The Story of Venice: An Interactive Timeline

An Interactive Qualifying Project Report
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submitted by

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Authorship

The group divided up authorship of the several sections of the paper, and then used meeting time to review the content of these several sections as a unit. All review was conducted thusly. Below are indicated which sections were written by each person. Sections not listed below were produced as the result of collaboration of the entire group.

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Abstract

The city of Venice has a history that spans over a thousand years. During this period the city became one of the most powerful republics in the Mediterranean and is today a World Heritage site. There are currently no digital sites where users can easily access, search, and organize a wide array of resources on Venetian history, however. To empower users to "make history" in this way, the team created an accessible, comprehensive, and expandable digital timeline application. Users can search and view an array of sources, keep records for their research, and expand the dataset. As the application grows, it will become a one-stop resource and research tool of Venetian historical data for tourists, students, and scholars.

Executive Summary

The story of Venice spans over a thousand years. There are records that date the beginning of the city all the way back to the year 421. As the city grew economically and culturally, it eventually became one of the most powerful city-states of Europe, dominating trade routes along the Adriatic and Mediterranean seas and expanding its territorial borders far outside the Venetian Lagoon. Venice maintained its influence along the Adriatic and Mediterranean seas until the year 1797, when the Republic fell at the hands of Napoleon. Nonetheless, the republic's historical importance has been mostly overlooked by its visitors as they focus mostly on the aesthetic aspects of Venice, even though those aesthetics are a direct result of the city's economic success.

The history of Venice is engraved in the minds of Venetian locals; they are proud of it. Currently, however, there is no single place where other people can locate a comprehensive archive of historical materials on Venice on the Internet. The lack of an exhaustive and engaging site where users can access a range of Venetian history resources created the need for this project.

Many sources on Venetian history are inaccessible to the general public. The Venice State Archives contain thousands of written manuscripts, the bulk of which are not available online. These manuscripts are primary sources providing incredibly detailed records of Venetian history from the 9th century on. The vast amount of data contained within the archives would be a valuable source of information if made available to the world. Moreover, language creates access problems as well, since many good sources on Venice are written in Italian or Veneto.

Venetian history books suffer another problem. Traditionally, history books are written by a small group of historians who choose what events and sources are important or relevant, creating a dearth of perspective of which events are important or relevant. With the creation of the Internet and modern search capabilities, it has become possible to democratize the process of reading and interpreting history by allowing all users to find events they deem are important. With this information, it becomes possible to present data in a way that is not influenced by the perspectives of any one person, but rather by the aggregate perspective of all users. However, many current sources on Venetian history are not easily searchable and engageable in this way, especially print-based histories.

To address these issues, the team sought to create an accessible, comprehensive, and expandable digital application about the history of Venice. After some research, the team decided that the best way to do this was through the creation of a digital interactive timeline. In the design phase, by looking at other web-based timelines and comparing them to our goals, the team was able to decide what functions and features the application should have. We created several mockups and use cases to help determine how the project should be executed. In the development phase, the application code was written, creating a version of the application in which all features were present. Some of these features, such as the timebar, zoom capability, search capability, and content panels can be seen in the image below. In the polishing phase, group focused on aesthetics and problems with the code were fixed, producing the final application. The team used several coding languages, including HTML, CSS and JavaScript.

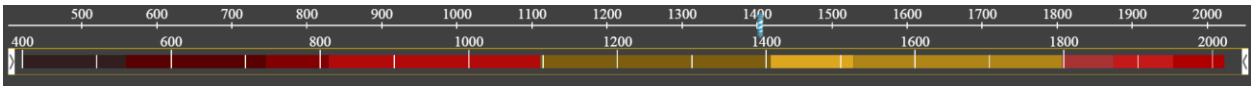
Content for the Application

The final application makes many sources on Venetian history accessible, and future versions will contain even more information. This first version of the site has been populated with basic entries of historical events taken from several sources: *L'Atlante storica di Venezia* and *L'Enciclopedia storica di Venezia*, books given to us by their author, Giovanni Distefano. *L'Atlante* is an extensive chronology of dated events, year by year. It has text content as well as images that correspond to many events. *L'Enciclopedia* contains detailed descriptions about specific locations and people. Both sources provided basic building blocks for the material in the timeline. Through the use of a parsing algorithm and some manual work, the team was able to extract events, locations, and images from *L'Atlante* and additional descriptions from

L'Enciclopedia. Populating the application with these sources made it a comprehensive site, which was one of the main goals of the project.

