A Video Game to Attract Interest to Gatchina Palace Museum in Gatchina, Russia

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AN INTERACTIVE QUALIFYING PROJECT REPORT
SUBMITTED TO THE FACULTY OF
WORCESTER POLYTECHNIC INSTITUTE IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF BACHELOR OF SCIENCE

Submitted: May 2021

Submitted to:
Project Liaisons: Elena Repman, NWOTU Project Sponsor
                 Kirill Kovnat, NWOTU Project Coordinator
                 Ekaterina Gaiduk, NWOTU Team Member
                 Daniil Bogdanov, NWOTU Team Member
Project Advisor: Ivan Mardilovich
Project Co-advisor: Karen Oates

Submitted by:
Luke Gebler
Reshawn George
Johnathan Lazo
Rianna Ray
Jonathan Rosenbaum

Date: 12 May 2021

Acknowledgements

Abstract

This project's goal was to create a video game focusing on the Order of the Knights Hospitaller with the intention of attracting visitors to the Gatchina Palace Museum in Russia. The game was sponsored by Northwestern Open Technological University in conjunction with the Financial University of Russia. A prototype game was produced using Unity engine. Playtesters were surveyed to determine the game's effect on interest in museums. Results indicate the game does increase interest, though it should be improved upon.

Executive Summary

The COVID-19 pandemic has been difficult for every industry that relies on in-person gatherings, as they face reduced or nonexistent customer traffic. Physical museums have been hard-hit by the reduction in visitors with 32% of museums either closing or expected to close due to COVID-19. However, museums are also uniquely suited to adapt their outreach to a more online format.

Under the direction of the Northwestern Open Technological University and in conjunction with the Financial University of Russia, we created a video game to bring attention to the Gatchina Palace Museum, which lost visitors under the COVID-19 pandemic. The goal of the game was to act as outreach to increase visits to the museum and offset the number of visitors lost due to the pandemic.

There is precedent for online outreach for museums, but it mostly consists of online tours and educational games, generally meant for science museums. The educational games focus on teaching the player skills or information instead of advertising for a specific museum, and though useful, were not what we were hoping to accomplish with the game. We took inspiration from "Father and Son", a beautiful outreach game designed for the National Archeological Museum in Naples, as it provided educational content about the museum's collection while also encouraging visits to the physical museum.

The game's story focuses on the Order of the Knights Hospitaller, a faction of Christian knights with ties to Gatchina Palace. The game shows historical figures and locations as to bring attention to the Order of the Knights Hospitaller, as the Order is a major part of the history of Gatchina Palace. One of the main goals of the game is to get people interested in this specific history, to indirectly advertise the museum's collection and increase interest in the museum. Specific artifacts are discussed in the game, as to educate players on the existence of such artifacts.

To formulate a game creation plan, we interviewed professors in game design to better understand the scope of the project. After gaining a better understanding of game design, we created a storyboard and paper prototype of the game. This was done to ensure that we had a plan for what the game would look like before development began. Upon completing the storyboard and paper prototype of the game, we focused on level planning, character design, art, and sound design. The art style we chose was a combination of abstract icons and photo manipulations. Character visuals and personality were based upon historical figures related to the Knights such as Tsar Paul I. We then rendered the characters in a similar style to the rest of the art in the game to ensure standardization. The music of the game was created by the group to ensure no legal issues with any music publishers and the sound effects in game were provided by royalty free sound libraries.

The final version of the game involved three parts - a level selection map based on the island of Malta, the home of the Knights, a combat mini game called Clash, and a visual novel-style storytelling minigame called Text Quest. The level selection map guides the player through Malta as the story progresses. The Clash minigame is placed intermittently throughout Text Quest and is the source of most of the gameplay. It is a turn-based volley fire war game wherein the player draws cards, or units, from their deck to play on the battlefield. Upon victory the player progresses the story and upon failure you will be prompted to retry. Text Quest is where the story takes place. The main purpose of Text Quest is to provide the educational aspect of the game. In order to keep the player engaged throughout the story, there are multiple points where the player has a choice in either what to do next or how to respond to the person talking to them. These choices can affect the rest of the game in a few different ways. Some choices will have a positive effect on the player, granting them extra units for an upcoming Clash battle, while other choices will have lasting negative effects such as a harder version of Clash or more battles to endure.

We ensured quality in our game through playtesting. We recruited volunteer playtesters to play the game, and then surveyed them on their experience to ensure the highest possible quality for the sponsor. The survey included a multitude of types of questions in order to get a diverse response from playtesters. These questions included multiple choice, Likert scale, and short response, allowing the playtester to respond with as much or as little detail as they felt necessary. The results of the survey indicated that the game needs to be more user-friendly, with perhaps a tutorial section for each type of gameplay. It also indicated the need for improved artwork and an expanded story, but also stated that the game works as outreach for Gatchina Palace.

For future development, we recommend the IQP team view the museum in person, to gain a better understanding of Russian Culture and learn more about the museum itself. The team also believes it to be important to set goals and timetables early to ensure all possible development time is used effectively. To that end it is necessary to divide the group based on their skills and have each member work on what they are best at. There are also changes to the story that can be made such as increasing the amount of filler dialogue. This change will result in a smoother flow to the dialogue and a longer fuller game. The story could also include more options/branches added to increase player choice and thus increase player engagement. More short stories should be added to the game to better utilize the map mechanic and to increase the length of the game. If the group lacks a skilled digital artist, we recommend the use of neural network programs to manipulate photos to create original art that can be used for the game, as art is one of the most labor-intensive facets of game development.

Overall, our work has laid out the groundwork for a continuation of the project. We believe that the end product has great potential to achieve the goal of attracting visitors to Gatchina Palace but needs more time and resources to make a truly polished game.

Authorship

All members of the team made contributions to this report and team consensus was reached on all major decisions. All team members assisted in editing each section. The original authors for each section are as follows:

Section	Authors
Title Page	Rianna
Abstract	Johnathan L, Rianna
Acknowledgements	Luke, Reshawn
Executive Summary	Johnathan L, Luke, Reshawn, Rianna
Introduction	Johnathan L, Reshawn
Background	Johnathan L, Jonathan R, Luke, Reshawn, Rianna
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Chapter 1: Introduction

The COVID-19 pandemic has been difficult for every industry that relies on in-person gatherings. Physical museums have been hard-hit by the reduction in visitors but are also uniquely suited to adapt their outreach to a more online format (Kishkovsky, 2020). The Smithsonian's digital archive and digital tours of St Petersburg's own Hermitage are excellent examples of this adaptation (Apple, 2020). However, these forms of digital outreach have their limitations, as they struggle with issues with navigability and a lack of widespread audience appeal (McClymer, 2008). These outreach programs are biased toward those visitors already invested in the museums, and don't work to develop interest among uninterested audiences. In order for museums to succeed in the modern, online age, more engaging forms of online outreach will have to develop. Those forms of outreach will greatly increase visitor attention and improve the educational reach of museums.

On the other hand, some museums opted for more ingenious ways to attract attention. The Archeological Museum of Naples, for example, created a game 'Father and Son' to teach online patrons about the history of their museum. The game became a featured game by Apple in 90 countries, far expanding the museum's outreach.

The goal of this project was to learn from the successes of Father and Son to appeal to a wider audience for our sponsor, The Gatchina Cultural Museum, housed in the Gatchina Palace, by creating a video game based around the fascinating history of the museum. Specifically, the focus was on the Order of the Knights of Saint John of Jerusalem, also known as the Knights Hospitaller, who first came to Russia under the auspices of Emperor Paul I, to whom Gatchina Palace belonged. The purpose of this game is to increase interest in the museum during the COVID-19 pandemic and attract more visitors when the museum can reopen, hopefully more so than a strictly archive-based outreach program. Furthermore, the game also provides educational opportunities for people who can't access the archives at this time. Our group found it beneficial to research the impact of COVID-19 on Russian museums, the history and progress of virtual museums, and the history and impact of the Knights Hospitaller for this project.

Ultimately the group hopes to help local museums in Russia increase outreach during this pandemic as they present a valuable learning resource that could be lost to us if they are not able to maintain engagement through these trying times. Other museums' efforts in creating online classes and discussion have shown us how museums could remain relevant and informative in a post COVID-19 and increasingly digital world.

In the chapters that follow we lay out the current situation of museums struggling with COVID-19 and the history of Gatchina Palace Museum, and the methodology we used in creating the game. We determined the background needed for the project centered on knowing the international and Russian museum response to COVID-19, what the Gatchina Cultural Historical Museum is, the history of the Knights Hospitaller, and other games that were published by museums. In methodology we discuss how we used interviews, storyboarding, level, character, art, and sound design to make the game. We also discuss the survey we took of audience reaction to the game.

Chapter 2: Background

In the wake of COVID-19 travel restrictions, many museums lost visitors and have had to turn to online outreach to maintain interest in their offerings (Kishkovsky, 2020). In order to renew interest in Gatchina Palace Museum, our sponsor museum, we were tasked with creating a video game based on the unique history of the museum. In this chapter we describe the impact COVID-19 has had on museums across the world and their responses and conclude with the history of the Order of the Knights Hospitaller and their connections to Gatchina Palace Museum. The Knights Hospitaller will form the basis of the story of our game.

