Missing Venice:

Tracking the Global Movement of Venetian Art and the Evolution of Venetian Architecture and Infrastructure

AN INTERACTIVE QUALIFYING PROJECT REPORT

WORCESTER POLYTECHNIC INSTITUTE

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ABSTRACT

Changes in the government of Venice heavily influenced Venice's art, architecture, and infrastructure. After creating a specific research method, the team added to 25 years of WPI's research by documenting displaced artwork, demolished churches, and filled-in canals. A platform, including an interactive website and timeline map web application, was created to display not only our data, but data collected by future teams as well. Additionally, a smartphone game to raise awareness about "Missing Venice" was designed.

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AUTHORSHIP

All members of the team contributed equally to the writing of this report.

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EXECUTIVE SUMMARY

The landscape of Venetian art, architecture, and infrastructure has undergone significant changes throughout the last 500 years. Art pieces were globally dispersed as they were stolen, lost, or moved for protection. Various governments of Venice demolished and repurposed churches to suit their different needs. Additionally, canals were filled to create more pedestrian walkways. The focus of this project was to document these changes. Information on "missing" (lost, stolen or relocated) art, demolished churches, and Rii Terà (filled-in canals) was collected and published in several different interactive ways.

There is little documentation of any research projects similar to this so it was necessary to develop and put into practice a customized research method. In order to collect data on missing art, a list of artists whose work was potentially on display in Venice was developed. Using this list, paintings were found by examining the artists' catalogue raisonnés, local museums, and online art databases. When a potential missing piece was found it was researched further to establish its current location and verify that it was once displayed in Venice. Beginning with a list of artists, we looked at approximately 2500 paintings to discover 101 pieces of missing Venetian artwork.

Our team also added to data collected by previous Venice Project Center (VPC) teams regarding demolished churches and Rii Terà. These were photographed and added to our website.

As depicted in Figure 1, our datasets were stored in the CK Console, an online database. They were also utilized in our website, timeline map, smartphone game design, Venipedia pages, and the de'Barbari Explorer. Our website, which has been optimized for both computers and mobile phones, displays images of missing treasures in a collage format. This allows for intuitive use and provides easily accessible information on missing items. The interactive timeline map traces the journeys of missing historical artifacts to their current destinations around the world. A timeline slider option allows the user to select a range of years to see which treasures left the city during that period. A functioning mock-up for a smartphone game was created as a recommendation for a future team to implement. All information we collected was published on Venipedia and the de'Barbari Explorer. Venipedia is structured much like Wikipedia to provide

users with a wealth of information about the city of Venice. The de'Barbari Explorer is an online interactive version of the famous map that allows users to view different aspects of the city.

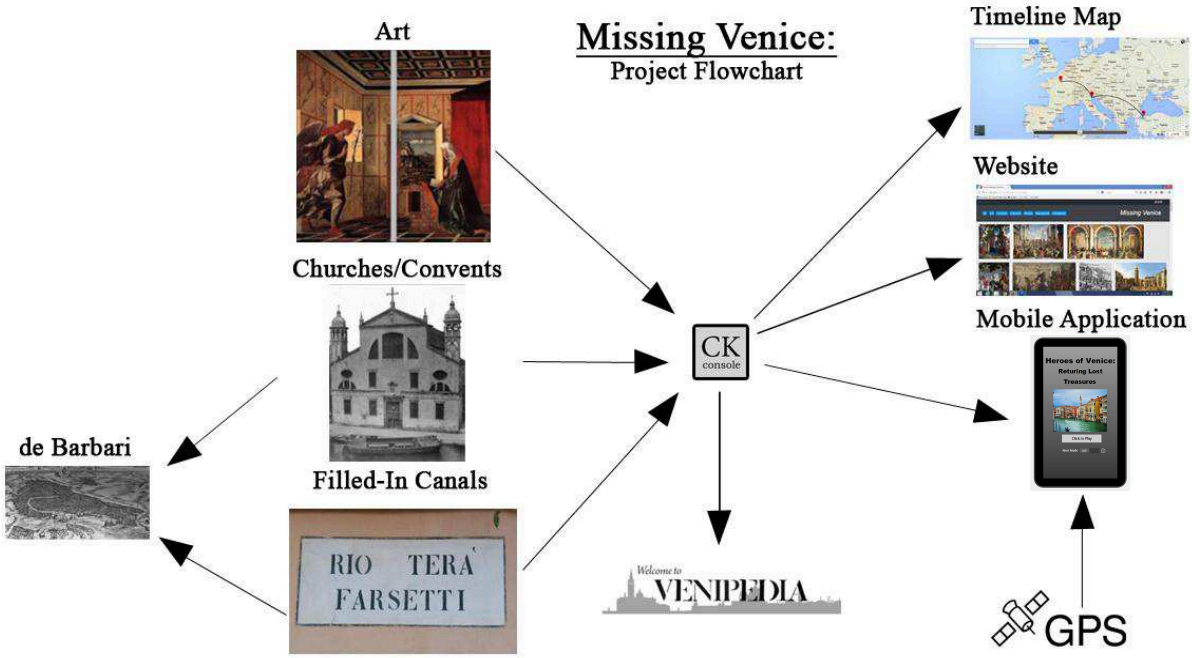

Figure 1: Project Data Flow Diagram

Our research methods and data publication solutions provide a strong platform for future teams to build upon. While we were unable to develop a comprehensive list of all missing Venetian treasures, our research method proved to be effective. We recommend that future teams utilize our procedure to expand the datasets and continue to provide this important information to the public.

1. INTRODUCTION

A city on the water, once at the center of the Renaissance movement, Venice is home to some of the finest artwork ever created, over 100 breathtaking churches, and a labyrinth of canals. Millions of tourists visit Venice each year to experience its world renowned art and architecture. While the Republic of Venice may be a familiar name to many of these visitors, a far fewer number of them will be aware that Venice's government has changed hands several times in the years following the Renaissance. From its traditional founding in 421 until 1797, the Republic of Venice was one of the most powerful states in the Mediterranean. The invasion of Napoleon in 1797 marked the beginning of foreign control. For the next 69 years, the French and Austrians traded possession of Venice, until it became part of Italy in 1866.[1]

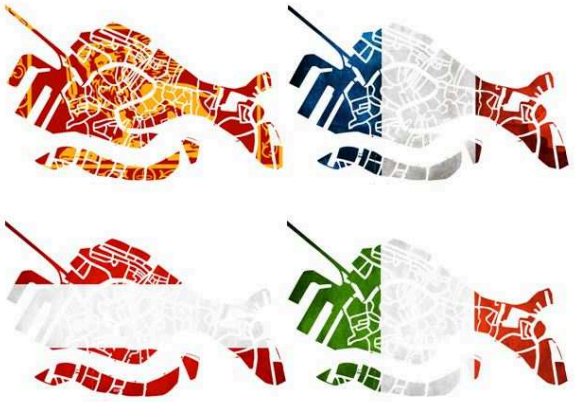

Figure 2: Changing Governments of Venice

With so many governments coming in and out of power, the art, architecture, and infrastructure of Venice underwent significant changes. The French and Austrians adapted Venice to suit their needs and stripped away what did not. Art was stolen by the controlling powers and brought back to their capitals to fill their museums and line the private collections of wealthy citizens. Churches were destroyed to conform to the wave of secularization sweeping across Europe and to make room for other buildings. Finally, canals were filled to make Venice more like the traditional land-based cities the controlling powers were accustomed to. Austria in particular sought to fill as many canals as possible to make a more traditional city. While these changes permanently altered the landscape of Venice, they also added to the rich history of this unique city.

Over the past 25 years of the Venice Project Center (VPC), previous Worcester Polytechnic Institute (WPI) Interactive Qualifying Project (IQP) teams have documented some of these changes in architecture and infrastructure. Although data had been collected, at the

[1] "Venice History" (n.d.) Venice World

beginning of our project, there was no way for the public to access this data in an easily digestible format. The goal of our project was three-fold: to expand upon previously collected data and create a platform to display it, establish a procedure for tracking displaced Venetian Art, and use this new procedure to collect information on displaced artwork and incorporate our findings into our new platform.

2. ART

Venice solidified its reputation as a city of artists during the Italian Renaissance. Giovanni Bellini, Veronese, Titian and Tintoretto are some of the famous artists who called Venice home. The number of artists and their productivity ensured that great paintings and sculptures adorned almost every public building. Art was so popular that it often extended beyond the canvas. Even utilitarian objects such as wellheads, featured elaborate decorations. Perhaps the greatest concentration of art can be found in the more than 100 churches in Venice. Sculptures and paintings cover the altar areas, floors, ceilings, and walls.

Figure 3: Decorative Venetian Wellhead

While many of these pieces remain within the city, a significant number can no longer be found in their original locations. For example, when Napoleon occupied Venice in 1797 his army removed hundreds of works.[2] Famous paintings and sculptures looted or sold from the city were scattered all around the world. They ended up in both private collections and museums. Similarly, famous Venetian works changed hands during the tumultuous years of World War II and have been the subject of many thefts throughout history.[3]

Looting of priceless art is a well-known problem around the world. Many modern art lootings and heists are well documented, but unfortunately in the past this was not the case. At present, there is no public source that contains a consolidated list of Venetian artifacts that have been lost, stolen, or transported away from the city. The majority of sources which document art lootings do not include lists of individual pieces that may have been stolen, sold, or damaged. Although it is well documented that Napoleon's army took hundreds of works from the city, specific pieces are rarely mentioned.

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[2] Blair, V. (2002, October 22). Venice: Napoleon's Italian Thorn. Research Subjects: Government & Politics, The Napoleon Series

[3] Charney, N. (2011, October 24). The Secret History of Art Noah Charney on Art Crimes and Art Historical Mysteries. 5-Minute History of Napoleonic Art Looting

One of the most well known pieces of art removed from Venice was the *Horses of Saint Mark's Basilica*. Napoleon removed these bronze sculptures and placed them atop his Arc de Triomphe in Paris in 1797. These horses are an excellent example of art looting; not only were they removed from Venice by Napoleon, the Venetians themselves stole the horses from Constantinople more than 500 years earlier in 1204. After Napoleon's occupation, the horses were returned to Venice in 1815 and placed back on the basilica. During the 1980's these horses underwent extensive restoration and now rest inside the basilica to protect them from the elements. They are replaced on the balcony to be viewed by the public by exact replicas.

Figure 4: The Bronze Horses of Saint Mark's

Fortunately, not all art displacement has happened due to war or greed. A significant number of Venetian paintings were removed from their original locations for preservation. The Gallerie dell'Accademia now houses many of the historical works that once adorned buildings and churches around the city.

2.1 Tracking the Movement of Venetian Art

Provenance research is an essential part of any project that involves the movement of valuable artifacts. "Provenance" is defined as, "The history of ownership of a valued object or work of art or literature."[4] Provenance can be very difficult to establish and often remains incomplete. Objects that have been looted often have much less documentation because they were stolen or transferred into private collections. Records will usually resume when the painting is sold back to a museum or public collection. Unfortunately, these provenance records are not easily accessible to the public and remain tucked away in museum libraries.