Navigation

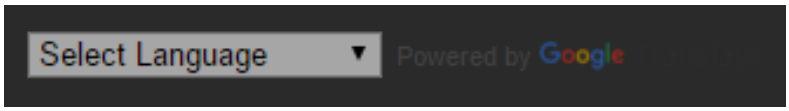
Another goal was to ensure that the application would provide accessibility to Venetian history by allowing users to traverse the application easily. Thus, while developing the timeline, it was important to consider how users would navigate the vast set of data contained therein. A timebar was placed at the bottom of the application, which has a slider on it that can be used to jump to a specific point in time. The slider also allows users to orient themselves in time. Additionally, a second timebar was placed under the first one. This timebar has two connected sliders on either end, which can be moved individually to adjust the range of time displayed on the above time bar. By adjusting the range of the top time bar user can be more precise when navigating a specific section of the timeline. Users can also navigate using the scroll bars on either side of the application or the scroll wheel.



Users can filter events through the use of the different layers of the application. A set of navigational buttons can be found under the timebar. These buttons represent the separate zoom levels of the application, each of which contain a different amount of information. Users with a more casual interest in Venetian history can view the upper layers, which contain only important events. Alternatively, researchers have the option to delve deeper into the bottom layers, which contain all of the information contained in the database.

Searchability

A search box was added to the interface on the top left of the application. Users are able to perform two different types of searches: search by year or by content. The application will show only events that occur in that year or are related to the content. This functionality allows users to access information easily and conveniently.

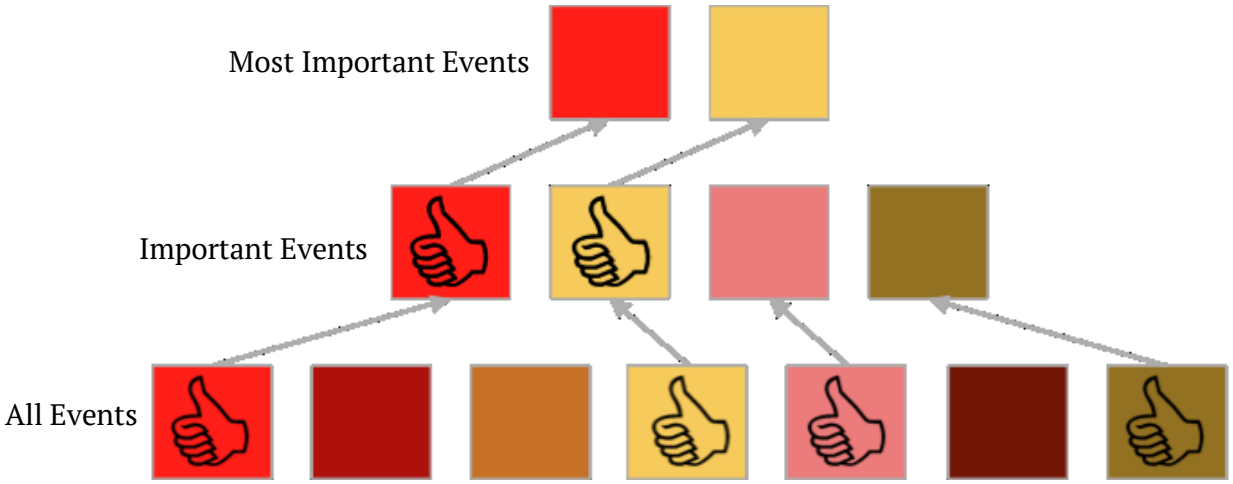


The base text is in Italian. Since not everyone speaks Italian, a translation function was implemented. The team used a Google Translate widget because it provides a large number of

destination languages. Through the widget, the application is now usable by a wide variety of users.

