td>
</tr>
<tr>
<td>Stewart/10</td>
<td>The base of the wall consists of stone blocks &amp; a dirt road with a drain &amp; a concrete slab</td>
<td>stone blocks</td>
<td>concrete slab</td>
<td>concrete slab</td>
<td>concrete slab</td>
</tr>
<tr>
<td>Stewart/10</td>
<td>A drain with a drain &amp; a dirt road with a concrete slab &amp; a stone block</td>
<td>drainage</td>
<td>concrete</td>
<td>concrete</td>
<td>concrete</td>
</tr>
<tr>
<td>Stewart/10</td>
<td>The base of the wall consists of stone blocks &amp; a dirt road with a drain &amp; a concrete slab</td>
<td>stone blocks</td>
<td>concrete slab</td>
<td>concrete slab</td>
<td>concrete slab</td>
</tr>
<tr>
<td>Stewart/7</td>
<td>A drain with a drain &amp; a dirt road with a concrete slab &amp; a stone block</td>
<td>drainage</td>
<td>concrete</td>
<td>concrete</td>
<td>concrete</td>
</tr>
<tr>
<td>Stewart/5</td>
<td>The base of the wall consists of stone blocks &amp; a dirt road with a drain &amp; a concrete slab</td>
<td>stone blocks</td>
<td>concrete slab</td>
<td>concrete slab</td>
<td>concrete slab</td>
</tr>
</tbody>
</table>
Appendix II: Emails with Mrs. Bazely

From: mxy3663@rit.edu (mailto:mxy3663@rit.edu)
Sent: December-05-13 2:02 AM
To: Sue Bazely (sue@bazely.ca)

Subject: Re: FW: City of Kingston - Fort Frontenac Archaeology

Hello Sue,

Thank you for sending me these interesting pictures of the model made of polystyrene.

I have following questions on Fort Frontenac.

1. Do you know which fort is mostly similar to Fort Frontenac? As you mentioned, Fort Chambly may be mostly similar to the fort. I want to visit another fort for my research work. I believe that Fort Chambly is probably your best bet for similarities plus being in a good location to visit. Crown Point is also another good possibility. It is in NY State http://nysparks.com/historic-sites/34/details.aspx although slightly later, it was also occupied by both the French and British and there are portions of buildings there. I know the New York State archaeologist who was involved in excavations there (I think) quite a few years ago. He is retired now, but may be a good resource for you. Let me know if you would like his contact info and I can send it.

2. Do you know historical buildings, such as a quarter, barrack, and magazine, that were built by French in the 17th and 18th centuries? They should be restored or still remain currently. Try looking at the Fortress of Louisbourg. It was reconstructed based on the archaeology, not sure if there was much of the original left http://www.fortressoflouisbourg.ca/index.php and the Parks Canada site http://www.pc.gc.ca/eng/lhn-nhs/ns/louisbourg/index.aspx It is French of that period and all the buildings you mention should be there. Same for Fort Chambly. If I think of any others I will send them to you,

3. What do you think of the URL? Is it reliable? http://ca.askmen.com/top_10/travel/top-10-forts.html This url has reasonable information, but I would stay away from the Hudson's Bay forts for several reasons. They are fur trading posts, but called forts, are all British, and are of a much later period. you will see that the buildings are more like large warehouses.

... 
I am looking forward to your response.

Thanks,

Mitsuyoshi

...
Hi Mitsuyoshi,

I have checked through some notes and found the excavated width to be on average 0.70 metres which is approximately 2 feet. I believe the reconstruction seen on the ground is faithful to that.

For lengths I did some quick measuring from the aerial as I could not find any recorded. These are:

West curtain - 21.41 m or 70.23 ft
SW face (long part of bastion) - 16.35 m or 53.64 ft
NW face - 18.13 m or 59.48 ft
N curtain - 9.52 m or 31.23 ft
S flank (short part of bastion) - 5.66 m or 18.58 ft
N flank - 5.79 m or 19 ft

For height, it is about just under 6 ft at the highest point in the point of the bastion and steps down to an average wall height of about 1 m or around 3 ft.