2.1 International museum responses to COVID-19 realities

COVID-19 lockdowns and travel restrictions have forced museums to become more virtual than they have ever been before. In the years preceding the COVID-19 pandemic, museums were already trying to modernize their offerings by expanding their digital presence. Even before travel and gathering restrictions, museums were trying to appeal to an increasingly digital audience and further drive engagement and interest in their physical offerings (Grant, 2020). Museums such as the Guggenheim Museum in New York offered online tours or viewings of some of their exhibits but refrained from offering most of their collection. For some museums limiting their online offerings is a strategy to avoid detracting from in-person visitors, though for others the limited selection is due to not investing enough resources into the project. During the pandemic, when virtual became the only option, museums started ramping up these existing projects. For example, the MET had a video series called MET 360 before the pandemic, which offered virtual tours of some of their collections. In the week after they closed down their physical location, they reported seeing a 4000% increase in online traffic to the 360 program (Grant, 2020). The increase in interest of virtual tours led them to expand on the program, offering more pieces online.

Museums took different approaches to creating their online content. While the majority of them virtualized their exhibits in some way, some went further. Some museums such as the Palais Garnier in Paris made educational games as a way of increasing engagement, especially among younger patrons. Other museums offer online educational opportunities apart from articles or recorded debates between experts. Some museums such as the American Museum of Natural History offer online field trips which range from virtualized experiences for kids to tailored educational experiences for classrooms (Cromwell, 2020).

While museums have seen increased traffic online and many of their programs have seemed to take off, financial directors don't have as positive of an outlook. The director of the museum of fine arts in Houston, Gary Tinterow has said this about online patrons: "There has been a longstanding debate within the museum field over whether virtual visitors are equivalent to actual visitors to the physical museum, and the answer is that they aren't equivalent" (Grant, 2020). The director then mentions how physical patrons end up purchasing entrance tickets, season passes, food at the cafes, and items at the gift shop, while online consumers tend to leave when forced to pay for access to a web offering. Successfully monetizing their online content is one of the major challenges facing museums in the COVID-19 pandemic and is something they have yet to find an answer to with 32% of museums reporting that they are either close to closing or are closing due to the pandemics impact on their revenue (Wright, 2020). The loss of revenue means it's more important than ever for museums to attract interested visitors, and the group' game will assist in spreading interest in the Gatchina Cultural Museum.

2.2 The Russian Museums response to COVID-19 pandemic realities

Like their international counterparts, Russian museums were closed to visitors for the majority of 2020. The Hermitage, Russia's largest museum, reported losing almost half its annual revenue after shutting down in March. With the Hermitage's catastrophic drop in revenue, museums need to start finding other ways to bring in money. On May 8th, 2020, a Russian government decree was signed to help compensate for the loss of revenue. While the government's decree helped, the museums are still closed to visitors, and there is still not a constant flow of revenue. Museums such as the Tretyakov opted to start construction in the absence of tourists, something that would have otherwise forced them to partly shut down. Most museums have also turned their focus to their online outreach, constantly updating their websites and spending money to expand their online content (Kishkovsky, 2020).

Many Russian museums switched to online events, which has both drawbacks and benefits. While interacting with exhibits virtually can be less immersive, virtual exhibits allow for larger audiences. Examples of online events held by Russian museums include the Tchaikovsky Concert Hall's online musicals and orchestras, and an interactive project where participants can send in artwork to the museum's website for an exhibit on self-isolation put on by The Museum of Moscow and Triumph Gallery (Latypova, 2020). Russian museums seem to be finding success by directly interacting with the audience, and this project's plan for a game meshes well with that trend.

2.3 Gatchina Cultural Historical Museum

Many of the museums impacted by COVID-19 are located in Saint Petersburg, a city seen as the cultural capital of Russia. Home to the Hermitage, the Russian Academy of Arts, the Faberge Museum, and many other centers of Russian heritage, Saint Petersburg supports a great wealth of grand museums (ZAO, 2021). However, the city is also home to a network of smaller museums, many of whom have been hit hard by the reduced traffic caused by the COVID-19 pandemic. The purpose of this project is to assist one of those museums, the Gatchina Cultural Historical Museum, in reconnecting with visitors and to encourage people to visit their collections once the pandemic is over.

Gatchina Cultural Historical Museum, housed 45 kilometers outside of St. Petersburg in the historical Gatchina Palace, is home to collections of historical Russian textiles, arms, lithographs, and furniture. The Palace, shown in Figure 1, itself is an important part of the history of the Russian aristocracy, as it was initially commissioned by Catherine the Great and gifted to her favored Count Orlov, and later passed down to her descendant Emperor Paul I (Gatchina Palace and Estate Museum, 2018). Paul I was the tsar responsible for inviting the Knights Hospitaller to establish themselves in Russia in 1797. Gatchina Palace, as Paul I's home, is thoroughly tied to the knightly order's history in Russia (Encyclopedia of St Petersburg, n.d.).

Figure 1: "The Great Gatchina Palace. Большой Гатчинский Дворец." by Peer.Gynt is licensed with CC BY-SA 2.0. To view a copy of this license, visit https://creativecommons.org/licenses/by-sa/2.0/

About 1.5 kilometers away, another part of the Gatchina palace organization called the Priory Palace, shown in Figure 2, stands as a small museum. The Priory Palace was presented by Emperor Paul I to the Maltese Order, a catholic humanitarian religious group which claims to be a continuation of the Knights Hospitaller, though they never used it. Uniquely for Russian palaces, the priory was built using rammed earth. The palace stands today as a historical museum which focuses on the unique architecture of the palace, and its history (Gatchina Palace and Estate Museum, 2018). The priory's history with the Maltese Order and their ties to the Knights Hospitaller offers another historical connection to the Knights that can be used to build the story of the project's game.

2.4 History of the Knights Hospitaller

The Order of St. John of Jerusalem was founded in the Hospital of St. John by the Benedictine lay brother Gerard Thom at the end of the First Crusade. This Order, which would eventually be known as the Knights Hospitaller, was charged with caring for the poor and sick among the Christian pilgrims to the Holy Land. Under Gerard's successor Raymond de Puy the Order acquired large amounts of land throughout Jerusalem to fund its growing militarization. Under Raymond de Puy, the Benedictine Rule of the Order was substituted by the Augustine Order, and the Knights combined the task of tending to the sick with defending the borders of Jerusalem (The Editors of Encyclopaedia Britannica, 1998). At the same time, the Knights expanded their role into protecting pilgrims as they traveled to the Holy Land, further increasing their militarization. The Knights would remain within the Holy Land until the fall of Acre in 1291, where the Hospitallers would move to Limassol in Cyprus (The Editors of Encyclopaedia Britannica, 1998). Less than a decade later the Knights Hospitaller would acquire the island of Rhodes by conquering it from the failing Byzantine Empire, becoming an independent state in the Eastern Mediterranean. The state founded by the Order was a unique state as it still held the structure of a monastic order and was ruled by a celibate brotherhood of knights and their elected grandmaster.

After conquering Rhodes, the knights became a major problem for Muslim shipping in the Eastern Mediterranean, attacking any ship they found that was not Christian. These actions effectively made the knights into pirates, though Christian rulers were willing to look the other way and even assist the knights since they would only harass Islamic nations. This period of piracy would last for over two centuries until the knights were finally forced off their island after a long and protracted siege by Suleiman the Magnificent. In an act of kindness, Suleiman allowed the Knights to leave peacefully with any citizen of the island who wished to join them. The Knights were without a central base for seven years, until the king of Spain gifted them the island of Malta, shown in reference to Europe in Figure 3, in 1530 (Overly Sarcastic Productions, 2019, 04:21-04:33). From their new base in Malta, the Knights continued their piracy against the Ottomans in the Western Mediterranean, becoming a major thorn in their side once more. Furious that the Knights had come back and continued to attack his empire after his show of mercy, Suleiman the Magnificent assembled 50,000 men to attack the island in 1565. The island had a garrison of only 5000 men, while Suleiman's army was the largest seen in nearly a millennium. The Knights managed to hold on for over four months until reinforcements from Spain and the rest of Christendom relieved the siege, saving Malta and the Knights. For their act in what likely saved Europe from further Ottoman invasions, the knights were given lavish gifts from all over Europe, which they used to rebuild and fortify Malta in the event of another Ottoman invasion.

Figure 3: "File:EU-Malta.svg" by NuclearVacuum is licensed with CC BY-SA 3.0. To view a copy of this license, visit https://creativecommons.org/licenses/by-sa/3.0. A map of Malta in context of Europe and the world. The magnified portion is the isle of Malta off the coast of Italy.