These functionalities make the timeline accessible by improving its usability and navigability. We also addressed the issue of expandability. To make the timeline expandable beyond its original dataset, the team added functions allowing for manual and automatic updates to the database. Users with login credentials have the ability to manually add events through an add event form, and a script will read an RSS feed from the city of Venice and automatically add events to the timeline. It is also possible that, through the use of transcription applications such as uScript, manuscripts from the Venice State Archives could be imported into the application. In this way, the application has the potential to become a digital home for the manuscripts from the Venice State Archives.

Over time, the application democratizes Venetian history by allowing users, and not a textbook or scholar, to determine which events are interesting and important. In the timeline, each event keeps track of the number of times it has been viewed. As the application is used events "float up" from lower zoom levels based on their popularity. A visualization of event movement can be seen below. This functionality allows a varied group of users to decide which events of history are most important, instead of the source's creators, a feat which has not been achieved by historical sources to date.



A secondary goal for the application was to make it visually appealing. If an application is not visually appealing, users will automatically be deterred from using it, so aesthetic features were addressed in the polishing phase. The color scheme was altered to match the colors of the Venetian Republic's flag, and the appearance and location of many different buttons and functions were tweaked. The end result was a crisp interface that draws users attention.

The application now has the potential to become a powerful research tool for tourists, students, Venetians, and historians alike. Over time, the team hopes the application continues to develop its features and grow in size. Some recommended actions to ensure that development and growth continues include user testing, which will highlight accessibility issues. The translation and search functions also require some improvement in order to work more smoothly and accurately, as the Google Translate algorithm makes many errors and the search function only finds exact matches within event content.

If successful, the application should make accessible more digital information about Venetian history, become a digital home for Venetian manuscripts, and help to democratize history making, aiding budding and experienced researchers as they seek, find, organize, and interpret a wide array of information and events. In the end, we hope that this new tool will create a new awareness of the value and contributions behind the beautiful and unique city that is Venice.

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1 Introduction

History is the study of the past.[1] People have always been very interested in their past since it gives them a better understanding of what they are and what they are capable of achieving as individuals and as a society. Since the origins of humanity, the ways in which history is portrayed and retold have evolved, from early oral accounts to written chronicles and more comprehensive publications based on archival materials. Today, the Internet houses and makes available many sources that can be used as a basis for constructing histories. Modern historians are exploring how to use the Internet not only to learn from our past, but to teach others about it.

The history of Venice, however, has not been thoroughly represented on the World Wide Web. This lack of representation is unexpected, because the city has a rich history, one which greatly affected and influenced the development of Europe and the rest of the World. A new way to show that there is much more to the story of Venice than just gondolas, canals, and expensive food is warranted.

Venice was once a naval and economic power in the Mediterranean. In the 11th century, Venice was the largest trading hub in Europe due to its central location in the continent. At its peak, the Venetian navy comprised over 3,000 ships that served for both trade and battle.[2] This formidable navy brought Venice great economic success, which is made evident by the fact that their currency, the Venetian Ducat, was used in trade throughout Europe during the Renaissance.[3] Both the economic and the naval successes of Venice are powerful indicators of the city's influence.[4]

The city has also long been considered an important European cultural center. The lagoon is a living monument that contains architectural masterpieces ranging from the Middle Ages to present day.[5] The city's cultural significance can be clearly observed through the works of the plethora of famous artists and musicians who lived in the city, such as Giovanni Bellini, Antonio Vivaldi, and Tintoretto.

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[1] Merriam-Webster s.v. *history*

[2] Lane, Frederic C., 1973, 337.

[3] Stahl, Alan M., 2000, 215

[4] Ibid. Lane, 5.

[5] UNESCO, 1987.

Currently, there are both primary and secondary sources that make up the history of Venice. Primary sources include historical chronicles, written manuscripts, cartography, and the events of modern day. Secondary sources of Venetian historical information include such works as historical textbooks, atlases, encyclopedias, and Internet sources such as Wikipedia. Other historical information is visual in nature. Venice has many ancient maps and drawings, as well as a rich history in art and architecture. More recent information may even be in audio or film format. While there are a variety of sources on the subject of Venetian history, many of these suffer from a lack of accessibility, expandability, or comprehensiveness.