Hope that is of help to you.

Sue.

Susan M. Bazely MA
Member, Association of Professional Archaeologists

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613-453-9644
Mitsuyoshi Yabe
Restoring Fort Frontenac in 3D:
Effective Usage of 3D Technology for Heritage Visualization

HI Mitsuyoshi,

apologies for not getting back to you sooner. I was finishing up a journal publication and was pretty focused on it for the last while.

I have had a look at your website and 3D reconstruction video clips, and also had a look through your thesis. Overall, I think you have done a fabulous job in the representations of the various periods, both interior and exterior.

To answer your specific questions:

1. The masonry movement looks fine. My initial thought was that some of the stones looked rather large in scale, but my inclination is to not worry about that.

2. The wood texture looks really good. We do not know if the log structures were built of squared log or left in the natural rounded state. At least I have not seen any reference to this, so should be fine as you have it. The palisade looks really good, however I think that in general the post diameter is too wide and not varied enough. While a reasonable attempt would have been made to get consistently sized trees, I do think there would have been more variation. Don’t know if this is possible to tweak so that there is a bit less consistency in the diameter. Otherwise, I think the palisade is a great representation.

3. The chronological series is ok. Since we only have the maps to work from and some of the historical record I think that the dates you have used are fine.

4. In the 3-D modeling I noticed on some of the building identifications you have "forge" I believe this should be forge (same as blacksmith forge). There should only be one forge and the other structures by the main gate are for the guards. Also there are a number of small structures identified as "mill". I believe there was a mill (probably windmill) in 1685, but none later on in the positions you show. Where you have located these mills, was only the bakery structure.

In your thesis I noticed a few things that need some changes:

a. In Figure 1 I would suggest putting a circle around the fort area or an arrow pointing to it to draw the reader's attention.

b. Figure 4 has an incorrect date. This plan is 1685 not 1759.

c. I did not see noted anywhere that what is currently on the ground at Fort Frontenac is the 1986 reconstruction based on the archaeological footprint and not remnants of the fort. Perhaps I missed that.

d. The archaeology was conducted between 1982 and 1986, so should be noted as such.

e. Fort Frontenac was not entirely destroyed during the 1758 attack. The remains were utilised 25 years later by the British - curtain walls, tower and at least one barrack building along the west curtain wall.

f. You have referenced a couple of times that Fort Frontenac was situated on a high bank of the Cataraqui River. Actually, it was located on the low level shore at the mouth of the river where it meets the St. Lawrence and Lake Ontario. This was one of the major criticisms to its defence as there is high ground to the west and east.

g. Should note that Shirley Bailey was the Manager for Heritage and Urban Design for the City of Kingston.

I hope these comments are helpful and not too late. If you are able to make any updates, please do send me the final results. Also, will your website be accessible on line once you are done? Just wondering as I think it is a great resource to pass on to people.

Sue,

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From: Mitsuyoshi Yabe (REIT Student) [mailto:my3653@sffit.edu]
Sent: July-30 14 11:25 PM
To: SUSAN BAZELY
Subject: Re: Fwd: Completion of my thesis work: Fort Frontenac
Appendix III: Usability Survey

My thesis focuses on effective usage of 3D technology for virtual Archaeology, especially restoring Fort Frontenac in 3D. The remnants of Fort Frontenac are located in Canada and have been never rebuilt since it was demolished in the 18th century. I have restored the fort in 3D now.

I want to get feedback on my thesis project from users. I want you to answer to the following questions 1-7 for my testing.