A second Ottoman invasion never came to pass, and the Knights would remain relatively peaceful until 1798, when Napoleon asked to dock in Malta for repairs and resupply on his way to Egypt. After being told he could only dock two ships at a time, Napoleon invaded the island, establishing a republic and scattering the knights across Europe. One prominent branch of the order went to Russia where they were sheltered by Tsar Paul I. The Russian Tsar had the Priory Palace built for them in Gatchina and in turn the Knights elected Paul I, a member of the Russian Orthodox faith, as grandmaster of their Roman Catholic order. Paul I invited the Knights to Russia because he admired their chivalrous nature and wanted them to spread their idea through Russia (Dijkhof & Johannes, 2006). As Napoleon ravaged Europe, the Knights were forced to rely increasingly on their Russian holdings to survive, even though the Pope did not recognize the Russian Tsars as the grandmasters of the Order. Eventually the Order was given a new grandmaster by the Pope in 1879 which led to an increased focus on international humanitarian and religious aid (MediaWiki, n.d.).

Given their fascinating history and strong ties to the Gatchina Palace, the Knights Hospitaller are well-suited to provide the basis for museum outreach materials; as such, this project's game is focused on the Knights and their experiences in Russia. In the present day, the Knights Hospitaller lives on through successor chapters. Many of them still provide humanitarian aid throughout the world, continuing the legacy of the Knights Hospitaller (Sovereign Military Order of Malta, n.d.).

2.5 Other Museum Game Applications

For most museums, their online outreach involves some type of virtual tour or online learning resource. Not many have an app or game dedicated to the museum. The majority of museum-based games that exist are part of science museums, mostly targeted towards children. However, non-science museums and historical buildings have begun to expand their repertoire. Though not a video game, in 2019 the Palais Garnier in Paris introduced an interactive live play called "Inside Opera", where the player explores the opera house and interacts with actors from the Phantom of the Opera to find clues and lift a curse (Styx, 2020). Another notable outlier is the game "Father and Son", a story driven app game where the player explores and slowly learns about each art piece in the Naples Archeological Museum while also

learning about the history of the area. Father and Son entwines the captivating story of an estranged father who worked as an archeologist and his long-lost son following in his footsteps, with the stories of artifacts in the museum. This interweaving narrative allows the story to progress while the player learns about different pieces of art or history (Father and Son, 2017). The common theme among museums is that the games tend to have an educational component or aspect, with traditional museums focusing on teaching history through a variety of ingenious methods. These educational components blend well with our planned focus on teaching about the Knights Hospitaller.

2.6 Summary

COVID-19 has created a crisis for museums that none were prepared for, causing financial difficulties as they had to close their doors to patrons and the money they previously brought in. Just like with many other businesses, museums have responded by trying to transition to an online format. This transition has brought its own challenges and opportunities, with budgets remaining tight while online engagement soars. It's our goal to help smaller local museums in Russia such as the Gatchina Cultural Historical Museum (housed 45 kilometers outside of St. Petersburg in Gatchina Palace) increase outreach and prepare to reopen their doors once the COVID-19 crisis is under control. We plan to achieve this increase in engagement and interest through the creation of a game that will focus on the history of the knights hospitaller. We hope this project helps these museums through these difficult times as the knowledge they contain is vast and unique in nature, it would be a loss for us all to see them close their doors for good.

Chapter 3: Methodology

The goal of this project was to produce a video game designed to create interest in the Gatchina Palace Museum in Gatchina, Russia. In order to ensure that the game functioned in its purpose of attracting visitors to the museum, we recruited volunteer playtesters to play the game and then surveyed them about their experience. Our approach to the project fulfilled these three goals:

1. Interviewing experts in the field of game development and using their expertise to shape our approach to game development.
2. Developing a video game in order to generate interest in the Gatchina Palace museum.
3. Having playtesters test the game to determine wide-spread appeal of the game.

This chapter describes the methods we used to fulfill these three goals.

3.1 Interviewing Game-Making Experts

To supplement our knowledge of game-making and game design, we interviewed Jennifer DeWinter and Brian Moriarty, both experts within WPI's Game Development faculty.

Our questions for Professors DeWinter and Moriarty were as follows:

- Is it possible to develop a video game without major artistic skill?
- What is the first step to storyboarding a video game?
- Do you have recommendations for useful guides to game/level development?
- Do you take accessibility concerns into account when designing games?
- Do you have any experience working in Unity? Any advice on that front?
  - Are there legal concerns about using assets from the Unity store?
- Do you have experience developing app-based games? Any advice on that front?
- Do you have any recommendations for acquiring/developing art assets?
- How much time should be devoted to bug testing in a 7 week development cycle?

Based upon the recommendations of the professors, the team chose the method of storyboarding to lay out the structure of the game.

3.2 Similar Museum Games

In order to support our stated goal of producing a video game, we examined the existing examples of museum-inspired games. The best outreach at the time was in the form of app-based games. The team studied the gameplay of the games "Father and Son", as well as "Total Darkness" and "Transmission" by the London Science Museum, other museum-sponsored games that provided an example for our own work (Science Museum, 2018). The development goal of the game is to mix educational aspects with advertising for the museum, and as such we studied the game with a gameplay style that best mixed those two goals. Every member of the group familiarized themselves with the chosen game.

3.3 Storyboarding the Game

In order to develop a coherent and educational narrative for the game, we used storyboarding to map out our ideas for the plot of the game. Storyboarding the game helps focus the scope of the game and determine what historical information is to be included, as it is

not possible to go over the entire historical context of the game's story. Rather, the purpose of the game is to drive engagement with the museum by acting as an introduction to its history. The game is based on the popular board game Risk, with the addition of various minigames and text quests to tie in historical figures and artifacts related to the Gatchina Palace Museum and their connections to the Order of the Knights Hospitaller.

The storyboarding process that we followed involved identifying the key moments in the plot and then meshing them together in order to provide an easy-to-follow story. The team researched historical figures connected to the Knights Hospitaller in the era of Napoleon's conquering of Malta, shown in reference to Europe in Figure 3; based on this research, the team selected important historical figures and places for inclusion in the game. Once the historical figures were chosen, we proceeded with the early steps in the storyboarding process, including character design. The storyboard was adapted and updated during development as the team's creative vision shifted and was challenged by the practicality of game development.

The story of the game was created in collaboration with our Russian counterparts and focuses on Napoleon's invasion of Malta and the subsequent movement of the Knights Hospitaller to Russia. The player views multiple historical events through both the Russian and Maltese perspective. The game depicts many historical figures making decisions and actions during the invasion of the island. The main faction defending the island are the Knights Hospitaller. In the game, the player moves alongside the Knights, and sees how they arrived in Gatchina, Russia after Napoleon's invasion.

Upon narrowing down the big picture story idea, we wrote a script for the story and implemented that into the game in an engaging and interactive way.

3.4 Level Design

When beginning to design the game, our focus was mainly taken from what the museum stated to be the most important aspect of the game, education, as well as the most important aspect for the player: fun gameplay. All of our level design was focused on the balancing act between these two clashing ideas, finding a way to implement both of them in a coherent and constructive manner.

Our sponsor expressed their desire to develop the game in the Unity engine, as it is a free and highly versatile game engine that is very useful to both experienced and inexperienced game developers (Unity Technologies, 2020). We used Unity version 2020.3.0f1 for this project. Additional information about Unity can be found in Appendix B.

We created three gameplay types for the game. The first was called Text Quest, in which the player is shown a dialogue to tell the story of the game and is given options to respond to the dialogue. The player's responses affect the story of future Text Quests, making for more engaging, player driven gameplay. To design the dialogue the group considered what style of writing best fit the story we were telling, as developed in the storyboarding section. Figure 4 shows an example of a dialogue with Paul Tsar I. The box contains Tsar Paul's dialogue, while the player's dialogue options are displayed on the left.
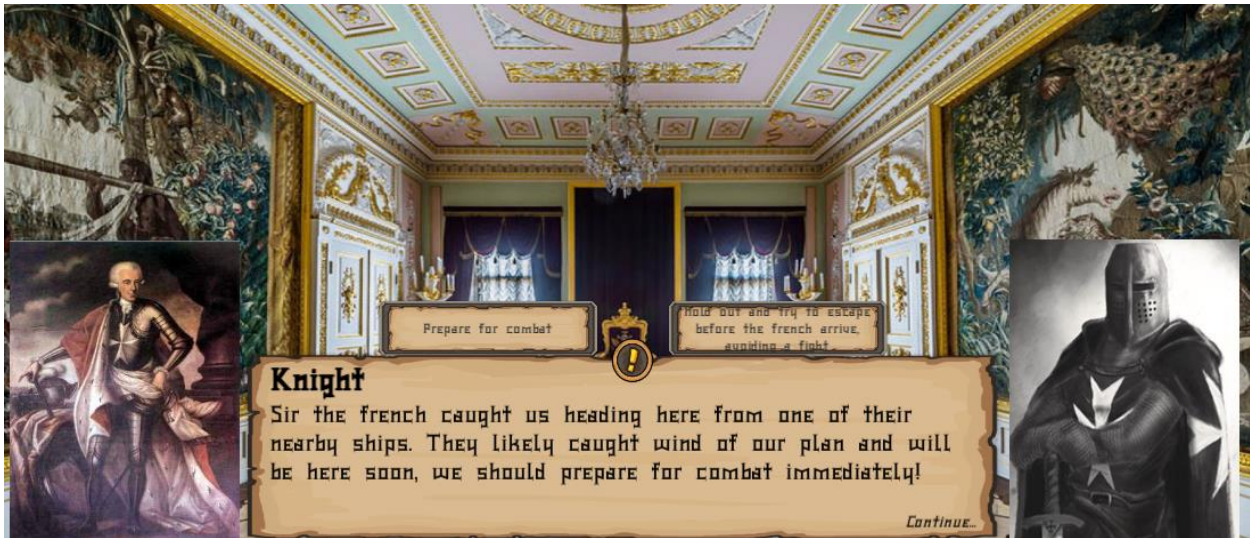
Figure 4: An example of the Text Quest gamemode. The middle box contains Tsar Paul's dialogue, while the boxes on the left contain the player's options.