One example of the difficulties encountered in tracing lost or stolen artwork can be seen in the post World War II efforts to recover stolen Jewish artwork. As expected, the movement of

[4] Provenance. (n.d.). Merriam-Webster Dictionary

art stolen by the Nazis was not accurately recorded. The only way to track down pieces was through first-hand accounts and memories. Nearly every European country, in addition to several others around the world, was involved in this effort. Fortunately, over 700,000 pieces have been made their way home, but many remain lost.[5]

Although the scope of displaced Venetian artwork is nowhere near that of stolen Jewish art during World War II, the lack of a comprehensive list of missing artwork made our research considerably more complicated. Before we could locate any artwork, it was necessary to establish a research procedure. Our procedure consisted of two primary approaches: searching for displaced artwork by its artist and searching through museum collections. This research process proved to be effective; we believe that a similar method could be used in the future to locate not only Venetian artwork, but other works as well.

2.1.1 Locating Displaced Artwork by Artist

Our first method to locate displaced art was by selecting a Venetian artist, or an artist that had a significant body of work on display in Venice at some point in history. We then located that artist's catalogue raisonné. A catalogue raisonné is a comprehensive listing of works over the life of a particular artist. These catalogues contain a biography, pictures of works, and, if available, a short provenance of each work. These publications are very expensive and are often only found in museum libraries. We were able to find several catalogues in the Worcester Art Museum's library. The catalogue raisonnés we utilized were almost exclusively written in Italian. In order to efficiently obtain information, we looked through the text for key words. Some examples of key words are, "venezia" (Venice), "veneziano" (Venetian), and "chiesa" (church). Once we identified a piece that was likely on display in Venice, we scanned its description and converted it to English using

Figure 5: Worcester Art Museum

[5] Holocaust Restitution: Recovering Stolen Art. (2014, September 1). Recovering Stolen Art from the Holocaust

Google Translate. After we had a list of potential missing works, we researched each piece individually to determine its current location. If the piece of art was no longer in its original location, it was classified as missing and added to our dataset.

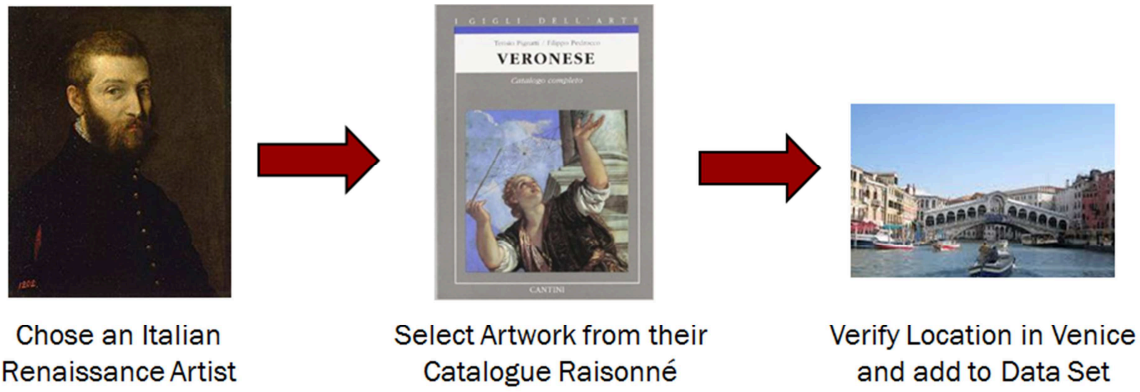


Figure 7: Art Research Process

2.1.2 Locating Displaced Artwork Utilizing Museums

A large amount of displaced Venetian art is housed in museums; therefore, searching through museum collections was necessary. The Gallerie dell'Accademia and Museo Correr in Venice contributed a significant amount of information for this project. In addition to physical museums, online collections of artwork were also heavily utilized.

Figure 6: Museo Correr

2.1.2.1 Physical Museums

Fortunately, museums often research the provenance for the works they acquire. This provenance will either be listed next to the painting on display or in their library archives. The Gallerie dell'Accademia was an excellent resource because the majority of its works were once on display elsewhere in Venice. The Gallerie was established in 1750 and houses a comprehensive collection of pre-19th century artwork. Most of its collection was taken directly from Venetian churches and other buildings for preservation and protection.[6]

[6] The Museum. (n.d.). Gallerie dell'Accademia

As we walked through the exhibits, we took note of specific paintings in each room that could be of interest. We purchased a museum catalog for the Gallerie in order to continue our research. A museum catalog contains a brief summary of the pieces in a museum's collection. It typically includes the artist, date of creation, and provenance. Unfortunately, this provenance was often incomplete. The catalog primarily described only how the Accademia acquired the pieces without a more detailed explanation of its movements. We used the information gathered from this catalog to add to our list of missing works.

In addition to the Gallerie, we visited the Museo Correr. This museum is located in Saint Mark's Square and houses a collection that covers both the art and history of Venice. The museum originated from Teodoro Correr's collection that was bequeathed to the city.[7] We used a similar process as the one outlined above for the Accademia to find missing art in the Correr Museum. We also made visits to various other museums, such as The National Gallery in London, The Louvre in Paris, and the Gallerie dell'Accademia in Florence during our travels throughout the term. Our findings at these museums followed the same outlined process.

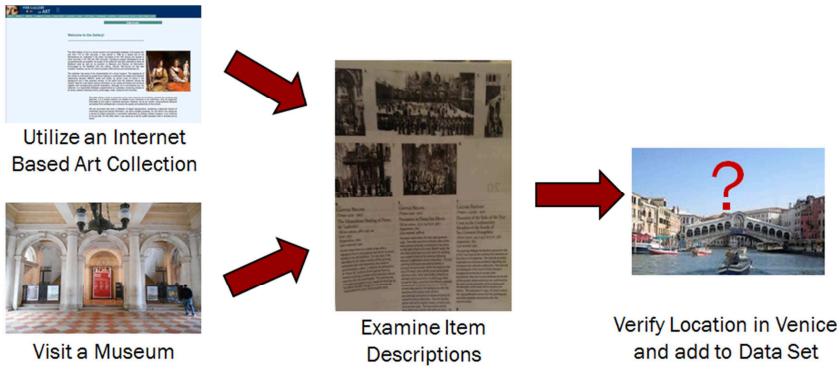


Figure 8: Museum Research Process

2.1.2.2 Virtual Museums

Researching missing works using virtual museums and collections on the internet followed a similar procedure to that of visiting a physical museum. First, we selected an online resource that contained a large collection of paintings from Renaissance artists. We then went through each individual piece in the collection until one displaced from Venice was found. We utilized whatever provenance research the museum had completed to trace the previous locations of the artwork we gathered.

The Web Gallery of Art (WGA), a virtual museum with an online catalogue of over 36,000 pieces of art, was utilized to add missing works to our list and to fill in missing

[7] Building and History. (n.d.). Museo Correr.

information in item descriptions.[8] The Frick Collection website, an online catalog of the collection of Henry Clay Frick, was utilized in a similar way as the WGA.[9]

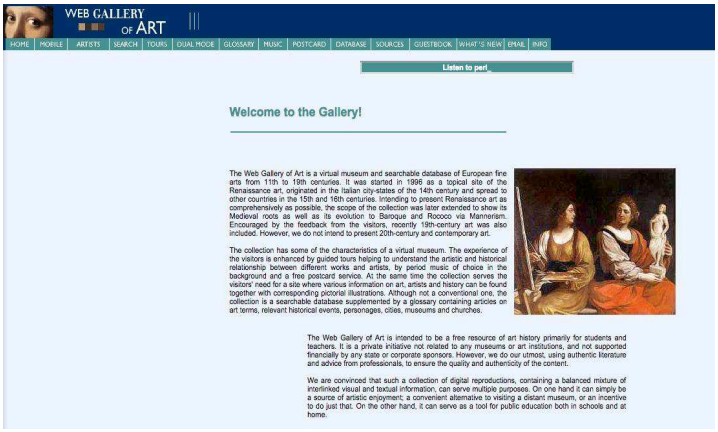


Figure 9: Web Gallery of Art

The Churches of Venice website also proved to be invaluable in locating additional pieces of missing artwork. This website, focusing on the history of Venetian Churches, was created by an independent researcher. It documents major changes to the churches and highlights "lost art" that was once in these religious buildings.[10] We cross-referenced this list of "lost art" with the list of displaced artwork we compiled from our other sources. Any paintings that we did not already have were added to our dataset.

2.2 Gathering Other Necessary Art Data

The creation of an effective visualization tool required more than just previous locations of art to be collected. GPS coordinates of each piece of artwork's locations, both past and present, were gathered for use in our interactive map and websites. These coordinates were obtained using Google Maps. In addition, photographs of each location were taken following the procedure outlined in Section 3.2. It was also necessary to collect images of each piece of artwork. We found that the ideal place to find these images was Wikimedia Commons. Most of the images in this collection have no copyright restrictions and are protected under fair use policies.

[8] Web Gallery of Art (n.d.).
[9] History. (n.d.). Frick Collection
[10] Cotton, J. (n.d.). The Churches of Venice. The Churches of Venice.

2.3 Results

At the beginning of our research, the original goal was to create a list of approximately 70 pieces of artwork. After hundreds of hours of research and field investigation, we gathered 101 pieces. This result was not easily attained. For each piece that we found to have been originally located in Venice, we researched about 25 paintings, bringing the total number of paintings we evaluated as possible candidates to approximately 2500. Although time consuming, we believe that this achievement speaks to the effectiveness of the method that we have developed for tracking displaced Venetian artwork. We also have created a timeline graphic, which can be seen in Figure 11. This graphic compares the amount of art displaced, with the year they it was removed and who removed it.

Figure 11: Identifying Displaced Venetian Artwork

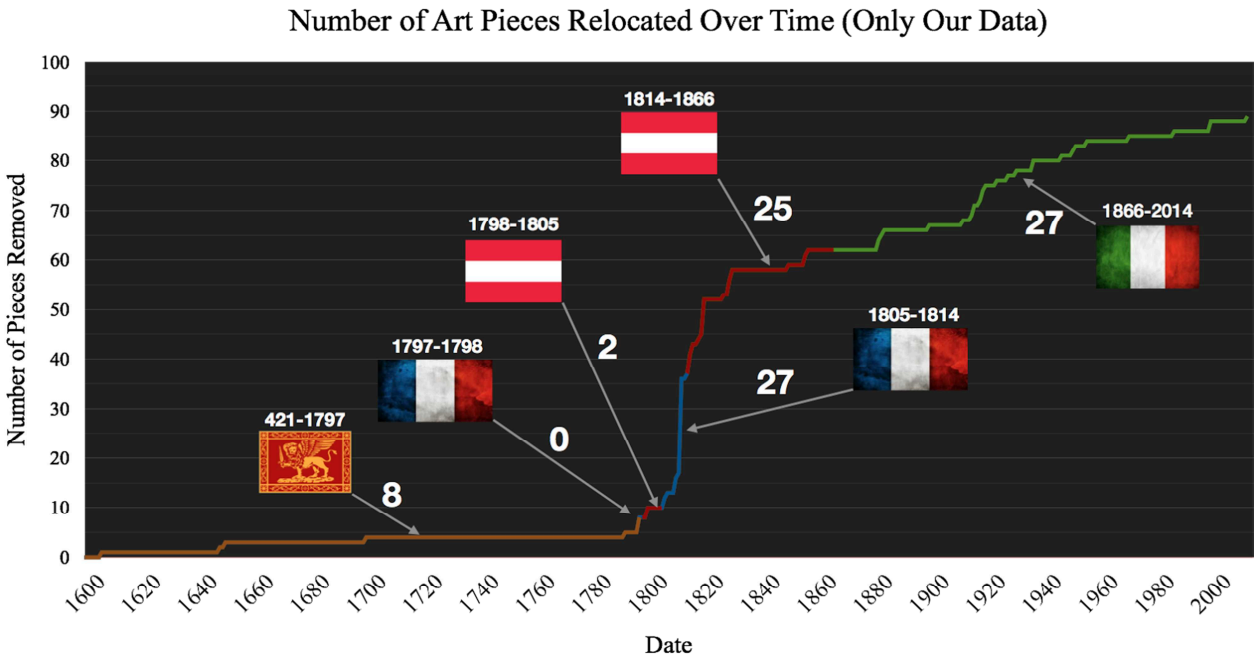


Figure 10: Number of Art Pieces Relocated Over Time

3. CHURCHES AND CONVENTS

Churches have always been a significant part of Venetian history and culture. The traditional founding of Venice was associated with the dedication of Venice's first church, San Giacomo.[11] Since then, over 140 churches have been constructed on the island. While the vast majority of Venetian churches are Catholic, there are a handful of other denominations, including Anglican and Orthodox Christian. Because of the large religious community in Venice, convents were also very numerous. Convents were often attached to churches. During the early 1800's, when Venice was under the control of Napoleon, many churches and convents were suppressed in an attempt at secularization. As time went on, and Venice changed hands from the French to the Austrians, some of these buildings were either destroyed or repurposed for other uses. The buildings of these "repurposed" structures are still present; however, they have been transformed to serve different functions. New functions for repurposed churches and convents in Venice include schools, prisons, public housing, museums, and concert halls.