1. What is your age?
   - 0 – 18
   - 18 – 30
   - 31 – 60  [ ]
   - 61 -

2. Are you Canadian? Have you even been there?
   - Yes
   - No  

3. What is your profession?
   
   "Teacher"

4. Please rate how much you agree or disagree with each statement about my work
   1 = strongly disagree >>>>>>>>>>>>>>> 5 = strongly agree
   - Is something I'd consider doing again 1 2 3 4 5
   - Was a quality experience 1 2 3 4 5
   - Was something my family enjoyed 1 2 3 4 5

5. Please rate what is the thing I could use most improvement on?
   1 = Don't need to improve >>>>>>>>>>>>>>> 5 = Must improve!
   - Website design (visual, layout, forts, etc.) 1 2 3 4 5
   - Camera movement in films 1 2 3 4 5
   - Fort design (visual, light, texture, etc) 1 2 3 4 5
   - Effective usage (easy, comfortable, visible, etc.) 1 2 3 4 5

6. Overall, are you satisfied?
   1 = strongly disagree >>>>>>>>>>>>>>> 5 = strongly agree
   1 2 3 4 5

7. Please give me any advice or questions on my thesis work
   Interesting topic there is a lot of information to convey. Text amount is a lot less compared to size of typeface. Light direction on 3D goes from shadow to light. I think it should go from right side to shadow size. Font size would be more comfortable to read. If a couple points size bigger consider listing main points in bullet form with a choice to read in a paragraph form.
My thesis focuses on effective usage of 3D technology for virtual Archaeology, especially restoring Fort Frontenac in 3D. The remnants of Fort Frontenac are located in Canada and have been never rebuilt since it was demolished in the 18th century. I have restored the fort in 3D now.

I want to get feedback on my thesis project from users. I want you to answer to the following questions 1-7 for my testing.

1. What is your age?
   - 0 – 18
   - 18 – 30
   - 31 – 60
   - 61 -

2. Are you Canadian? Have you even been there?
   - Yes
   - No

3. What is your profession?
   ____________

4. Please rate how much you agree or disagree with each statement about my work
   1 = strongly disagree >>>>>>>>>>>>>> 5 = strongly agree
   • Is something I’d consider doing again 1 2 3 4 5
   • Was a quality experience 1 2 3 4 5
   • Was something my family enjoyed 1 2 3 4 5

5. Please rate what is the thing I could use most improvement on?
   1 = Don’t need to improve >>>>>>>>>>>>>> 5 = Must improve!
   • Website design (visual, layout, forts, etc.) 1 2 3 4 5
   • Camera movement in films 1 2 3 4 5
   • Fort design (visual, light, texture, etc) 1 2 3 4 5
   • Effective usage (easy, comfortable, visible, etc.) 1 2 3 4 5

6. Overall, are you satisfied?
   1 = strongly disagree >>>>>>>>>>>>>> 5 = strongly agree
   1 2 3 4 5

7. Please give me any advice or questions on my thesis work

   I would suggest adding captions to the pictures so people know what they are looking at. Also, on the virtual tour it might be nice if the descriptions popped-up as you scrolled over them instead of needing to click on it.
Mitsuyoshi Yabe
Restoring Fort Frontenac in 3D:
Effective Usage of 3D Technology for Heritage Visualization

My thesis focuses on effective usage of 3D technology for virtual Archaeology, especially restoring Fort Frontenac in 3D. The remnants of Fort Frontenac are located in Canada and have been never rebuilt since it was demolished in the 18th century. I have restored the fort in 3D now.

I want to get feedback on my thesis project from users. I want you to answer to the following questions 1-7 for my testing.

1. What is your age?
   - 0 – 18
   - 18 – 30
   - 31 – 60
   - 61 -

2. Are you Canadian? Have you even been there?
   - Yes
   - No

3. What is your profession?

4. Please rate how much you agree or disagree with each statement about my work
   1 = strongly disagree 5 = strongly agree
   - Is something I’d consider doing again
   - Was a quality experience
   - Was something my family enjoyed

5. Please rate what is the thing I could use most improvement on?
   1 = Don’t need to improve 5 = Must improve!
   - Website design (visual, layout, forts, etc.)
   - Camera movement in films
   - Fort design (visual, light, texture, etc)
   - Effective usage (easy, comfortable, visible, etc.)