Next the group created Clash, the combat phase of the game, shown in Figure 5. In this phase the player places combat units on a grid, each with different strengths – e.g., infantry, cavalry, and cannon. The player sets up their units on one side of the battlefield while the game sets up enemy units on the opposite side of the field, and then the simulated battle occurs. If the player wins they gain additional units which will help them with harder battles.
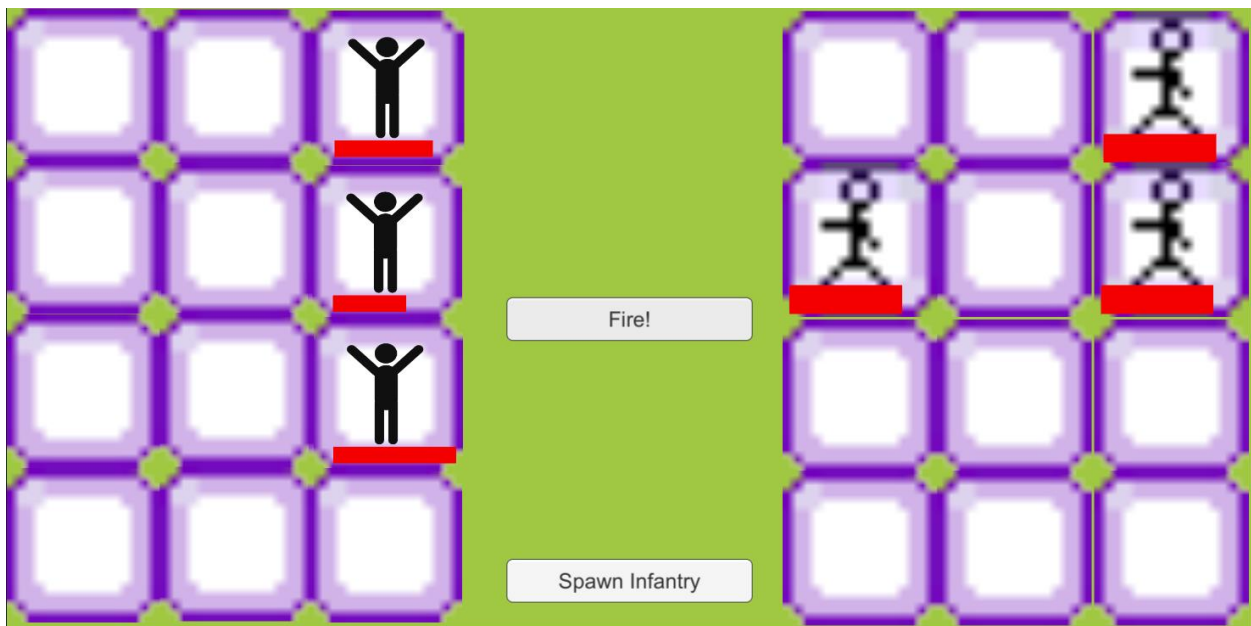
Figure 5: An example of the Clash gamemode. On the left are the player's combat units, while on the right are the enemy's units.

Players access the separate parts of the game with an interactive map of Malta, demonstrated in Figure 6. The map shows different regions that the player can select. Each region progresses the story and shows the type of gameplay available within the region.

Figure 6. An example of the selection map.

The game begins with a text quest that sets up the story. After the text quest concludes, the player is shown the selection map and can choose different regions. Each region takes the player to a Clash minigame, and after completing each minigame the player is shown another Text Quest which advances the story.

3.5 Character Design

Characters are the instruments that drive the plot. Our focus on the history of the Knights Hospitaller means that most of our characters are based on real historical figures. One of these figures is Tsar Paul I of Russia, who brought the Hospitallers to Russia, and as such is very important to the story.

The characters were designed in a style that represents their historic period and their role within it. The fact that they are historical figures presented a challenge in that their appearances are predetermined, which gave the team less leeway in terms of art design. Original models were created in the team's original art style to represent the historical figures, while the characters' personalities are based on accounts of the actual personalities of the historical figures.

3.6 Art and Sound Design

All games need art assets in order to define what's actually happening in the levels, and to make the visuals appealing in order to encourage longer play. The visuals in the game were a combination of free assets from the Unity Asset Store and art assets we developed ourselves. The Unity Asset Store is a library of free and paid art and sound assets that game developers can freely use in games developed in Unity (Unity Technologies, 2020). Additional information about Unity and the Unity Asset Store can be found in Appendix B. For the most part our group chose to design the visuals ourselves so we could have more freedom over what the game looks and sounds like.

For the development of art assets, our group used the program Gimp to draw two-dimensional (2D) sprites, backgrounds, and tiles. A sprite is a computer graphic which may be moved on screen or manipulated. This is either the character model or something the character needs to move or interact with. A tile is a block that is placed on the screen for the character to stand on or to act as a wall. This is either the floor, ceiling, or wall of the level. The specific style

of the art is often referred to as pixel art. This is a common art style in old and retro games for its simplicity and ease of implementation.

Our group developed an original score for the game using Hookpad, an online MIDI generator (Anderson & Carlton & Miyakawa & Schwachhofer, 2020). A MIDI is a type of file that contains notes that can be played using different sound libraries and is commonly used for digital orchestration. Additional information about Hookpad is available in Appendix C. Our group wrote several original background songs to portray different moods - e.g., slower music for the title screen, and fast-paced, intense music for battles.

3.7 Survey of Audience Reaction

Ensuring the player has a consistent and enjoyable experience when playing the game is an essential part of game design. Making sure that the game runs without bugs, runs on most hardware, and that the process of interacting with the app is enjoyable are all parts of improving the gaming experience.

To achieve the goal of a smooth experience, our team ran testing ourselves and recruited playtesters to make sure that no bugs or other gameplay inhibiting issues remained. To evaluate their gaming experience, the playtesters were asked to fill out the audience reaction survey detailed in Appendix A, which includes questions about gameplay and asks them to describe in detail any bugs or glitches they ran into.

The usage of surveys allowed us to gather a plethora of important information on the game. Surveying was extremely important following the game development process as it gave valuable feedback on the strengths and failures of the game. In the case of gameplay issues and glitches, the survey responses helped the team identify what was causing the issue and how to potentially rectify it. Getting more people to test the final product allowed us to see how the game functioned on a wide range of hardware. As well, it allowed us to identify more exploits or bugs than we would have been able to isolate ourselves. A wide range of playtesters mitigated the risk of rare bugs being overlooked and allowed us to see the severity of issues, and how common they were among the playerbase.

The audience reaction survey also asked questions about the player's interest in Gatchina Palace Museum and its associated history - e.g., "The game made me want to learn more about the Knights Hospitaller". The survey responses helped guide us on the big picture questions that ultimately shaped how the game functions. Formatting each question was just as crucial as the question itself. It was important to assess whether the information was more valuable as a yes/no question or on a 1-5 Likert scale. It is also important to allow people to elaborate on certain topics to give more detailed input, especially in detailing bugs they experienced. Having open ended short response questions was invaluable to deciphering what people experienced with the game. A full list of survey questions is available in Appendix A.

After all the data was gathered, we compiled all the responses to give us averages on yes/no questions, the average score for the scaled questions, and a list of the individual responses to short answer questions. Each issue identified was given a severity rating of 1-4, with 1 representing major experience-breaking issues that needed to be fixed immediately, while 4 represented small cosmetic issues like fonts or colors. For each of the quantitative questions, if over a third of survey respondents indicated the existence of a problem then the problem was considered a high-severity issue and the group reached a consensus about the appropriate response to each issue. With the severity ratings of problems, we were able to prioritize the issues we needed to focus development time on. Quality assurance and testing continued throughout the development process, so we could fix problems as they appeared.

Each individual response was reviewed by the group and any new ideas we found valuable were developed into recommendations for future development of the game.

Chapter 4: Results

The focus of this project was developing a game for Gatchina Palace Museum in Gatchina, Russia, and then using that game to answer a research question: Can a video game be used to increase interest in a museum?

4.1 Summary of Interview of Game Experts

Interview responses from Professor Jennifer DeWinter fell into three categories. The first category revolved around inspiration. She suggested we familiarize ourselves with Gatchina Palace, in order to present it properly in the game. As well, she suggested we choose games similar to our game idea and familiarize ourselves with them - we decided to study the game "Father and Son". She also mentioned that a game about knights is very masculine and might not resonate well with a female audience.