Figure 12: Demolished Church of Santa Lucia

Churches were not only affected by new governments, but by new forms of art and architecture as well. It was not uncommon for a church to be "remodeled" in order to conform with the contemporary artistic period. Church facades were often "remodeled" from gothic to renaissance architecture. Although these buildings have been modified, they still serve as churches.

Many churches in Venice are very ornate and are decorated by paintings and sculptures created by world renowned Gothic and Renaissance artists. Because of this, churches in Venice are an attraction to not only the religious, but to art lovers as well. Tens of thousands of tourists visit Venice's most famous church, the Basilica of Saint Mark, every year.

[11] Cotton, J. (n.d.). The Churches of Venice. The Churches of Venice.

3.1 Verifying and Expanding Church Data

Due to the scope of the changes in Venetian architecture, we chose to focus our efforts on demolished and repurposed structures. We did not research remodeled churches due to time constraints. Previous IQP teams had compiled a list of demolished churches which we updated and expanded.[12] To uncover additional demolished churches, we utilized a book titled *Venezia Scomparsa* which translates to "Disappeared Venice." This book contains information regarding several demolished churches along with other building types that have been destroyed. One challenge presented by this book is that it is written in Italian. To overcome this challenge, we translated each demolished church page by scanning it into Google Translate. From these translations, we were able to extract the necessary information for each church.

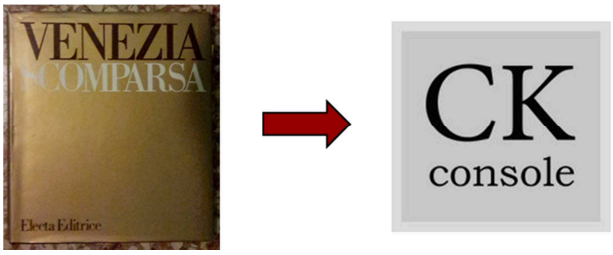


Figure 13: Demolished Church Research Process

3.2 Photographing Demolished Church Locations

In order to help visualize where demolished churches were located, modern photographs of former church locations were taken. Due to the large number of photographs taken, weather constraints, and the distance between locations, it was necessary to develop an efficient system of collecting these images. Using Google Maps, we plotted the GPS coordinates of each location we had to photograph. These points were divided up into 6 easily manageable

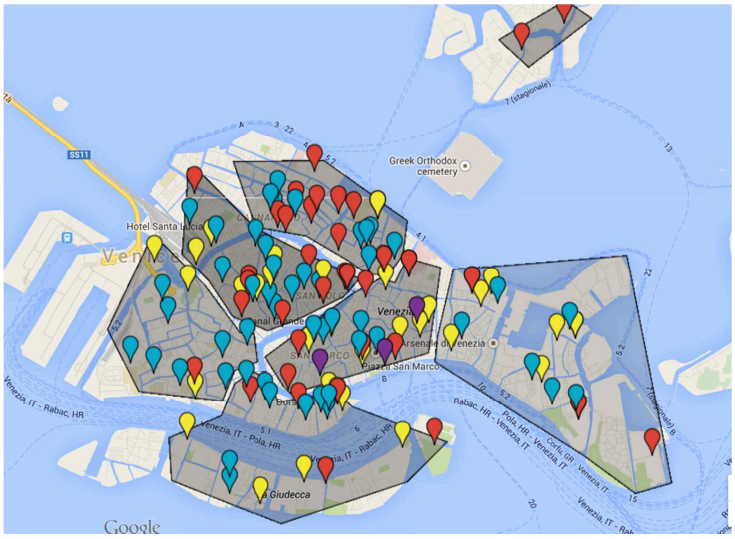


Figure 14: Map of Locations to Photograph

[12] Weis, Amanda Michelle et al (2013) *Venice through the canals of time -- mapping the physical evolution of the city*

sections. Each section required one day to complete.

To collect photographs, we downloaded copies of our map to a smartphone in order to navigate to the locations. At each location several pictures were taken. If we had iconography of the original church available, we replicated the original image to the best of our abilities. Each time a photograph was taken, it was recorded on paper to ensure we accurately matched the image with the location. Upon uploading the images to the computer, the best photograph for each location was chosen.

3.3 Results

During the course of our research, we added information on two additional demolished churches not previously present in the WPI dataset. While the addition of two new churches is important, we feel that our greatest contribution to the churches dataset was 27 modern photographs of demolished church locations. These photographs help those who view our data to better understand what replaced these structures. We also have created a timeline graphic, which can be seen in Figure 16. This graphic compares the number of churches and the year in which they were demolished with the government in power at the time of their demolition.

Figure 15: Replicating the Photo of a Demolished Church

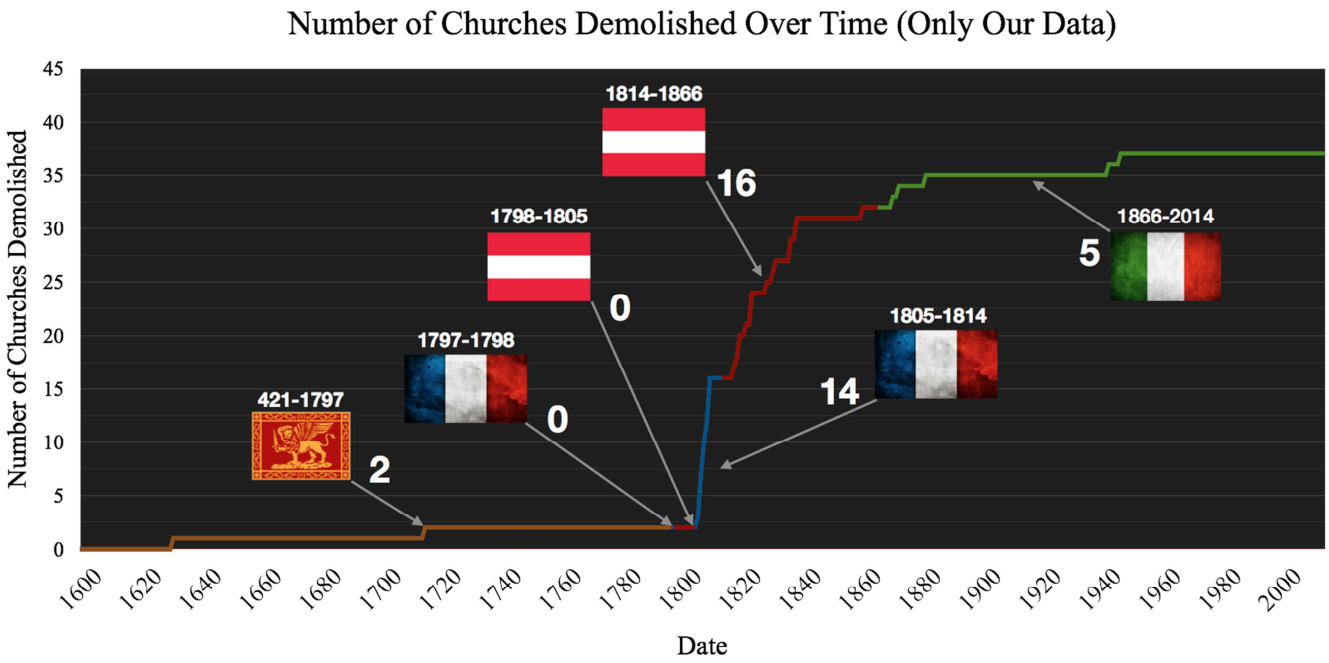


Figure 16: Number of Churches Demolished Over Time

4. RII TERÀ

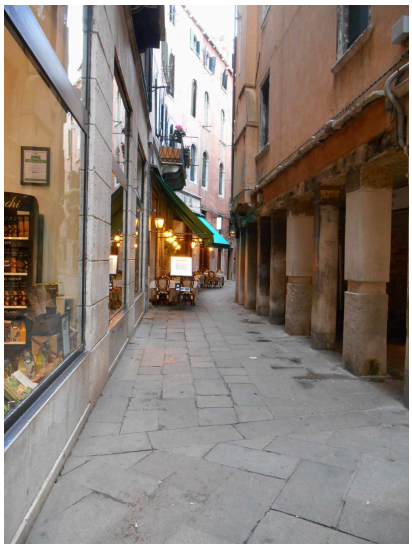


Figure 17: Rio Terà de le Colonne

Some of the modern alleyways in Venice actually cover former canals, which were transformed into streets as early as the 14th century. In Venice, filled-in canals are called Rii Terà, meaning "earthed canals". Two different types of Rii Terà exist: Rii Terà "tombati", which are actually "entombed" (i.e. completely filled with dirt), and Rii Terà "a volto", where the canal was enclosed in a conduit and capped by a street. Entombing a canal greatly disrupts the flow of surrounding canals, but eliminates any need for periodic dredging. When a canal is capped, water still flows underneath it, so the overall hydrodynamics of the area are not affected; however, the hidden conduit under the street requires periodic cleaning to remove accumulated sediment. All governments who have controlled Venice have been responsible for filling some of its canals, about half of which were filled by the Austrians. [13]

4.1 Verifying and Photographing Rii Terà

In order to effectively incorporate Rii Terà into our deliverables, data collected by previous teams was verified and images of each Rio Terà were added to the VPC database. In order to do this, we went to each Rio Tera' and photographed it. The procedure we used to gather photographs is the same one used to gather images of art and demolished church locations. Images of both the street sign and the street itself were taken when possible. Several misspellings and GPS locations in previously collected data were corrected.

4.2 Results

Over the course of several weeks, we took 86 photographs of Rii Terà around Venice. These photographs were added to the data collected by previous WPI teams. An example of the types of photographs that were taken can be found in Figure 18. We also have created a timeline

[13] Rii Tera' (n.d.). Venipedia.

graphic, which can be seen in **(FIGURE X)**. This graphic compares the number of canals and the year they were filled with the government who filled them.