6. Overall, are you satisfied?
   1 = strongly disagree 5 = strongly agree
   -

7. Please give me any advice or questions on my thesis work
Appendix IV: Thesis Proposal

Situation Analysis

Although restoring structures in 3D computer graphics is apparently beneficial to visual communications and education, a good amount of historical knowledge of Fort Frontenac is required to restore the fort because of very limited information and archaeological remains about maps and plans of Fort Frontenac. Additionally, the powers of imagination and computer graphics design skills are essential to help correct wrong assumptions. For example, what was color of the building? Color may be involved with an overly subjective viewpoint. What were its social system, habits, and historical events at that time? Meticulously following the limited historical records, the sophisticated restoration of archaeological buildings draws viewers to the historical world of Fort Frontenac. This pushes them into effective understandings of its social system, habits, and historical events that occurred at that time.

I have a strong background of art and design and have an enthusiastic interest in geography and history. I have been trained in different design methods that range from traditional page layout and illustration to new 3D computer graphics. I devote myself to my hobby of doing research on the field of Ethnology on weekends. For my thesis, I have chosen the virtual restoration of Fort Frontenac, one of the known designated French forts, because of the resources available to do historical and archaeological research and to easily envision the restoration using 3D modeling.

My target audiences are those interested in history. Fort Frontenac was an important military fortress and a fur trading post that was built in Kingston, Ontario, Canada in 1673. In 1758, during the Battle of Fort Frontenac, the fortress was destroyed entirely and has not been renovated nor preserved since then (“Canada’s historic Places” para 2). I want to reconstruct all the buildings to restore them to their original look. It is applied to the field called Virtual Archaeology based on a combination of conventional archaeological methods and 3D computer graphics design. The field has created digital models in antiquity, such as ancient Egypt and Rome, at worldwide research institutes. It would be a great opportunity to rebuild Fort Frontenac because many forts have been renovated to become historical reenactment sites.

Problem Statement

Actual restorations of archaeological building remains require a great deal of time and money due to great involvement of architects, engineers, and lawyers for property development and land ownership. Can the use of computer graphics design inform and create an interest in virtual
archaeology by rebuilding Fort Frontenac using 3D modeling and interaction design? Even though the remains of Fort Frontenac get repaired, the fort’s location has limited transportation access for visitors. Additionally, existing templates illustrate the fortress’s outer appearance but its interior is not shown. 3D technology will help people get a better understanding of how Fort Frontenac was built. Through the use of interaction design, the user can be informed about the fort’s historical importance in a more dynamic way while they are at home. In addition, they can view the fort’s interior in a different perspective and detail.

My goal is to virtually restore an archaeological building, Fort Frontenac, which in turn will draw viewers into the historical world of Fort Frontenac. It will also allow them to effectively understand the fort’s social system, habits, and historical events.

Figure1: The remnants of Fort Frontenac
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Effective Usage of 3D Technology for Heritage Visualization

Figure 2: Current map showing the former location of Fort Frontenac

Figure 3: Sketch showing Fort Frontenac in 1759

Review of Literature
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Restoring Fort Frontenac in 3D: Effective Usage of 3D Technology for Heritage Visualization

**Online Documentation**

**Fort Frontenac**
Cataraqui Archaeological Research foundation  
September 2013  
http://www.carf.info/kingston-past/fort-frontenac
This webpage is sponsored by an archaeological research foundation and provides a detailed history of Fort Frontenac. The Foundation stresses effective research on archaeological and historical details of buildings and events in the past. It is beneficial to not only archaeological experts, but also prospective students who wish to become archaeologists. This research supports accuracy of building restoration in 3D computer graphics.

**Hypostyle Hall of King Raneferef Ancient Egypt**
Corinth  
September 2013  
http://www.ecorinth.com/projekty/#4
For archaeological practice, this video shows the interactive reconstruction of Raneferef’s Hypostyle Hall from Ancient Egypt in 3D computing. It illustrates the virtual reconstruction of the inside hall in 3D graphic design. It obviously exemplifies my thesis plan to use a 3D video and an interactive webpage.