The second category revolved around workflow. This involved suggestions that we finish the game in 3.5 weeks so we could have the rest of the IQP for bug fixing. She also suggested we familiarize ourselves with scrum and agile development strategies, which are commonly used in game development - luckily our group already had familiarity with these strategies. Her suggestion that we make a paper prototype to lay out the structure and goal of the game prior to beginning development led us to storyboarding the game.

The last category concerned practical considerations about the development process. Professor DeWinter said that the most important part of game development is developing the art assets but reassured us that for our game the assets should be relatively easy to make. She also urged us to consider how the museum would integrate into the game, and how the game would ultimately reach its intended audience - e.g., a link to download the game on the museum's website, or perhaps a discount code that can be redeemed on the app store. For art, Professor DeWinter recommended that we investigate the Unity Asset Store.

The interview with Professor Brian Moriarty revolved around the process of creating art for video games, especially without the input of a skilled artist. He also recommended the Unity Asset Store, as well as that we investigate databases of free-to-use icons such as Thenounproject.com. For art that couldn't be represented through abstract icons, he pointed us toward style transfer programs, which are AI-driven programs that transfer the art style of a painting onto another piece of art, and recommended we apply picture filters, available on a variety of photo editing software and phone apps, in order to produce art of stylistic consistency. As an example, he recommended "Streams of Nurture", a video game produced as part of a WPI IMGD MQP that used style transfer programs to generate its art (Sabbagh & Miller, 2017). Professor Moriarty also suggested that we clarify our priorities and determine the essential parts of the project and build a plan around those essential goals.

As a result of these interviews, the team determined that the most integral parts of the game were the basic functionality for the Clash and Text Quest minigames and the level selection map and focused on completing those objectives within our timeframe. The team also decided to explore more creative options to produce artwork for the game, determining that we preferred iconic representation of objects for the minigames.

4.2 Evaluation of Similar Museum Games

"Total Darkness" and "Transmission" by the London Science Museum did not fit our qualifications for inspiration for the game, as they focused on education rather than the museum itself (Science Museum, 2018). "Father and Son" by contrast, mixes educational aspects with advertising for the museum, which is the development goal of the game (*Father and Son* (1.5.1), 2017).

Published by the Museo Archeologico Nazionale in Naples in 2017, Father and Son is an app-based game that uses the simple story of a son learning about his dead father to explore the history of Pompeii and Ancient Egypt. The game itself is a side scrolling point-and-click

adventure, with button prompts and object interactions acting as controls. The game is powered by the Unity engine, and is available in English, French, German, Russian, Chinese, Italian, Neapolitan, Spanish, Portuguese, and Japanese. The art style is simple, but distinct and beautiful, with most detail lost to impressionist silhouettes and smears of color that don't clutter the screen, as shown in Figure 7 (*Father and Son* (1.5.1), 2017).

Figure 7: Father and Son game still. Image courtesy of Father and Son website.

The story revolves around a son, whose father was an archeologist at the Naples National Archaeological Museum. The father and son were not close, and the game starts with the father passing away. The father leaves his work for his son to experience and explore. The son is an artist and can make his father's work into more than simple historical pieces.

Primary gameplay is available upon downloading the free game; the gameplay loop centers on walking through the Naples National Archaeological Museum as the son and exploring the exhibits. When the player clicks on an exhibit, they are transported back in time to whenever the artifact was significant, and play out the story of that artifact, providing an educational insight into its history. Certain wings of the museum are locked unless the player turns on location services on their phone while in the Museo Archeologico. Locking gameplay in this manner is useful for attracting visitors to the museum when they can visit but is less useful during the COVID-19 pandemic when visitation is not possible (Museo Archeologico Nazionale di Napoli, 2017).

4.3 Results of Storyboarding and Paper Prototype

The storyboard provided a plan to follow for development. Each of the three major sections of the game were storyboarded separately and reviewed with our sponsor before we began development.

The first paper prototype developed for the game, shown in Figure 8, was based on the point-and-click adventure game genre. This style of game would have the player character move between various screens, looking for items and interacting with the scene to solve puzzles and progress the story. In game design, a puzzle is anything where the player must manipulate the environment to progress in the game. However, the sponsor indicated that they were not looking for a point-and-click adventure game, which led the team to design the second paper prototype.
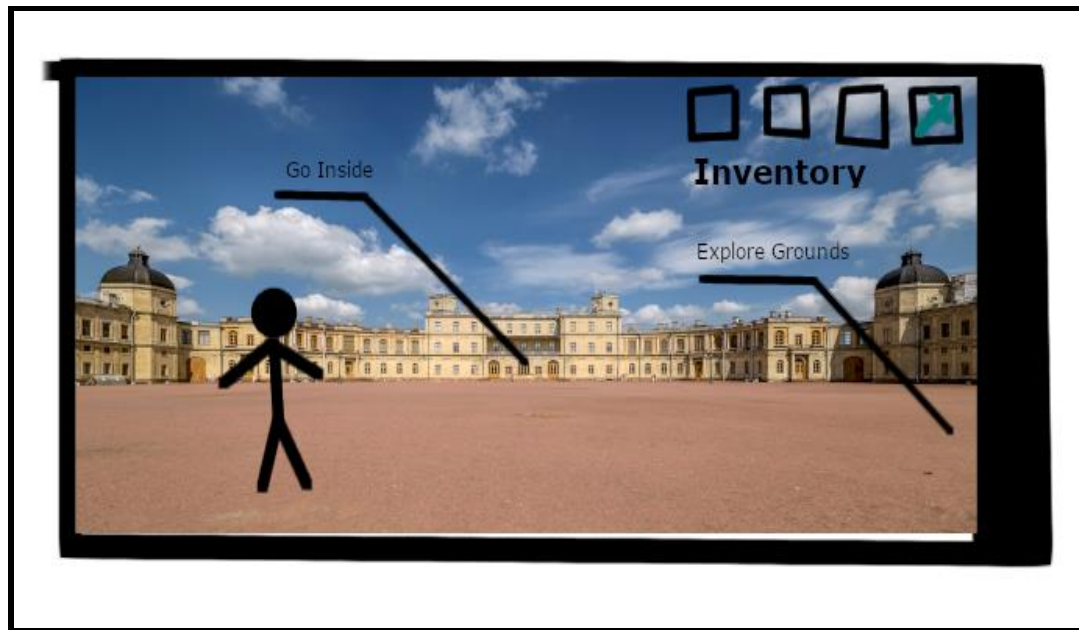
Figure 8: Paper Prototype of the point-and-click adventure game

      The prototype that ultimately met the sponsor's approval was divided into three parts, making up the three sections of the game, which were the level selection map, the Clash minigame, and the text quest minigame.

      The paper prototype of the level selection map included a map of Malta, displayed in context of Europe in Figure 3, and an example of the menu, shown in Figure 9, that would pop up when the player clicked on a region. The menu would include the name of the region, the minigame that could be played in that region, and a settings tab. It also included a button to close out of the menu, indicated in the prototype with a red arrow.
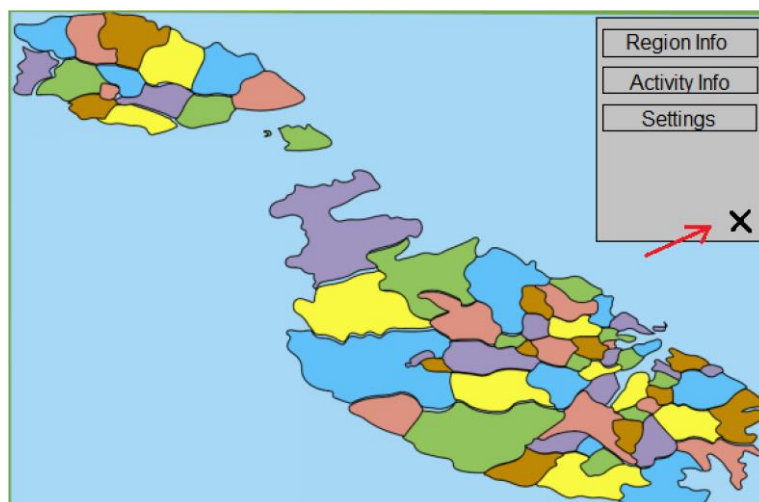
Figure 9: Paper prototype of Level Selection Map.

      Figure 10 is the paper prototype of the text quest minigame. It provided a basic layout of the activity, including the image of the character speaking, the character's dialogue in a box to the character's side, and a continue button that could be pressed to move the dialogue forward.

Figure 10: Paper prototype of Text Quest.

The paper prototype of the Clash minigame, shown in Figure 11, demonstrated the battle grid the battle would be laid out on, the player's and enemy's combat units, the button to begin combat, and the menu on the bottom of the screen where the player could drag and drop units and artifacts from for use in combat.

Figure 11: Paper prototype of Clash minigame.