Figure 18: Two Types of Rii Terà Photos

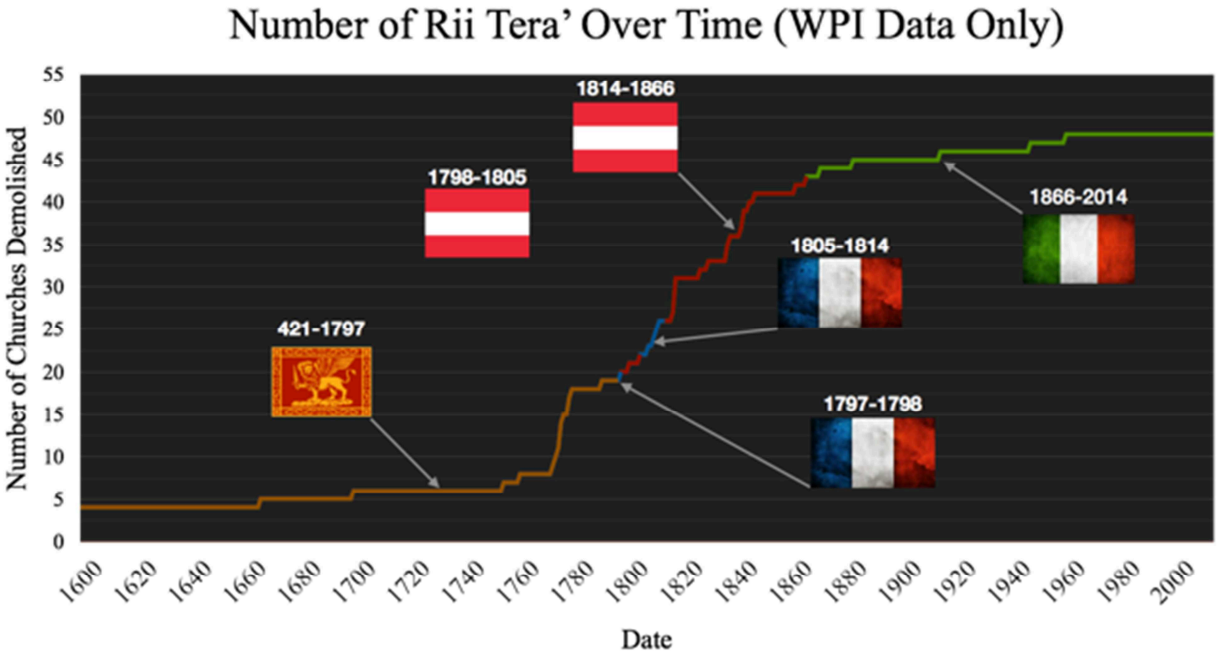


Figure 19: Number of Rii Tera Over Time

5. CREATING INTERACTIVE DATA SOLUTIONS

To display our data we created a website, an interactive timeline map, and a smartphone game design. We also updated the de'Barbari Explorer and created Venipedia pages. To accomplish this, proper data management was necessary.

5.1 Managing and Collecting Data

In order to create effective ways to display our data, it was necessary to retrieve and modify existing data, as well as create entirely new datasets. All of these datasets are currently stored on the City Knowledge (CK) Console. The CK Console is an online database used to store information that has been collected by teams at the Venice Project Center over the past 25 years. Each year, teams add to the Console as well as utilize data previously stored there. We utilized the following datasets from the Console: demolished churches, repurposed churches, repurposed convents[14], and Rii Terà.

5.1.1 Creating a Better CK Console Viewer

In order to more efficiently view data collected in the CK Console by previous teams, we created a web application, the CK Console Viewer, to organize and display data in an easily digestible fashion. The CK Console interface, although very helpful in storing data, can often be hard to navigate. In order to view a dataset in the CK Console, permission from the administrative account must be granted. After a dataset becomes accessible, it is very difficult to navigate due to the structure of the Console. It is

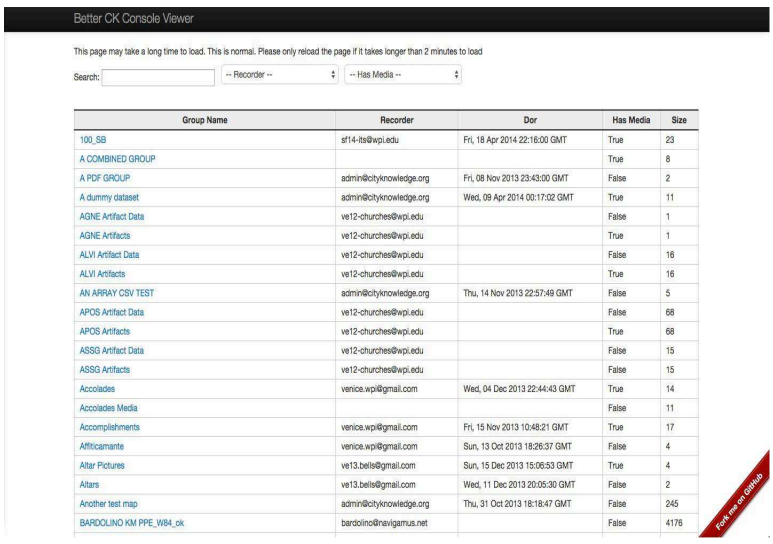


Figure 20: CK Console Viewer

[14] Convents were researched in *Ecclesiastical architecture -- preserving convents, churches, bells and bell towers.*

also challenging to quickly browse through the expansive amount of data that can be found there; datasets are broken up by the groups that created them which makes switching between datasets from different projects frustratingly slow.

The CK Console Viewer allows the user much easier access to the content in any and all of the datasets. It allows users to view all data in the Console, regardless of administrative permission; however, data cannot be edited in the Viewer. In addition, there are many advanced sorting options available.

The CK Console Viewer greatly assisted in our research and finding data that is relevant to our project. It also greatly increased our efficiency in updating and validating old information. The CK Console Viewer has been made available to future project teams to enhance the accessibility of the vast amounts of data stored in the CK Console.

5.1.2 Recording Data

All of the data we collected was uploaded to the CK Console. This preserves our data for future teams and allows our website and interactive map to dynamically load our data. In order to upload the data to the console, we first placed our data into a series of Microsoft Excel spreadsheets. These spreadsheets contained all of the information associated with each missing treasure. Since all items do not share the same characteristics, we created a different spreadsheet for each type of missing item. For example, a piece of missing art has a date moved while a demolished church has a date destroyed. Once the spreadsheets were completed, they were exported as comma separated value (CSV) files and uploaded to the CK Console. Images cannot be uploaded as comma separated values, thus it was necessary for us to upload them separately. Each spreadsheet contains a column with the name of its associated picture file. After uploading the images and the data to the console, they were merged together using the filename of the image. An example of a data spreadsheet can be found in Appendix A.

5.2 Deliverables

To effectively display our research, we developed a series of electronic aids, including a website, an interactive timeline map and a design for a mobile application.

5.2.1 Developing a Website

Since the beginning of this project, we felt that publishing out data on an easily navigable webpage would allow for the greatest access to our research findings. The first step in this process was to determine what we wanted to display on this website. Based on the data we had available and the scope of our research, we decided to include displaced artwork, demolished churches, repurposed churches, repurposed convents, and Rii Terà. Next, we compiled a list of the features we wanted our site to have and what we thought users would want to see.

In addition to a list of potential features, we also needed a website design. We began searching for websites similar in concept to ours and found inspiration in Poland's "Lost Museum" website. The Lost Museum website, created by the Polish Ministry of Culture and National Heritage, contains images of art stolen from Poland during WWII that have yet to be recovered.[15] We decided to use a similar collage layout in our website because it is visually appealing and it allows users to easily browse a catalog of images.

Figure 21: Polish Lost Museum Website

We began to create our website by drawing out several collage-style designs on a whiteboard. When we were satisfied with these sketches, we moved to pen and paper. Next, we photoshopped different designs and used mock-up tools to show the different ways the site could look. The mock-ups we created allowed us to discuss the designs with our advisors and make multiple revisions before putting anything into code. Several of our mock-ups can be found in Appendix B. In each mock-up we tried to address as many of the different use cases as possible in order to appeal to the greatest amount of users.

[15] Obiekty utracone w wyniku wojny. (n.d.). Ministerstwo Kultury i Dziedzictwa Narodowego

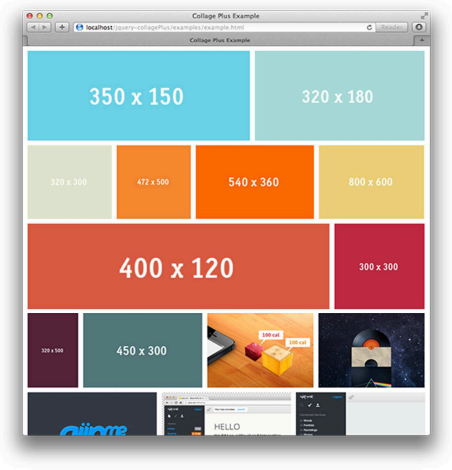


Figure 23: Collage Style Template

After we had a list of features and decided upon our favorite pieces of the mock-ups, we began to develop our site. For the backbone of our website, we chose a template which displays images in collage style. Although this template may seem visually similar to our final site design, the resemblance is merely passing. In addition to cosmetic changes, large parts of the templates were recoded and many additional features were added to optimize the way we display our data. An advanced search function was added to allow users to search the large catalog of items. In order to display more detailed information for each item in the collage, an information page was created. This page, accessed by clicking on an image, shows all of the relevant information we have available for each item. It will usually include a description of the item, a data table, and a carousel of pictures. An example of the information page for a demolished church can be seen in **(FIGURE X).** This page will help users who are looking for detailed information on an individual page.