**Iron Age House 3D Reconstruction – Virtual Archaeology**
Corinth  
September 2013  
http://www.youtube.com/watch?v=GRyv34HVRuw
This video advises researchers on how to work on a virtual Archaeology reconstruction project about Early Iron age house. It describes the development of graphical user interface through the iPad based on the architectural context of real reconstruction of the ancient villages. It is a helpful resource on my thesis plan for the restoration.

**Kingston, Ontario – the Founding of Fort Frontenac**
YodelOut  
September 2013  
This is an educational online page for learners of Canadian history. It discusses the background of Fort Frontenac, its surrounding area, and Canada according to cultural methods and social events that occurred at that time. It is a convenient way to integrate the content into 3D technology so as to restore the background.

**Rome Reborn**
Bernard Frischer  
Institute of Advanced Technology in the humanities
Mitsuyoshi Yabe
Restoring Fort Frontenac in 3D:
Effective Usage of 3D Technology for Heritage Visualization

September 2013
http://romereborn.frischerconsulting.com

This organization is developing the creation of 3D modeling on the basis of making urban reconstruction of ancient Rome. The team encourages users to understand the urban topography of ancient Rome through online resources. It publishes many articles that help give me tips of how to work on my thesis plan for 3D modeling and multimedia.

Books

Battles of the French and Indian War
By Diane Smolinski
Heinemann Library 2003
This book is for the education of children and is designed to take a quick look at the outlines of the French and Indian War, in which colonists of North America fought together for control of the North American continent. The context of historical importance plays a role in developing basic understandings of Virtual Archaeology.

La Salle
By Donald S. Johnson
Cooper Square Press 2002
This book provides informative nonfiction of the formidable and challenging journey of La Salle, a French explorer. It is designed to grasp the context of social systems, such as business and colonization that happened in the 17th century. It draws viewers into the historical world and is applied to Virtual Archaeology.

Objects
By Chris Caple
Routledge 2006
This book exemplifies and analyzes archaeological and historical objects in great detail. Its abundant information is very helpful to archaeological experts and prospective students who wish to become an archaeologist. It expands my knowledge and skills of restoring archaeological buildings.

Royal Fort Frontenac
By Richard Arthur Preston
The Champlain Society 1958
This is the best book for those with a strong interest in Fort Frontenac. It contains a storehouse of information connected to the fort and proves an assemblage of old French forts leading up to the spot of Kingston, Ontario in which Fort Frontenac is located. It is the essential tool to conduct research on my thesis work.

Virtual Archaeology
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Restoring Fort Frontenac in 3D:
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By Maurizio Forte
Thames & Hudson Ltd 1997
This book is a good match for those who want to learn Virtual Archaeology. It offers that basic computerized reconstruction is seen through wide-ranging contents of worldwide ancient sites and buildings. This abundant information is fundamental to research on a combination of 3D graphics design and Virtual Archaeology.

**Design Ideation**
First, I will meticulously conduct research on historical maps, plans, and architectural styles of Fort Frontenac and its surrounding area at that time. I need to refer to architectural styles of restored forts similar to Fort Frontenac. I plan to visit the Fort Frontenac Museum in order to glean information and photograph the fort. Furthermore, I will take the opportunity to consult archaeological experts and local residents who are familiar with the fort; I want them to share their knowledge and insights with me. Filtering the collected information and photographs, I will sketch out my designs on paper for envisioning its restoration.

With the design research completed, I will use 3D computer graphics to model my drawn plans. I will model the exterior of the fort and an interior room. The 3D computer graphics will include polygon modeling, texturing, and lighting. Interior props will be built to approximate the look of a room from when the fort was built and occupied.

To inform the user about the fort’s social system, habits, and historical events, I will create an interactive website. The website will integrate the 3D models of the fort with clickable hyperlinks to learn more about the fort’s structure and historical importance.
Mitsuyoshi Yabe
Restoring Fort Frontenac in 3D:
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Figure 4: My sketch illustrating the plan for the passage of time through Fort Frontenac

Figure 5: My sketch illustrating the plan for my website design interface
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Restoring Fort Frontenac in 3D: Effective Usage of 3D Technology for Heritage Visualization

**Methodological Design**

In order to approach a true image of Fort Frontenac in the past, I need to forage through information and records on the fort over the Internet and libraries. When I discover something helpful to research, I will underline points, such as old and limited records, maps, plans, and architectural styles of the fort, its similarities, its environs, and list of references.