Once a paper prototype was produced that pleased the sponsor, development of the game began in earnest.

4.4 Results of Level Design

To progress in the game, the selection map will allow you to move from one part of the game to another. Selecting a region on the map shows historical information about the area, as well as the type of activity that can be played in that area. A sample version of the map can be seen below in Figure 12:

Figure 12: A sample of the selection map

Text Quest is used to progress the story while also teaching the player history and giving them choices along the way. An example of a choice being made is shown below in Figure 13:

Figure 13: An example choice in Text Quest

The choices the player makes during the Text Quest affect how the rest of the game plays out. In this scenario, preparing for battle allows you to be better prepared for the upcoming clash event while attempting to flee 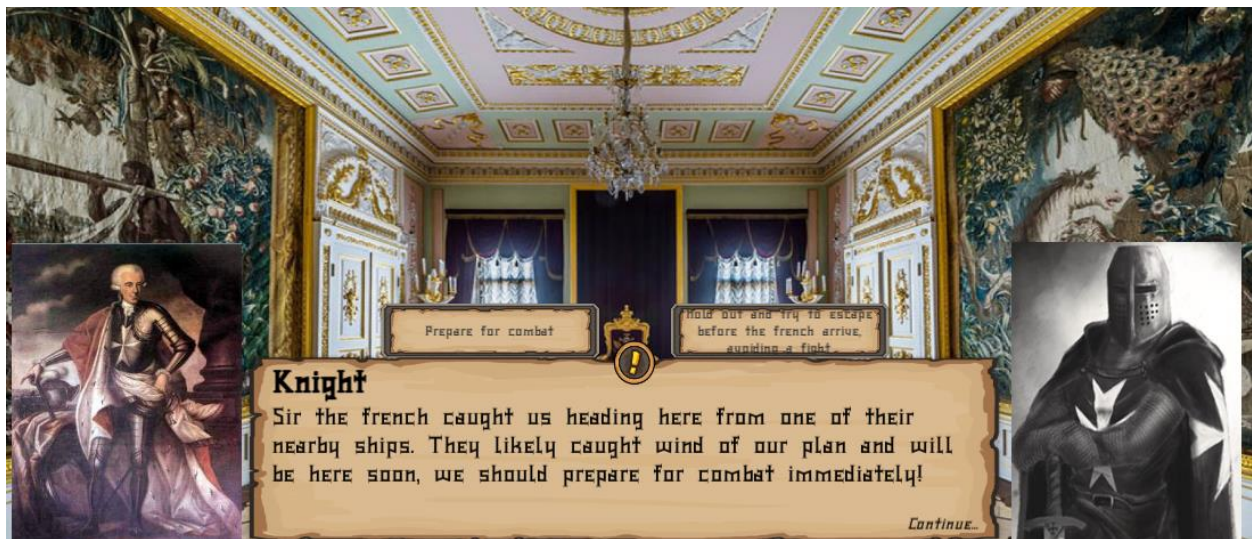allows the French enough time to get extra reinforcements to fight you. These options are used in order to keep the player engaged with the story which allows for us to more easily teach the history to the player.

The historical aspect of Text Quest is meant to teach the history surrounding Gatchina Palace and how it came to be. After fighting Napoleon and fleeing Malta, you meet with Emperor Paul 1st of Russia who builds the Gatchina Priory Palace for you and the rest of the Knights Hospitaller, which eventually became the modern-day museum this game is centralized around. While not every detail in the story is accurate, since dialogue and individual actions must be imagined, it is important for the overarching aspects of the story to be historically accurate as to not give the player any false information about the museum.

Clash can be divided into 3 parts: Setup, Battle, and Ending. During the setup phase the player can draw X unit cards from the card deck and place them onto their side of the battlefield. These unit cards can be placed into any formation the player decides, and this formation is a major part of the strategy aspect of the game. An example setup is shown in Figure 14:

Figure 14: An example of the setup for Clash

Once the player has placed down their X starting units, the second phase of Clash begins. This phase is divided further into 3 parts: Fire, Move, and Reinforce. During the fire phase, each side will take turns attacking the other side, starting with the player. This is done to better simulate the musket style of warfare that took place at this time. Each type of unit will have a unique way of doing damage to the opponent. The first unit, the Infantry, has the most health but can only attack the closest enemy in a straight line. The second unit, the cavalry, attacks all units in a straight line but takes damage for each infantry unit it passes over within that line. The final main unit is the cannon, which has the lowest health being able to be killed in 1 hit but does the most damage in a 3x3 area. Once each side is done firing, the player will have the opportunity to move their units around their side of the battlefield. The final part of the Fire Phase is Reinforce, where the player can draw 1 unit from the Deck and place it on their side of the battlefield. If there are no units left in the Deck, then it disappears, and the player can no longer draw from it.

The final phase of Clash is where the battle ends, and a victor is determined. If the player lost the battle, then they will have the opportunity to retry the battle. If the player loses too many times, then an option will be offered to have the difficulty lowered. If the player wins the battle, as seen in Figure 15, then they are given new units for their Deck as a reward to be used in future battles.
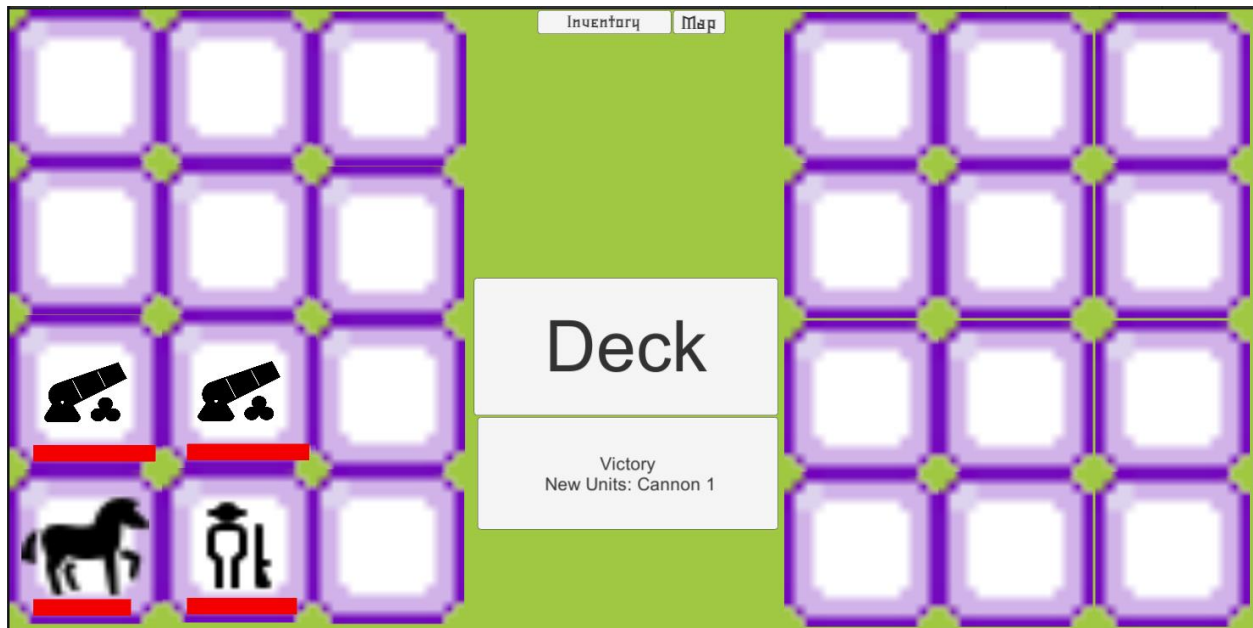
Figure 15: Example of Clash ending

4.5 Results of Character Design

Characters were real historical figures connected to the Knights Hospitaller, chosen from the historical period where the story takes place. This includes Napoleon, as he invaded the island of Malta, and Tsar Paul I, as he was the grandmaster of the Knights Hospitaller during the time period. Grandmaster Hompesch, the leader of the Knights Hospitaller in Malta, fled to Russia from Napoleon where he met with Tsar Paul I. Prince de Conde took over a branch of the Order of the Knights Hospitaller after Hompesch capitulated to Napoleon and led them to Russia to be welcomed by Tsar Paul I. The characters were depicted in the likeness as their portraits from the time period, for example, a portrait of Tsar Paul 1st as shown below in Figure 16.

Figure 16: Painting of Tsar Paul 1st of Russia from Heritage Images

4.6 Results of Art and Sound Design

Background art was sourced from Creative Commons photographs of Malta and Gatchina, as well as photographs owned by the museum of the Gatchina Palace grounds. Character art for the Text Quests were sourced from Creative Commons artwork, usually oil paintings of the historical figures. The art was then run through a set of photo filters to render the characters in the unique art style of the game. For abstract artwork, such as the icons representing combat units in the Clash minigame, images from TheNounProject.com database were used (Polyakov & Boatman & Kocherhans, 2010). An example of such icons is shown in Figure 17:
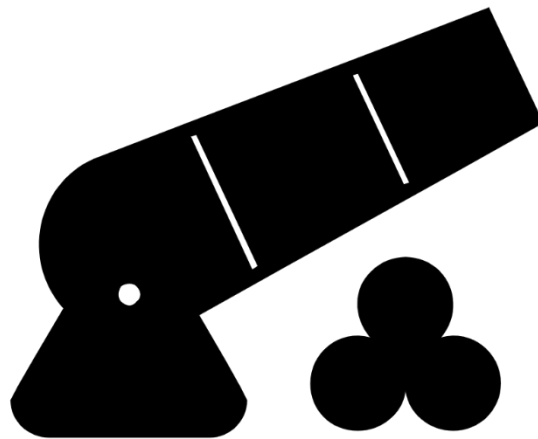

Figure 17: Cannon Icon from TheNounProject.com used in Clash.