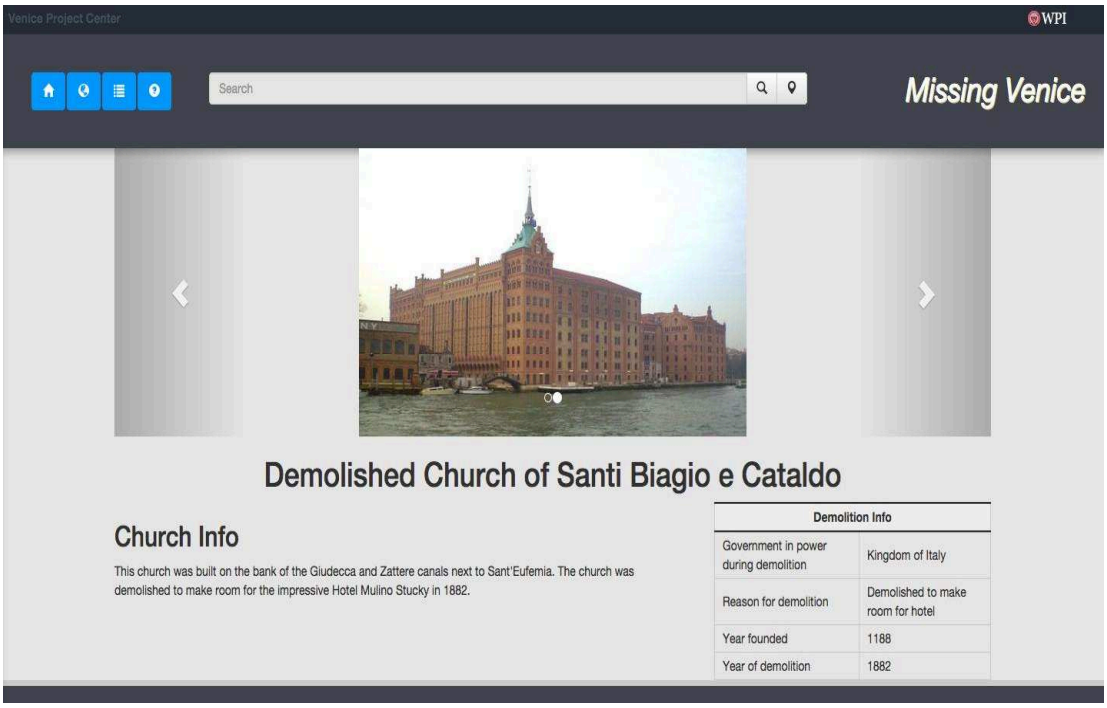


Figure 22: Example Website Information Page

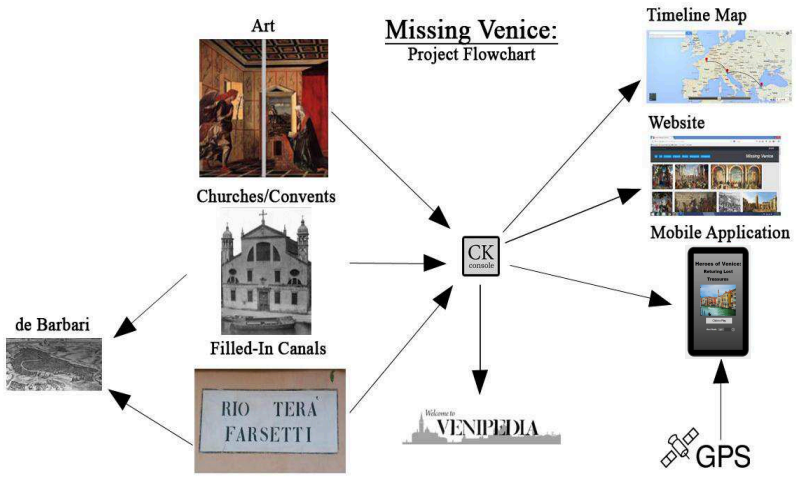


Figure 24: Project Data Flow Diagram

Unlike the original template, all images in this collage are loaded dynamically from the CK Console. This allowed us to use both our own data and data collected by previous WPI teams. The dynamic loading also allows for any changes made to data in the CK Console to be instantly reflected on the website. This feature makes maintaining and expanding the website much easier. When a new piece is found, it can be added to our website by simply adding the new piece to the existing dataset in the console. This dynamic data flow can be seen in Figure 23.

We also wanted to make our website accessible to smartphone users. In order to do this we needed to make the website viewable on all sizes of screens. The website was coded to automatically resize to any screen. An example of the website being displayed on a smartphone can be seen in Figure 24. In addition to optimizing its display for smartphones, the website also has an option to load the items closest in proximity to the user first. This is accomplished using GPS data associated with each individual item and comparing it to the GPS data provided by the user's smartphone. For more in-depth technical details about our website, see Appendix C.

Our website also includes a built-in interactive timeline map which is described below.

Figure 25: Website Displayed on Smartphone

5.2.2 Creating an Interactive Timeline Map

Although our website offers a wealth of information to users about art and its movement from Venice, it can be difficult to visualize just how much the landscape of Venetian art has changed in the last 500 years. In order to allow user to better visualize this movement, we decided upon the creation of an interactive timeline map. This map shows the travels of different art pieces as they leave Venice and are transported to their new locations around the world.

Each point on the map is a place where Venetian art has been at some point in history. When a single location is selected, the paths of the associated pieces are highlighted. A list of the pieces also appears in the sidebar, which links to their respective information pages on our website. When a path is selected, only the locations associated with that piece are displayed.

Finally, we added a slider function to allow the user to select the range of dates during which pieces could have moved to be displayed on the map. This makes the map more practical for research purposes. It is a useful tool for researches to help establish trends in the movement of Venetian art over certain periods of time. For more in-depth technical details about our map, see Appendix D.

5.2.3 Designing a Smartphone Game

In addition to our timeline map and website, we created a design for a mobile application based game, called "Heroes of Venice: Returning Lost Treasures." Through this game, users are able to explore the city of Venice while "returning" its missing art, "rebuilding" demolished churches and "unfilling" Rii Terà. Due to time constraints, we were unable to develop a fully functioning app; however a detailed mock-up was created. Justinmind Prototyper was used to develop this mock-up. Using this tool, it is possible to simulate the playing of the game.

When the app is launched, the user has the ability to turn on Alert Mode or to begin playing in Active Mode. When Alert Mode is activated, the user will receive a notification

Figure 26: Smartphone Game Home Screen

when he or she walks near a location where art used to be, the site of a demolished church, or a Rio Terà. Further information regarding this missing treasure will appear.

Active Mode can be played using several different settings. The user has the ability to choose a playing style, game length, playing level, and navigation style. Users will have the ability to choose a specific treasure or to receive a random treasure to return. Game lengths range from one hour to a full day. The length of game will determine how many treasures will be returned and the area of the city that will be covered. Playing levels range from easy to hard. Each level includes all categories of missing treasures. Some treasures are easier to locate than others because they are marked or have not been fully demolished. The user has two choices for navigation style: navigating utilizing a map or receiving turn-by-turn GPS based directions.

When a missing treasure is "returned," the user will be provided with an image of the treasure and some basic information. In addition, he or she can earn points for returning each missing treasure. These points can be accumulated to earn badges that can be shared on social media sites such as Facebook and recorded on the High Scores board at the end of the game. People of any age can use this app to learn more about this history of Venice while exploring the city.

5.2.4 Updating the de'Barbari Explorer

In 1500, Jacopo de'Barbari created an ultra-accurate map of Venice that was about four square meters in size. It was created using six large blocks of wood carved with the impressions in reverse so they could be pressed into paper. At the time, this was one of, if not the largest prints in existence and remains one of the most impressive pieces of the Renaissance period.[16] A past WPI IQP team took the de'Barbari Map and created the de'Barbari Explorer.[17] The Explorer, created from high quality scans of a reproduction of the original map, is an online tool which allows users to explore what Venice looked like during 1500. It allows viewers to zoom in and out of the map to reveal ultra-fine details. Layers have also been created that allow users to highlight specific types of locations, such as demolished churches.

[16] The British Museum

[17] Weis, Amanda Michelle et al (2013) *Venice through the canals of time -- mapping the physical evolution of the city*

While we were verifying previously collected data, we came across several demolished churches and Rii Terà that had not been highlighted on the de'Barbari Explorer. We updated the de'Barbari by comparing the locations highlighted on the Explorer to the locations on the map we created for gathering photographs. Any discrepancies were corrected; a total of three Rii Terà and five demolished churches were added to the de'Barbari Explorer.

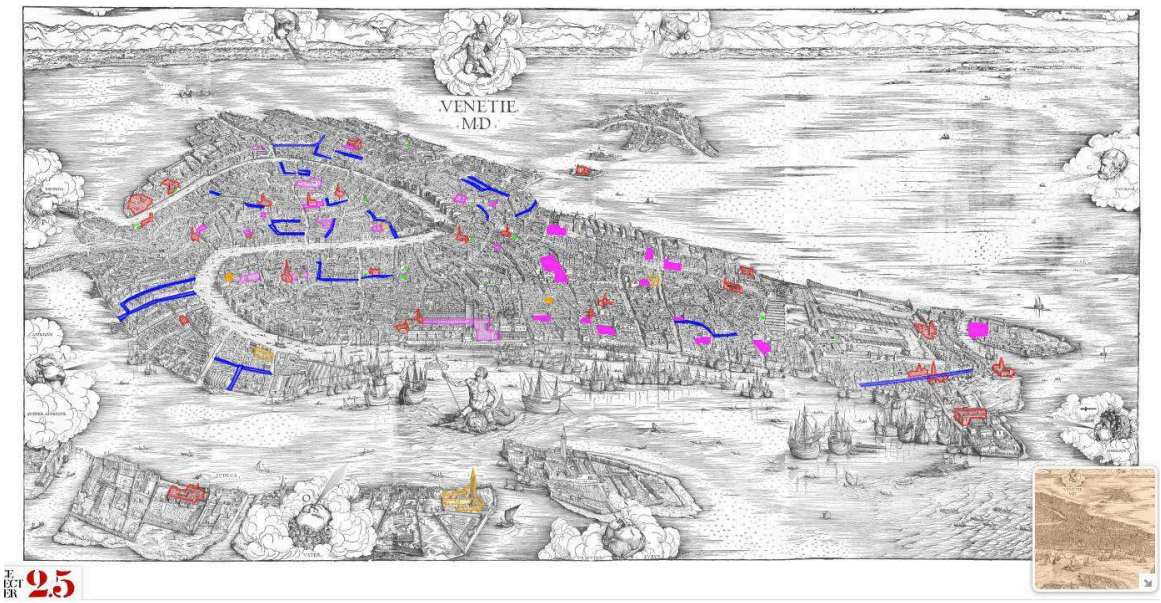


Figure 27: The de'Barbari Explorer

5.2.5 Creating Venipedia Templates

Templates for Venipedia pages are automatically generated by the CK Console. After uploading all of our data to the CK console, the template for missing art was edited to display the appropriate data fields and images. From this template a Venipedia page for each art piece was automatically generated.

6. CONCLUSIONS

The fundamental purpose of the WPI Interactive Qualifying Project is to perform "applied research that connects science or technology with social issues and human needs."[18] We believe that we accomplished this goal. The platform that we created has made previously unavailable information accessible to the public. Not only is this information publicly accessible, it is displayed in a format that is easy to understand through the use of our visualizations.

When we started this project, we were told a multitude of times that our project would not be possible in our given timeframe. Undeterred, we were able to establish a process to track down "missing treasures," in particular displaced Venetian artwork. We believe that through our research, we have proved this methodology to be repeatable and successful. This research platform could be used for both the continuation of our research in Venice, as well as other cities around the world.

Similar to our research process, our technological platform can also be expanded upon. We believe that our platform is an ideal solution for tracking missing treasures due to its modularity and ease of use. For example, one of these modules, the interactive timeline map could be used as a tool for both a casual enthusiast and a professional researcher. This map can be used to establish trends in the global movement of art throughout history and answer questions regarding these trends.

Due to their interactive nature, our visualizations make learning about history more interesting. We hope that our work will inspire people of all ages to take an interest in Venetian treasures.

[18] "Interactive Qualifying Project" Worcester Polytechnic Institute

7. FUTURE RECOMMENDATIONS

Unfortunately, due to time constraints and available software, we were not able to fully bring to fruition all of our ideas. Some of these ideas, along with other recommendations for future teams are included here. Very little information is available regarding the Venetian treasures that no longer exist, have been moved from their original location, or repurposed from their original use. The scarcity of this information makes it difficult for art lovers and tourists to get a full appreciation for Venice's colorful past. It also makes it difficult for researchers to find the information they need in an easily digestible format.

In the timeframe available to conduct this project, we demonstrated the value of this information, developed a process to efficiently and effectively continue to conduct the research necessary to uncover these treasures, and created innovative tools to display and analyze this information in a meaningful and interesting way.

While we made significant progress on this important task, much work remains before missing Venice is fully documented in a single, easily accessible database. Below is a list of projects we recommend to continue this important work.