I will move on to the next step, which is to visit the fort. Not only will I obtain information from the museum and take pictures of the fort, but I will also make appointments with the archaeological experts and local residents to gain information, such as its history, cultural methods, and social views. The collected information and reports will be categorized as the following artistic methods of restoration.

After the design research is done, I will make a draft of my 3D plans including the building elements: bricks, stones, timbers, roofs, windows and window frames, floors, and beams used in the structure. Next, I will setup and scan my drawings and blueprints as a guide for my 3D modeling using the MAYA software. The 3D modeling techniques I will incorporate into my fort’s restoration include modeling, lighting, shading, and motion.

After the modeling is complete, I will develop an interactive web page to integrate the 3D model and animation according to visual communications and the usability of a mouse. For example, users will navigate through an old manuscript plan to show the building. They will navigate over to a wall of the building to inform them of how the wall was constructed using stones. They will be able to magnify it in more details. Moreover, they will be able to rotate the building for a 360 degree view. It is for the purpose of the basic circumstance that people prefer staying at home without visiting a location that is far away from their residence.

**Deliverables**

The two computer graphics components for my thesis are 3D modeling and interactive web design.

The MAYA software provides the essential 3D tools to restore the remains of Fort Frontenac. Using actual historical records, maps, plans, and architectural styles of the fort and its surrounding area, I will carefully restore the fort using a 3D model. I need to acknowledge the color of the exterior of the building and the materials it is made from. I plan to visit the Fort Frontenac Museum in order to gain more information and photograph the fort’s remains.
The collected information will assist me in designing my deliverable for my thesis project:

1. Use the MAYA software to model the restoration of the exterior building. Here is a comprehensive listing of 3D models that I will need to build.
   - Bakehouse, Guardhouse, and Hospital
   - Houses for Indian Traders and Houses for Officers
   - Gardens, Barn, and Cow-House
   - Magazines
   - Barracks and Caserns
   - Military and Naval Storehouses
   - Batteries and Retrenchments
   - Shot and Artillery Yard
   - Bulwark
   - Fields
   - Lake Ontario
   - The Cataraqui River

2. Shade the textures of the building included in window frames, walls, and architectural accessories.

3. Add the background of the building and its surrounding environment by lighting adjustment. It effectively brings scenes of the frequent historical enactments.

4. Set in motion a placed 3D camera to create a bird’s eye-view from the fort. It will draw viewers to the greatness of Fort Frontenac and expand their new knowledge of and interest in the fort.

5. Integrate the final model/animation into an interactive website. The user interface design will contain some components to give an archaeological atmosphere to viewers. The layout will look like an archaeological print. The website will be designed to excite their curiosity.

6. I will upload my website to the World Wide Web.
Implementation Strategies

I have been trained in digital art methods, including diverse computer software such as Photoshop, Illustrator, Flash, After Effects, Premiere Pro, Maya, and Cinema4D at Rochester Institute of Technology. Digital art is the cutting-edge artistic method of using digital technology. In addition, I have learned different traditional art techniques, including drawing, watercolor, gouache, traditional print, and pen and ink through my own and at the New York Botanical Garden. These experiences are to build my career in technical illustration. Because I have gone back and forth between traditional techniques, artwork for scientific illustration and digital schoolwork at RIT, my creative activities and theoretical works are crucial aspects of my thesis project. Currently, I am still honing my 3D skills in advanced rendering, lighting, and shading in Maya by means of doing class assignments. My consistent practices expand my skills and knowledge and contribute to the thesis.