The team wrote several original background songs to portray different moods - e.g., slower music for the title screen, and fast-paced, intense music for battles. Sheet music for the background songs can be found in Appendix C.

4.7 Results of Audience Survey

The audience reaction survey was administered to a population of University students (n = 6). After signing the informed consent agreement, available in Appendix E, the subjects were sent a link to both the game and the audience survey. After playing the game, they were asked to fill out the Audience Reaction Survey to gauge their experience playing the game. A full list of survey questions can be found in Appendix A.

One of the more important aspects of the game was the time it takes to play. Too long and players would lose interest due to boredom. Too short and players would likely not learn enough. All playertesters indicated that they finished the game in one sitting, demonstrating that the game as developed is very short at the moment.

Table 1 lists the percentages of respondents who agreed with each point on the Likert scale for each statement.

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The game was easy to navigate	33%	16%	16%		33%
The level design was easy to follow.	16%	33%	16%	33%	
The game was difficult.	66%	16%	16%		
The game was interactive.		50%	33%	16%	
I learned something about the Knights Hospitaller.	16%	33%	16%	33%	
I learned something about the Gatchina Palace Museum.	16%	16%	33%	33%	
The game's visuals were appealing.	16%	83%			
The game's icons depicted clearly identifiable objects.				33%	66%
The game was able to capture my attention the entire time I was playing.	33%	66%			
The progression of the story was paced well.	50%	16%	16%	16%	
There should have been more educational content.	16%		16%	16%	50%
The game made me more interested in learning about Gatchina Palace Museum.	33%	16%	50%		
The game made me want to learn more about the Knights Hospitaller.	16%		50%	33%	
The game explained the historical context well.	33%	16%	33%	16%	
The story was easy to follow.	50%		16%	16%	16%

Table 1: Results of the Likert scale questions on the playtester survey. Reported as percentages of the surveyed who agreed with each point on the Likert Scale for each question.

Answers to the short response questions are listed in Table 2, organized into three subcategories. Irrelevant or repeated responses, such as answers indicating that the player did not experience any bugs in the gameplay, were omitted.

Navigational Issues	Difficulty figuring out how to advance the text
	Rules of battle section were unclear
	Controls were unclear and made me less invested
Bugs	Getting stuck in the combat section and being unable to continue
	I found an issue where your units could be placed on the enemy battlefield and combat would proceed normally
	[On the level map] Any region I picked it only picked the central region
Suggestions for Future Improvement	The combat system seems like it has potential, but seems very barebones at the moment
	Add a tutorial to the combat section
	The visuals could use improvement
	Needs a back button in case someone misses text

Table 2: Relevant responses to the short response questions on the playtester survey, divided into the three primary categories.

Chapter 5: Discussion and Recommendations

The focus of this project was developing a game for Gatchina Palace Museum. In this section we discuss the outcomes of this project and provide recommendations for future development of the game.

5.1 Discussion of Making the Game

We developed a game intended to increase awareness in the Gatchina Palace Museum. It fits into the genre of text adventure with a collection of minigames. In the process of developing the game, several team members gained the skills to effectively use the Unity Game Engine. Once our developers familiarized themselves with Unity and the sponsor approved our proposed design for the game, development proceeded at a rapid pace. We were able to develop working prototypes of all aspects of the game within a week of receiving the sponsor's desired direction for the game. This showed that although we lacked knowledge and experience with the Unity Game Engine, our group's ingenuity and ability to improvise allowed us to succeed. Working on the project taught our developers how to use the Unity Game Engine and what it is like to work in game development.

We designed the video game to appeal to a wide target audience, in order to act as effective outreach for Gatchina Palace. The Clash minigame had a simplistic rock-paper-scissors style ruleset that made it engaging and intuitive for those with prior experience with video games. This helps make the game appealing to our target audience. The map portion of the game provides a simple overlay that makes it easy to understand where the story takes place and where the player needs to go. This assists our target audience in understanding the geographical context of the game. The text quest portion of the game tells a simple story written in association with our Russian counterparts. Its simplicity helps to fuel a desire within players to learn more, which in turn drives them to visit the Gatchina Palace Museum.

When beginning development on the game, we noticed that the project lacked an in-depth goal for the end product. Though we took leadership on production where we could, it was difficult to begin development when we didn't know what genre or style of play the sponsor was looking for in the game. The unclear goals slowed production more than anticipated, as it was difficult to determine what was expected out of the team and the game.

Over the course of development, we gained many new skills that contributed to the game. Our group's existing coding capability was absolutely necessary for development, and several team members gained new skills with the Unity Game Engine. A big point of contention was on how the game would look. In the end, we decided on using minimalist icons combined with photo manipulation software to produce the desired look of the game. We were somewhat hamstrung in creating the story of the game by the sponsor's lack of clarity on the desired setting. We were originally under the impression that the game would be set in Gatchina, Russia and revolve around the actions of the Order of the Knights Hospitaller there, but the sponsors eventually determined that the primary story of the game concerns Napoleon's invasion of Malta, which required us to adjust the story we were attempting to tell.

Having a clear image of how different aspects of the game fit together is not always easy, but it was necessary for development of the game as different team members focused on different aspects of game development. It was crucial that the entire group understood how the final game would fit together, and how the story and gameplay connect.

5.2 Discussion of Project Dynamics and Impact

The primary challenge our group ran into in our uniquely online IQP was the lack of engagement and communication from our sponsors. As Russia is seven hours ahead it was

hard to arrange meeting times, but even after times were set the sponsors would not reliably show up for the agreed meeting. Additionally, while the sponsors originally proposed that they would work on the game with us and outlined how some of their team would help with coding and others with the story, they never provided the promised assistance. These issues with division of labor would have been mitigated if expectations and direction for the game were set out properly from the start, but as outlined in section 5.1 the goals for the development of the game were never made clear. Several times throughout development the sponsors changed the direction of the game and their desired design for certain mechanics or story elements. Some proposed mechanics were completely forgotten when crafting their desired story.

5.3 Discussion of Survey Results

Our survey results indicate that the game had good educational content but was difficult to navigate as a first-time player. The playtesters also indicated a slightly increased interest in Gatchina Palace Museum, which shows that a video game can be used as outreach for a museum. With future development and increased educational content, which the playtesters also indicated a desire for, the game could work to greatly increase interest.

Overall, our work has laid out the groundwork for a continuation of the project. We believe that the end product has great potential to achieve the goal of attracting visitors to Gatchina Palace, but needs more time and resources to make a truly polished game.

5.4 Recommendations for the Continuation of the Project

- Further development is required in order to produce the best possible game for Gatchina Palace Museum, and further research is required into the uses of video games as a method to increase interest in museums.
- If this IQP is to continue in the future, we recommend the genre and goal of the game be decided prior to the project beginning.
- We recommend that projects of this magnitude with unique location requirements be reserved for on-site research only.
    - This will help with engagement and asset development
    - Access to the museum will improve art creation.
- Establish the role of our Russian counterparts early in the project and develop a work plan that outlines the timeline and expected contributions of every team member.
- Establish the aspects of the museum and history that the game will focus on very early in the project, and do not change them.
- Team composition
    - Working with the sponsor and the project director for the Moscow Project Center, develop a set of skills necessary for future game development and identify students in possession of those skills.
    - Some members of the must have coding capability and familiarity with the GitHub remote version control repository. The developers would preferably have familiarity with the Unity Game Engine, but it is not required.
    - Though not necessarily required, some familiarity with digital artwork will assist in improving the quality of the game, as our group struggled with finding alternate routes to produce artwork that did not require artistic skill.
- If it is impossible to include an artist, we recommend that future development of the game use the minimalist art style we developed. This includes creative use of icons and digitally manipulating photos to render them in the original art style of the game.

- o As well, contact the Gatchina Palace Museum for use of artwork hosted by the museum.
- The story of the game currently revolves around Napoleon's invasion of Malta and the Order of the Knights Hospitaller fleeing to Russia. Future short stories about the Knights can be developed and told through Text Quests, as there is room on the Malta level selection map for more Text Quests and other minigames.
- Work on translating the game to Russian as it is primarily aimed at Russian audiences.
- Establish cleaner UI.
- Create a save file system.