7.1 Continuation of Missing Item Research

Although we made considerable progress, there are still many pieces of missing art unaccounted for. When we began this project, there was very little published data available in a single location about missing Venetian artwork. We believe that the one of the greatest contributions we have made has been our creation of a consolidated list of artwork removed from its original location. When published in the public domain, this list will make life easier for researches, art lovers, and tourists alike to gain a better understanding of Venice's colorful past. We strongly encourage future teams to continue to expand upon this data.

Another candidate for additional research should be remodeled churches. The VPC currently does not have any data on remodeled churches. Due to the ubiquity of churches in Venice, and their historical ties to the city, we believe research upon the remodeled churches would be met with enthusiasm by the Venetian community, researchers, and tourists.

Due to the nature of our platform, missing item research is not only limited to Venice, any other city could be examined as well. We also recommend that future teams apply our process to examine the displacement of art in other countries.

7.2 Creation of Advanced Data Interaction and Visualization Tools

Although the creation of our website and interactive timeline map make great advances toward helping people to visualize the history of Venetian artifacts, architecture, and infrastructure, more advanced solutions can be created. The solutions below, which we believe to be ideal, require a very high level of programing ability and would make excellent goals for the future.

7.2.1 Development of Mobile Applications

Each year, smartphones are making greater strides towards ubiquity, not only in the United States but around the world. We believe that the creation of applications made specifically for the mobile platform would greatly enhance the usability of our data.

7.2.1.1 Development of "Heroes of Venice"

Millions of mobile games have been created since the inception of the smartphone. We created the "Heroes of Venice" mock-up because we wanted to add a fun and informative game to this total. Although we were limited by time, a significant amount of the research necessary to create "Heroes of Venice" has been gathered. We recommend a future team develop this application to completion. Not only will it provide tourists with an entertaining way to see Venice, it will undoubtedly help to instill an appreciation for Venetian history and provide insight on the changes Venice has experienced, which would have otherwise gone unnoticed.

7.3.1.2 Development of a "Visulization" Application

Perhaps the most used part of a smartphone is the camera; we recommend the creation of a mobile application which will utilize the camera and GPS capabilities of smartphones. This application will allow the user to "see" items, such as churches and wellheads, in their original locations. Using the camera, the phone will overlay an image of the "missing" item over what the user is viewing through their camera, allowing the user to see what it would have originally looked like. A mock-up of this concept can be seen

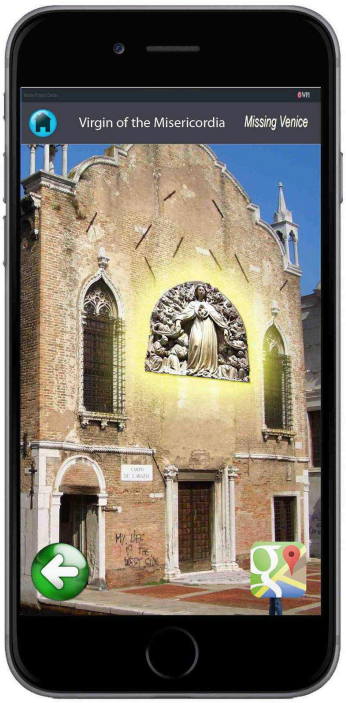


Figure 28: Visualization Application Mock-up

in Figure 27. The application would have other functionality as well, such as walking directions around the city and alerts when the user approaches previous locations of relocated items.

7.2.2 Creation of a Rendered 3D Missing Item Tour

We believe that 2D images, maps, and sketches can only go so far in illustrating where churches, convents, and canals used to be located. We strongly believe that the creation of a rendered 3D environment would allow residents, tourists, and researchers to gain a full appreciation of "Missing Venice." We recommend the creation of a 3D environment, similar to Google Street View. This set of 3D maps would include all demolished churches and convents in their former glory and all Rii Terà would be seen as canals. Users would be able to navigate this map in two ways, as if they were on street level, or as if they were viewing the city from an elevated position. When the user selects the street level option, they could enter demolished buildings, see where art used to hang, and travel in a gondola down a Rio Terà. When the user is viewing the city from an elevated position, they would be able to pan around the outside of buildings and see the detailed architecture that is so prominent throughout Venice. Ideally, this application could be run both on a mobile device and traditional computer. We recognize that this would be a challenge; a significant amount of research would still need to be completed and advanced programing skills would be necessary. Despite these challenges, we believe that it would be a worthwhile endeavor and a great achievement for the VPC.

7.2.3 Virtualizing the Canal Filling Process

While we were walking around the city verifying data and gathering the pictures, one thing that we found to be interesting was the work that would have been necessary to fill in a canal. We believe that it would be very informative if an animation of the canal-filling process were to be created. This animation would show the difference between filling and capping a canal, as well as the hydrodynamic effects created by modifying the Venetian canals. They would also shed light on the engineering challenges faced in both the construction and modernization of Venice. We believe these animations would be valuable education tools. In combination with our research and other recommendations above, they would add to the usefulness of the data we have collected.

APPENDICES

A. Data Spreadsheets

The following is example of the spreadsheets we used to collect our data and upload it to the CK Console. Due to its size, only portions of the sheet were included.

Venice Missing Items

PVID	Source	Item Name	Artist	wiki_friendly_title	Category
10001	Scire, Gio	Coronation of the Virgi	Paolo Veneziano	Art - 10001	Painting
10002	Scire, Gio	Polyptych: The Annunc	Lorenzo Veneziano	Art - 10002	Painting
10003	Scire, Gio	Polyptych of the Apocal	Jacobello Alberegno	Art - 10003	Painting
10004	Scire, Gio	Madonna and Child Ent	Nicolò di Pietro	Art - 10004	Painting
10005	Scire, Gio	Justice between the Arc	Jacobello Del Fiore	Art - 10005	Painting
10006	Scire, Gio	Saint Helena Polyptych	Michele di Matteo	Art - 10006	Painting
10007	Scire, Gio	Coronation of the Virgi	Michele Giambono	Art - 10007	Painting
10008	Scire, Gio	Saint James the Elder, a	Michele Giambono	Art - 10008	Painting
10009	Scire, Gio	The Marriage of Saint	Antonio Vivarini	Art - 10009	Painting
10010	Scire, Gio	Madonna and Child Ent	Antonio Vivarini and Giova	Art - 10010	Painting
10011	Scire, Gio	Saint George	Andrea Mantegna	Art - 10011	Painting
10012	Scire, Gio	Enthroned Madonna wit	Bartolomeo Vivarini	Art - 10012	Painting
10013	Scire, Gio	Tryptych: Saints Vincen	Andrea Da Murano	Art - 10013	Painting
10014	Scire, Gio	Madonna and Child Ble	Giovanni Bellini	Art - 10014	Painting
10015	Scire, Gio	Madonna Enthroned Ad	Giovanni Bellini	Art - 10015	Painting
10016	Scire, Gio	The San Giobbe Altarpi	Giovanni Bellini	Art - 10016	Painting
10017	Informati	The Adoration of the Ki	Paolo Caliari (Veronese)	Art - 10017	Painting
10018	Informati	The Wedding at Cana	Paolo Caliari (Veronese)	Art - 10018	Painting
10019	A Visit to	Feast in the House of Le	Paolo Caliari (Veronese)	Art - 10019	Painting
10020	Informati	The Family of Darius at	Paolo Caliari (Veronese)	Art - 10020	Painting
10021	Scire, Gio	Mourning the Dead Chr	Giovanni Bellini and others	Art - 10021	Painting
10022	Scire, Gio	The Angel of Annunciat	Giovanni Bellini and others	Art - 10022	Painting
10023	Nepi Scir	Saint John the Baptist	Alvise Vivarini	Art - 10023	Painting
10024	Nepi Scir	Saint Matthew	Alvise Vivarini	Art - 10024	Painting
10025	Scire, Gio	Blessed Lorenzo Giusti	Gentile Bellini	Art - 10025	Painting
10026	Informati	The Four Allegories of	Paolo Caliari (Veronese)	Art - 10026	Painting
10027	Informati	The Four Allegories of	Paolo Caliari (Veronese)	Art - 10027	Painting
10028	Informati	The Four Allegories of	Paolo Caliari (Veronese)	Art - 10028	Painting
10029	Informati	The Four Allegories of	Paolo Caliari (Veronese)	Art - 10029	Painting
10030	Frick Coll	St. Francis in the Desert	Giovanni Bellini	Art - 10030	Painting
10031	Informati	Mystical Marriage of St	Paolo Caliari (Veronese)	Art - 10031	Painting
10032	Informati	St Lanfranc Enthroned	Cima da Conegliano	Art - 10032	Painting
10033	Informati	Christ Washing the Disc	Tintoretto	Art - 10033	Painting
10034	Informati	Christ Carried to the To	Tintoretto	Art - 10034	Painting
10035	Informati	St Catherine of Sienna	Giovanni Bellini	Art - 10035	Painting
10036	Informati	Virgin of the Misericord	Bartolomeo Bon	Art - 10036	Sculpture
10037	Informati	The Virgin and Child w	Giovanni Buora	Art - 10037	Sculpture
10038	Informati	Naked Youth with Rais	Francesco da Sant'Agata	Art - 10038	Sculpture
10039	Informati	Head of an Athlete(Apo	Lysippos	Art - 10039	Sculpture
10040	Informati	Coronation of the Virgi	Paolo Veronese	Art - 10040	Painting
10041	http://ww	Tobias and the Angel	Titian	Art - 10041	Painting
10042	Informati	Christ Washing the Disc	Tintoretto	Art - 10042	Painting
10043	A Visit to	Madonna del Parto with	Maestro della Madonna del	Art - 10043	Painting
10044	A Visit to	Saint Peter Martyr	Vittore Carpaccio	Art - 10044	Painting

Venice Missing Items

Medium	Type	Item Description	Description Source	Picture	Picture Source
Tempera	Wood	"The development Physical and spirit The contrast of the	Quoted from the	painting_10001.jp	Image Taken from
Tempera	Wood	This work is of very	fine artistic qualit	painting_10002.jp	Image Taken from
Tempera	Wood	"The picture show The ineffably expr	Quoted from the	painting_10003.jp	Image Taken from
Tempera	Wood	"While the chief in	Quoted from the	painting_10004.jp	Image Taken from
Tempera	Wood	"In his early work,	Quoted from the	painting_10005.jp	Image Taken from
Tempera	Wood	"This polyptych by	Quoted from Save	painting_10006.jp	Image Taken from
Tempera	Wood	"After a probable i	Quoted from the	painting_10007.jp	Image Taken from
Tempera	Wood	"The polyptych is Again in this late The polyptych is si	Quoted from the	painting_10008.jp	Image Taken from
Tempera	Wood	"This small panel, toge	Quoted from the	painting_10009.jp	Image Taken from
Oil	Canvas	"In this grandiose t	Quoted from the	painting_10010.jp	Image Taken from
Tempera	Wood	"The saint stands s	Quoted from the	painting_10011.jp	Image Taken from
Tempera	Wood	"The central panel	Quoted from the	painting_10012.jp	Image Taken from
Tempera	Wood	"Although conceiv The work was pro The paintings in th	Quoted from the	painting_10013.jp	Image Taken from
Tempera	Wood	"This picture still r	Quoted from the	painting_10014.jp	Image Taken from
Tempera	Wood	"The upper part of The new relationsh	Quoted from the	painting_10015.jp	Image Taken from
Oil	Canvas	"Bellini composed There are eleven fi	Quoted from ArtBi	painting_10016.jp	Image Taken from
Oil	Canvas	"The Three Kings The dominant diag The picture is date	Quoted from the N	painting_10017.jp	Image Taken from
Oil	Canvas	"Veronese mixes t Veronese orchestra The painter selecte	Quoted from the L	painting_10018.jp	Image Taken from
Oil	Canvas	"This work, painte The sumptuous ba The expressive he	Quoted from the	painting_10019.jp	Image Taken from