Dissemination

For those who are not able to visit Fort Frontenac that is too far away from their residence, this thesis is designed to equip them for expanding their knowledge while saving their money and time. Multimedia in 3D computer graphics design for Archaeology is essential for the future society. Today, people often prefer searching the Internet that provides clickable hyperlinks. Future audience interaction is the main focus of the evident convenience of graphical user interface in computing. Virtual Archaeology is a vital field by means of Internet access to view not only the fort, but also many other forts and traditional and architectural features, such as castles, all over the world. The method is important to distribute my thesis for educational purpose and economy.
To contribute to the thesis, I will make good use of my wide-range skills in traditional art methods and 3D computer graphics design. I will transform historical features that are done in traditional 2D illustrations, into 3D models. Additionally, the idea of the fusion of traditional and digital art methods would be recognized as an innovative artistic expression for technical illustration. Hence, I want to study 3D graphic design in order to contribute to technical illustration which will need resources in the future because of a lack of technical illustrators who are skilled in 3D graphics technology. Therefore, in order to hone the advanced 3D techniques, I believe that the thesis will push me to step up to achieve my theoretical skills in preparation for my future job that will help me to develop wisdom and creativity.

Evaluation Plan
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I will make questionnaires for usability testing according to the effectiveness of knowledge acquisition and the enhancement of user interface, navigation, orientation, visual effect, and physical convenience. I will pilot them with various types of respondents: Faculty members of Visual Communication Design divided into two sections: interaction design and 3D design, faculty members of Archaeology and Museum Study, faculty members, nonrelated to these majors, whose hobby is archaeology or not, respectively. Students who major in Visual Communication Design can also be placed into two sections: interaction design and 3D digital design, students who major in Archaeology and Museum Study, students, nonrelated to these majors, whose hobby is archaeology or not, respectively. This focus group will give me an opportunity to reform my website, and it will be renovated by following and analyzing their feedback.

As a result of revisions on the basis of their responses, I will assess my final project. Evaluations will be based on number of visitors to the site. If it is implemented in public, I will set up online statistics of how many people visit the website per day. I want to carry out new work of the restoration of other models, such as remains of castles and historical sites all over the world.

**Pragmatic Considerations**

I have books on Fort Frontenac borrowed from the Central Library of Rochester and Monroe County. The books and online information are good resources. However, a physical and visual visit is more advantageous to exceptional research. The fort is located in Kingston, Ontario, Canada and it would take three hours and half to drive from Rochester. I want to stay there for a few days, long enough to conduct further research. It would create driving and stay expenses. Additional expenses are art materials, including photograph supplies and working supplies, such as clay and a diorama for modeling a miniature fort standing on the landscape with trees and stones. I have software for 3D, Maya, and for multimedia, BBEdit, Adobe Flash, and Adobe Dreamweaver. I would spend time at school computer laboratory because a large screen of the computer will be dealt easily so as to sophisticate my project work.

**Timeline**

I wish to attain my Master’s thesis before I receive a Master’s degree in May of 2014. I will start thesis research in the mid-fall. I will need to widely read books and webpages on history and social systems when the fort stood at that time in order to imagine the real restoration in 3D view. I will visit the site in November. After collecting good data, I will start building miniature models in a diorama. I will start modeling archaeological buildings in Maya and designing my
webpage interface in the winter and spring. When my final project is completed, I want to hand my evaluation to people in order to make last revisions to the project.
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Conclusion

My 3D virtual model and interactive website will enable users to learn about the historical Fort Frontenac. In addition, they can take a look at its exterior from different perspectives and in detail. The development of an interactive website is essential to and prevalent in our current society. I want to develop a versatile website that informs and promotes virtual archeology. My goal is to take the content and make it a more beneficial experience through the vivid screen rather than studying through textbooks. This encourages them to understand its social system, habits, and historical events that occurred at that time of the fort’s operation.

While we change our understandings from an archaeological viewpoint, the field evolves itself step-by-step. Simultaneously, 3D techniques and web design gradually evolve even though their technology is still developing according to the comfort and convenience for modeling, importing colors and sounds, lighting, shading, setting in motion in 3D and visually communicating a 3D screen and treating with a mouse in a website. The more their technology improves, the more virtual archaeology can develop. Historical sites in repair and abolished cultural methods can be resuscitated through technology.