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Appendix A - Audience Reaction Survey
This survey will be administered to players of the group's game in order to gauge their engagement with the game and the museum and determine whether there's any parts of the game that need to be fixed. The questions on the survey will be answered using the 1-5 Likert Scale, multiple choice, and short response, and are as follows:

Likert Scale:
- The game was easy to navigate
- The level design was easy to follow
- The game was difficult
- The game was interactive
- I learned something about the Knights Hospitaller
- I learned something about the Gatchina Palace Museum
- The game's visuals were appealing
- The game's icons depicted clearly identifiable objects
- The game was able to capture my attention the entire time I was playing
- The progression of the story was paced well
- There should have been more educational content
- The game made me more interested in learning about Gatchina Palace Museum
- The game made me want to learn more about the Knights Hospitaller
- The game explained the historical context well
- The story was easy to follow

Multiple Choice:
- How did you play?
  - In one sitting
  - In several smaller sittings
  - Other (Describe)
- What device did you play the game on?
  - iPhone
  - Android
  - Computer
  - Other

Short Response:
- If there was one thing you could change about the game, what would it be? Why?
- Did you encounter any bugs or issues while playing the game that interrupted your experience? If so please describe the issue and where you encountered it.
- Which key aspects of the game either piqued or lost your attention?

Appendix B - Unity Game Engine
Released in 2005, Unity is a cross platform game engine developed by Unity Technologies. When it was first released, it was exclusively for developing games for Mac OS X but has since expanded to more than 25 platforms. Unity is one of the few free game engines available that does not require the game developers to pay Unity Technologies in any way. This makes the game engine ideal for small independent developers with very limited budgets. Unity does have paid versions that come with more features, but the free version has all the utility our project requires (Unity Technologies, 2019).

The second major advantage of the Unity game engine is its ease of use and the large amount of tutorials available for it. Unity is a great game engine for those with little programming experience, as a developer can create an entire game without touching code once. Unity also has a very simple and straightforward method of adding assets to the game world which increases its appeal for game developers creating their first game (Unity Technologies, 2019).

The third major advantage of the Unity game engine is the Unity Asset Store. This is a vast repository of art, sound, effects, and more that a game developer can buy or download for free. All assets are owned by the developer who downloads them so there is no commercial or legal complications with acquiring them. This makes Unity extremely appealing to developers with low artistic talent who need decent art assets for their game (Unity Technologies, 2020).

Appendix C - Hookpad MIDI Generator & Original Score

Began as a passion project attempting to mix music and technology, Hookpad was published in 2013 as a platform to teach music theory in an engaging and hands-on way. The program exists both as a paid downloadable software and as a free online form hosted on the Hooktheory website. In both versions of the software, the composer is able to lay down multiple MIDI tracks using a variety of sound libraries, as well as get recommendations for proper chord progression (Anderson & Carlton & Miyakawa & Schwachhofer, 2020). Shown below, Figure 18, 19, and 20 are the sheet music made for the game using Hookpad.
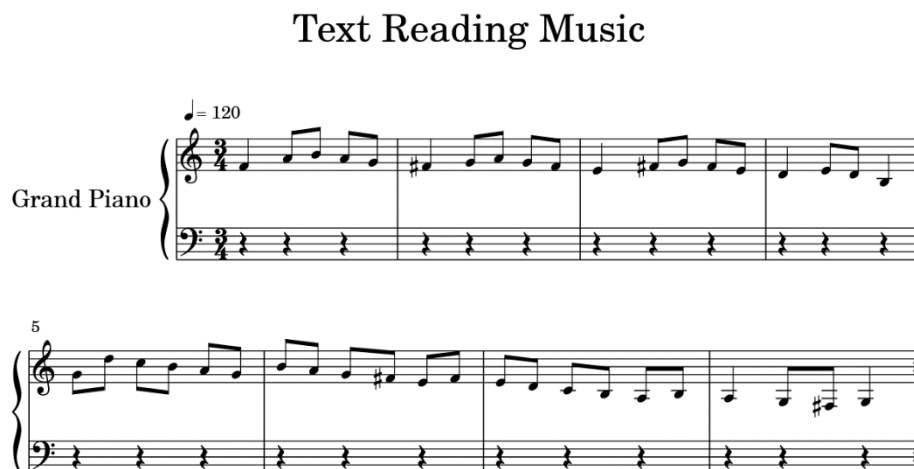

Figure 18: Sheet music for the Text Quest soundtrack created by the team. Sheet music produced in flat.io.

Battle Music

Figure 19: Sheet music for the Clash soundtrack created by the team. Sheet music produced in flat.io.

Level Selection Music

Figure 20: Sheet music for the Level Selection Map soundtrack created by the team. Sheet music produced in flat.io.

Appendix D - IRB Exemption Approval

WORCESTER POLYTECHNIC INSTITUTE

100 INSTITUTE ROAD, WORCESTER MA 01609 USA

Institutional Review Board
FWA #00015024 - HHS #00007374

Notification of IRB Approval

Date: 05-Apr-2021

PI: Mardilovich, Ivan P

Protocol Number: IRB-21-0388

Protocol Title: Museum Recovery Game Audience Reaction Survey

Study Personnel: Ray, Rianna~Rosenbaum, Jonathan~George, Reshawn~Lazo, Johnathan~Gebler, Luke~Mardilovich, Ivan P~Oates, Karen K~

Effective Date: 05-Apr-2021

Exemption Category: 3

Sponsor*:

The WPI Institutional Review Board (IRB) has reviewed the materials submitted with regard to the above-mentioned protocol.We have determined that this research is exempt from further IRB review under 45 CFR § 46.104 (d). For a detailed description of the categories of exempt research, please refer to the IRB website.

The study is approved indefinitely unless terminated sooner (in writing) by yourself or the WPI IRB. Amendments or changes to the research that might alter this specific approval must be submitted to the WPI IRB for review and may require a full IRB application in order for the research to continue. You are also required to report any adverse events with regard to your study subjects or their data.

Changes to the research which might affect its exempt status must be submitted to the WPI IRB for review and approval before such changes are put into practice. A full IRB application may be required in order for the research to continue.

Please contact the IRB at irb@wpi.edu if you have any questions.

*if blank, the IRB has not reviewed any funding proposal for this protocol

Appendix E - Informed Consent Agreement for Participation in a Research
Study Investigator: Rianna Ray

Contact Information: Email: rfray@wpi.edu

Title of Research Study: Museum Recovery Game Audience Response

Sponsor: Northwestern Technological University, St. Petersburg & The Financial University Under the Government of the Russian Federation

Introduction: You are being asked to participate in a research study. Before you agree, however, you must be fully informed about the purpose of the study, the procedures to be followed, and any benefits, risks or discomfort that you may experience as a result of your participation. This form presents information about the study so that you may make a fully informed decision regarding your participation.

Purpose of the study: This study is intended to help our group identify problems with our video game, and to determine how the public will react to the historical and teaching aspects of the game.

Procedures to be followed: Upon signing this consent form, you will be sent a copy of the game and a link to the Google Forms survey. You will be asked to play through the game at your leisure and then to fill out the form with your honest conclusions. The survey questions only concern the game. The game should take approximately twenty minutes to play through, and the survey should only take five minutes to fill out. Survey responses will be divorced from any identifying information, so survey takers will be entirely anonymous.

Risks to study participants: This survey should carry no risk for the participants.

Benefits to research participants and others: This study provides no immediate benefits to the subject or others.

Record keeping and confidentiality: All survey responses will be submitted anonymously through Google Forms. No identifying information will be associated with any of the survey responses. All group members will have access to the anonymized survey responses, and select responses may be reported to the sponsor as a basis for further improvements to the game. Records of your participation in this study will be held confidential so far as permitted

by law. However, the study investigators, the sponsor or it's designee and, under certain circumstances, the Worcester Polytechnic Institute Institutional Review Board (WPI IRB) will be able to inspect and have access to confidential data that identify you by name. Any publication or presentation of the data will not identify you.

Compensation or treatment in the event of injury: It is not anticipated that this study could cause any form of injury or harm. You do not give up any of your legal rights by signing this statement.

For more information about this research or about the rights of research participants, or in case of research-related injury, contact: Rianna Ray (rfray@wpi.edu). In addition, include the contact information for the IRB Manager (Ruth McKeogh, Tel. 508 831- 6699, Email: irb@wpi.edu) and the Human Protection Administrator (Gabriel Johnson, Tel. 508-831-4989, Email: gjohnson@wpi.edu).

Should a participant wish to withdraw from the study after it has begun, the following procedures should be followed: Please email Rianna Ray (rfray@wpi.edu) to indicate that you no longer wish to participate in the study. There are no consequences to early withdrawal.

Your participation in this research is voluntary. Your refusal to participate will not result in any penalty to you or any loss of benefits to which you may otherwise be entitled. You may decide to stop participating in the research at any time without penalty or loss of other benefits. The project investigators retain the right to cancel or postpone the experimental procedures at any time they see fit.

By signing below, you acknowledge that you have been informed about and consent to be a participant in the study described above. Make sure that your questions are answered to your satisfaction before signing. You are entitled to retain a copy of this consent agreement.

Date: _____

Study Participant Signature

Study Participant Name (Please print)

Date: _____

Signature of Person who explained this study