Venice Missing Items

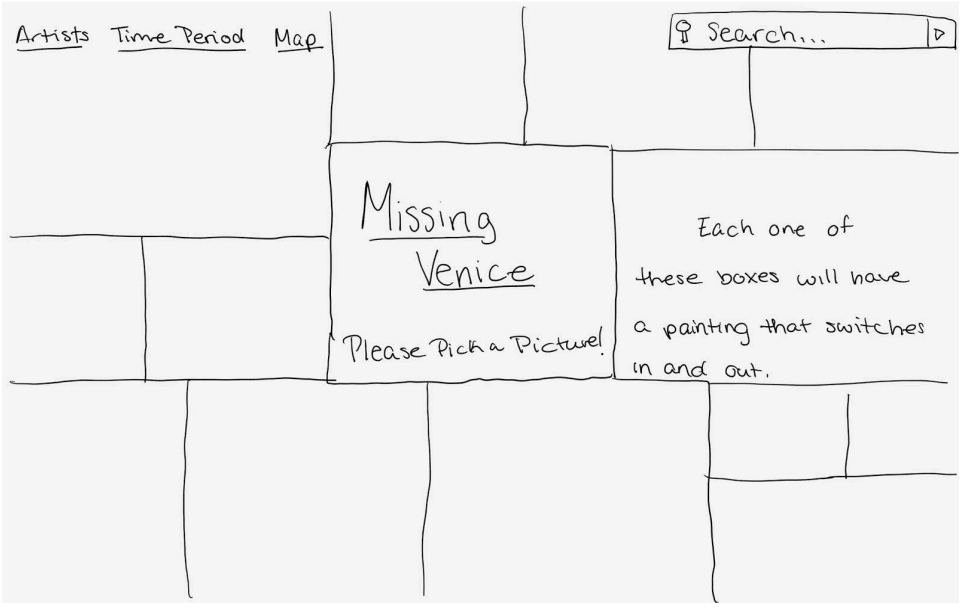
Date to Current	Current Location	Current Latitud	Current Longitude	Current Loc P	Current Loca
1812	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1812	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1951	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1856	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1884	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1827	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1816	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1812	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1951	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1807	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1856	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1812	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1883	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1812	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1812	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1815	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1800	National Gallery,	51.5091765	-0.1282105	NationalGalle	Image Taken
1797	Louvre, Paris	48.860611	2.337644	Louvre.JPG	Image Taken
1815	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1857	National Gallery,	51.5091765	-0.1282105	NationalGalle	Image Taken
1829	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1907	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1812	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1812	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1850	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
	National Gallery,	51.5091765	-0.1282105	NationalGalle	Image Taken
	National Gallery,	51.5091765	-0.1282105	NationalGalle	Image Taken
	National Gallery,	51.5091765	-0.1282105	NationalGalle	Image Taken
	National Gallery,	51.5091765	-0.1282105	NationalGalle	Image Taken
1915	Frick Collection,	40.77097	-73.967384	Frick.JPG	Image Taken
1918	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
1912	Fitzwilliam Muse	52.199534	0.119944	Fitzwilliam.J	Image Taken
1650	Museo del Prado,	40.413782	-3.692127	Prado.JPG	Image Taken
1984	National Gallery,	55.950902	-3.195686	NationalGalle	Image Taken
1867	Destroyed				
1882	Victoria and Albe	51.4967225	-0.1721787	VictoriaAlber	Image Taken
	Victoria and Albe	51.4967225	-0.1721787	VictoriaAlber	Image Taken
1916	Frick Collection,	40.77097	-73.967384	Frick.JPG	Image Taken
2000	Kimbell Art Muse	32.748612	-97.365136	Kimbell.JPG	Image Taken
	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
2000	Church of the Ma	45.4456991	12.3326235	Orto.JPG	Photograph
1900	National Gallery,	51.5091765	-0.1282105	NationalGalle	Image Taken
1916	Gallerie dell'Acca	45.431078	12.328139	Gallerie.JPG	Photograph
	Correr Museum	45.443034	12.332175	Correr.JPG	Photograph

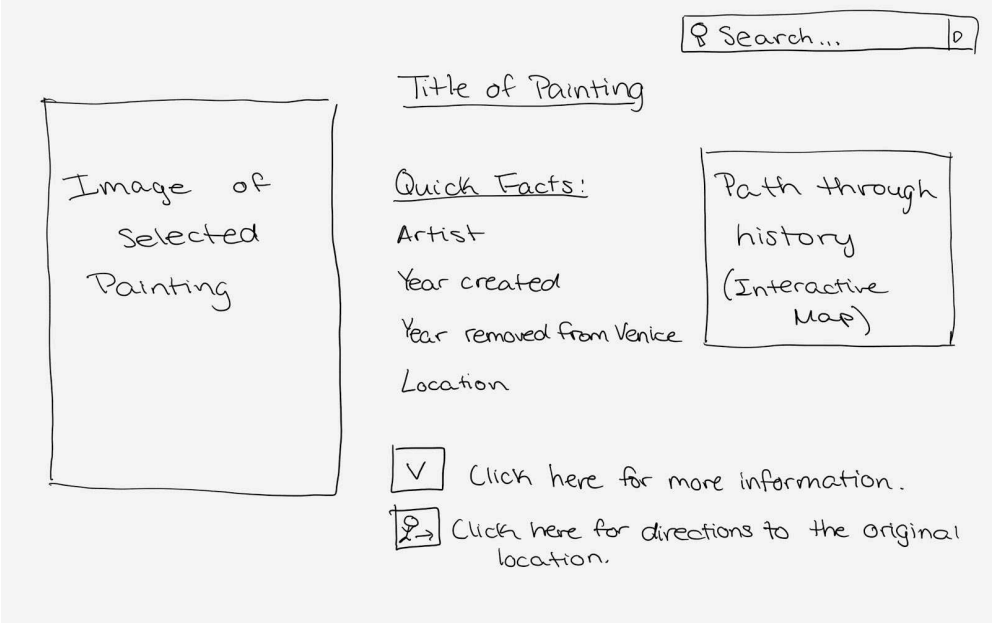
Venice Missing Items

Date Created	Original Location	Original Lata	Original Longitude	Original Location	Orginial Loca
1350	Church of Saint Clare	45.4404	12.316875	SaintClare.JPG	Venipedia
1358	Church of Sant'Antonio di Castello	45.429597	12.3582	Castello.JPG	Image Taken
1397	Church of San Giovanni Evangelista	45.438	12.326	GioEvan.JPG	Image Taken
1394	Palazzo Barbaro	45.431631	12.329975	Barbaro.JPG	Photograph T
1421	Palazzo Ducale	45.433704	12.340389	Ducale.JPG	Photograph T
1427	Church of Sant'Elena	45.427101	12.365394	Elena.JPG	Photograph T
1447	Church of Sant'Agnese	45.430319	12.330979	Agnese.JPG	Image Taken
1450	Church of San Giacomo	45.438515	12.335497	Giacomo.JPG	Photograph T
1440	Church of San Stefano	45.433952	12.330974	Jeans.JPG	Photograph T
1415	Scuola Grande San Rocco	45.436602	12.325394	Rocco.JPG	Photograph T
1431	Priuli Venier Manfrin Palace	45.263786	12.192939	Manfrin.JPG	Photograph T
1464	Church of Sant'Andrea alla Certosa	45.433756	12.372573	SantAndreaCertosa	Image Taken
1472	Church of San Pietro. Martire	45.454834	12.35267	Pietro.JPG	Photograph T
1460	Palazzo dei Camerlenghi	45.438497	12.335704	Camerlenghi.JPG	Photograph T
1470	Palazzo Ducale	45.433704	12.340389	Ducale.JPG	Photograph T
1493	Church of San Giobbe e Bernardino	45.445028	12.320732	Giobbe.JPG	Photograph T
1573	Church of San Silvestro	45.437553	12.333396	Silvestro.JPG	Photograph T
1563	Benedictine Monastery of San Giorgio	45.4278406	12.3442092	GMaggiore.JPG	Image Taken
1573	Basilica di Santi Giovanni e Paolo	45.439379	12.341713	Paolo.JPG	Photograph T
1565	Palazzo Pisani Moretta	45.435976	12.329428	Moretta.JPG	Photograph T
1664	Church of Santa Maria dei Servi	45.444016	12.330737	Kitty.JPG	Photograph T
	Church of Santa Maria dei Miracoli	45.439691	12.339293	MariaMiracoli.JPG	Photograph T
1480	Church of San Pietro. Martire	45.4539158	12.3564466	Pietro.JPG	Photograph T
1480	Church of San Pietro. Martire	45.4539158	12.3564466	Pietro.JPG	Photograph T
1445	Church of the Madonna Dell'orto	45.4456991	12.3326235	Orto.JPG	Photograph T
1575	Venice	45.4057148	12.3817426		
1575	Venice	45.4057148	12.3817426		
1575	Venice	45.4057148	12.3817426		
1575	Venice	45.4057148	12.3817426		
1478	Venice	45.4057148	12.3817426		
1575	Church of Santa Caterina	45.443339	12.336359	Caterina.JPG	Photograph T
1515	Church of Gesuiti	45.443361	12.338644	Gesuiti.JPG	Photograph T
1548	Church of San Marcuola	45.442767	12.32895	Marcuola.JPG	Image Taken
1550	Chiesa di San Francesco della Vigna	45.438277	12.347875	Vigna.JPG	Photograph T
	Church of San Zanipolo	45.439379	12.341713	Paolo.JPG	Photograph T
1445	Scuola Vecchia di Santa Maria della Mi	45.443678	12.334825	Fabio.JPG	Photograph T
1495	Chiesa di San Francesco della Vigna	45.438277	12.347875	Vigna.JPG	Photograph T
1500	Venice	45.4057148	12.3817426		
365 BC	Palazzo Bernardo Nani	45.4308256	12.3350504	BernardoNani.JPG	Image Taken
1555	Church of San Sebastiano	45.4320603	12.3207727	Sebastiano.JPG	Photograph T
1550	Church of San Marziale	45.44378	12.332761	Marziale.JPG	Photograph T
1575	Church of San Trovaso	45.4307351	12.3262468	Trovaso.JPG	Photograph T
1390	Church of Santa Caterina	45.3181224	12.1736649	Caterina.JPG	Photograph T
1514	Church of Santa Fosca	45.443034	12.332175	Fosca.JPG	Photograph T

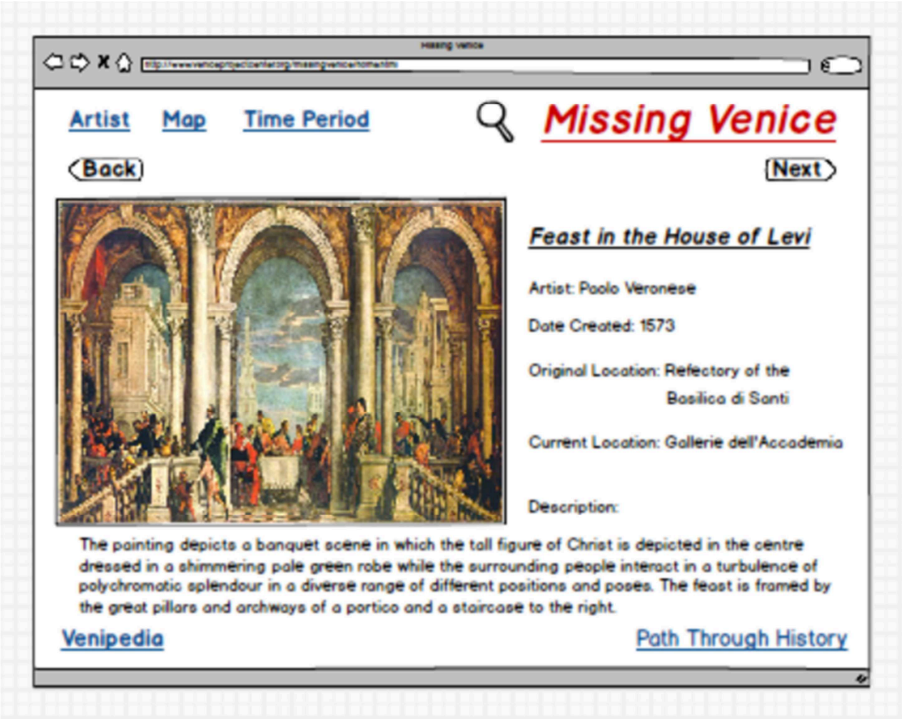
B. Website Mock-Ups

The following two sketches were our concept of the first and second page, respectively, of our website design.

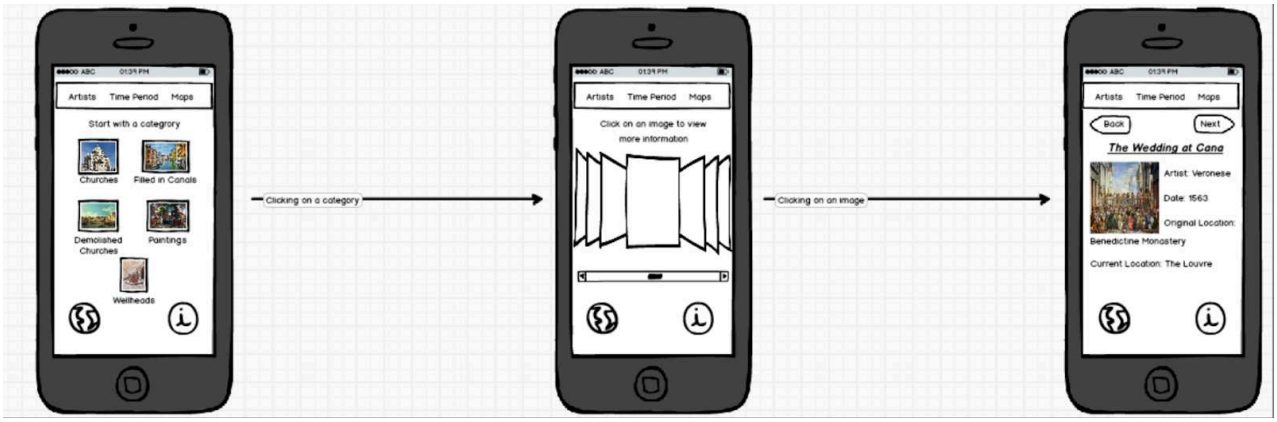




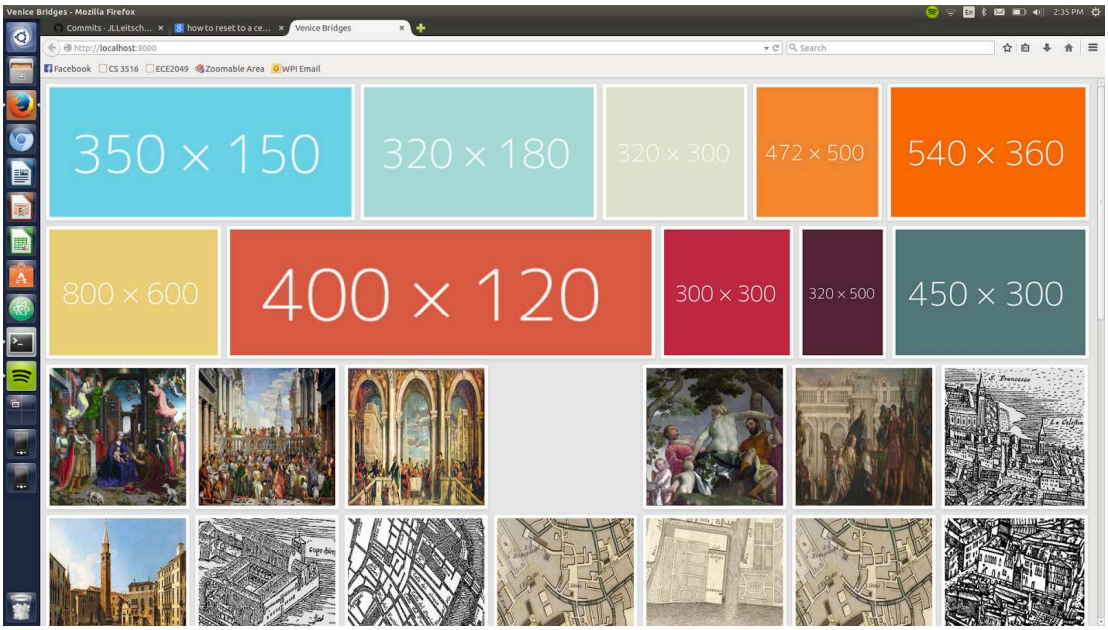
The following image is from the second phase of our mock-ups. It depicts what we expected would be on an information page of our website.



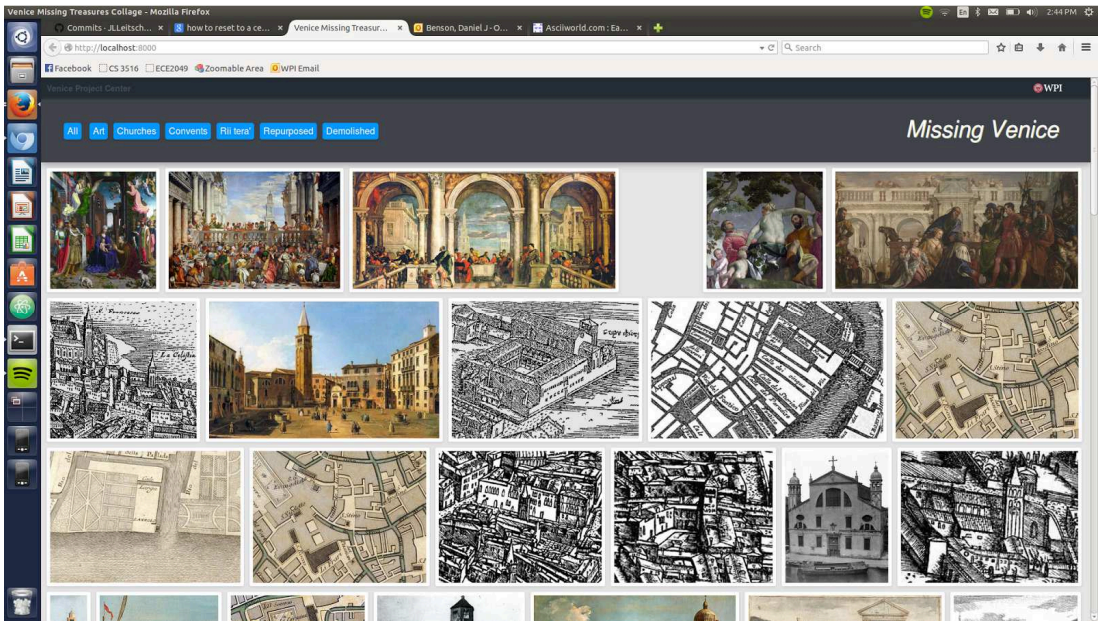
The image below shows how we originally envisioned our website would appear on a mobile device. This approach was abandoned after we were able to dynamically change the size of our collage to fit various screen sizes.



The website in its beginning stages can be seen below. Note the template in the background and the lack of a navigation bar.



The website in an intermediate stage of construction can be seen below. Note the lack of a search bar.



C. Coding the Website

After multiple revisions to our mock-ups we began to code the website. The website is written using multiple javascript libraries and loaded and displayed dynamically using Angular. We used javascript to create a single standardized dataset class from each of our different types of missing treasure datasets. This class retrieves and parses the fields that are relevant for display on our website and creates an object of this class for each treasure. These objects are then displayed in the collage picture format on the main page of our website. When one picture is selected, a second page retrieves the object's data fields and displays it in a table format, with the pictures in a carousel, and other relevant information in paragraph format.

In order to make our website available to all users we had took into consideration how it would look when displayed on a smartphone. We made sure that the user would be able to easily navigate using the buttons in the header of our website, as well as the search bar and the collage itself. The website dynamically resizes to fit the size of the window, which makes is useable from any smartphone. When the screen resizes, all of the images in the collage change sizes proportionally and the buttons create rows so they do not overlap.

Finally, after the completion of our website we ran a series of tests to analysis the usability of our interface. We tested the site both amongst ourselves and with people from outside of the group. We tested to make sure that each of the users could find different parts of the website and could find specific pieces. We also asked them for opinions which we used to improve the layout of our website. This greatly helped to increase the usefulness of our website.

D. Coding the Interactive Map

Over the course of the past term we experimented with many different javascript libraries and other visualization tools in the development of our timeline map. We started by designing the map in the Google Maps Application Programming Interface (API) as a proof of concept. We knew that we would not be able to use this API to accomplish the entirety of our desired functionality so we began to look into alternatives. We researched and contacted a team creating a new map data visualization program, Datacollider. Unfortunately, this program was temporarily in a closed, private beta period.

Next we created a 3-Dimensional map using the D3js javascript libraries. We used this to create a functional globe that the user could zoom in on and manipulate by clicking and dragging. Although this form of the map was aesthetically pleasing, it experienced shortcomings in its ability to give the user the ability to interact with our data.

Finally, we moved on to the Mapbox.js and Leaflet javascript libraries. The mapbox tools and plugins gave us all of the functionality that we needed for a successful map visualization. It allows the user to click on any point or line drawn on the map which could be created dynamically from the CK console. It also allows us to import plugin features such as the ability to locate the user. By clicking on an icon, the map will zoom into the user's exact location from their GPS data on their phone or computer. Another feature we added through mapbox plugins was the implementation of a full screen mode.

After getting the base functionality of the map we needed to display our data. Each of the points on the map are places where one of the art pieces was displayed at some point in history. We parsed through the data from the CK console as described above and recorded location data in the fields of the standardized dataset object. This location data is then parsed and added as a marker to the map. The markers' sequence numbers in the piece's movement is also recorded (e.g. current, original, second, third, etc..). These are used to create the polyline strings, displayed on the map as an arc, which are placed on the map as the path the piece travels.

The user can add a filter to the markers and lines that are displayed on the map by inputting a certain range of years. This will limit the points shown on the map to the pieces which moved during this range.

When one point or line is selected, we iterate through all of the other points and lines and dull the colors to make it appear as though the selected point is highlighted. To clear the selection, the user can click on the "Clear Selection" button and we again iterate through all the points and lines and reset the colors to be their original values.

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