Although there is a lot of information on Venice's history, much of it is not easily accessible. Much of Venice's historical information is stored in manuscripts contained in the Venice State Archives. These documents are only accessible to a limited group of people. The archives contain detailed information, such as records, birth certificates, and letters, which describe the day-to-day events in Venice since the beginning of the republic in the 9th century. There is currently an effort to digitize these documents, but the digital copies are kept in the intranet of the archives, which is only accessible on-site in Venice. Secondary sources, such as atlases and encyclopedias, are easier to obtain than manuscripts, yet many are still available only in print. Both manuscripts and printed secondary sources have limited accessibility because they are published only in one language. Print media are not searchable and filterable in the same way as online sources, which makes them even more challenging to use for the average reader.

Another common problem with current sources of Venetian history is a lack of expandability. Written works such as encyclopedias and chronicles must be republished in order for more information to be added into them. The only current sources of information that are easily expandable are websites, such as Wikipedia, and news sources, such as *Il Gazzettino*. However, these two sources suffer from other problems.

The multitudes of manuscripts contained within the Venice State Archives comprise a comprehensive dataset one might use to explore Venetian history. Atlases and encyclopedias are somewhat comprehensive, but even they must make some decisions on which aspects of history are selected to be told. There is not one source of Venetian historical information that displays all three characteristics of being comprehensive, expandable, and easily accessible.

The goal of this project was to portray the history of Venice in a new way. The group sought to address this problem by creating a digital repository of sources of Venetian history which encompasses all three qualities. In order to achieve this, the team created a web-based

multimedia timeline application. Over time, the application could become a powerful research tool for tourists and historians alike.

2 Background

In order to achieve its goal, the team did research on several different topics. To make this historical compilation, some basic knowledge of the history of the city was necessary. Because the team wanted to avoid the problems with existing sources today, research was also conducted on current representations of Venetian history and their limitations. The team conducted research on how a timeline could solve these problems. Finally, the team investigated the important elements of interactive interfaces and analyzed their uses in other applications in order to identify strategies for creating the application.

2.1 A Brief History of Venice

The city of Venice has an extensive history that spans from the year 421 C.E. to the present. The Venetian islands were initially governed by the Roman Empire.[6] During this period, the majority of the area was unpopulated until the invading forces of Attila the Hun caused many people to flee to the lagoon. After Roman rule, the Byzantine Empire took over Venice.[7] The Venetians, through their naval power, developed a great relationship with the Byzantines, which allowed the Venetians to be semi-autonomous under Byzantine rule.[8] Afterwards, Venice obtained its independence from foreign rule and was able to create one of the most powerful republics in history.[9] Nonetheless, the Most Serene Republic of Venice fell to Napoleon's army in 1797 and became part of the Austrian Empire.[10] During this period the city of Venice was passed between the Austrian Empire and the first French Republic.[11] Finally, in 1866, the city of Venice became part of the Italian Kingdom as result of a treaty between Italy and Austria. Since then, the city of Venice has remained a part of Italy.[12] Today, it is known as one of the most crowded tourist destinations in the world

2.1.1 Romans in the Venetian Lagoon

The region that encompasses modern day Venice was part of the Roman Empire from the early stages of the lagoon. Nonetheless, it was mostly unpopulated since it was composed

[6] Norwich, John J., 1989, 4-5

[7] Ibid. 8-9.

[8] Ibid.

[9] Ibid. 24.

[10] Ballard, Richard, 2012, 62-63.

[11] Madden, Thomas F., 2013, 376.

[12] Gooch, John, 1986, 35-36.

of sandy islands produced by sediment deposits caused by the change of tide heights.[13] At this time in history, only a few fishermen lived there.[14] It was not until the year 421 that Venice as a city is believed to be founded by a group of Romans that installed a trading post in Rialto.[15] The lagoon started to be populated by refugees who were fleeing the wrath of Attila the Hun (Figure 1), whose forces had started invading northern Italy in 452.[16,17] During the later stages of the Roman Empire, Venice developed its own economy and built a formidable navy.[18]

Figure 1. Attila the Hun

2.1.2 The Venetian Lagoon under the Byzantine Empire

Before then, the Roman Empire had already started to fall, dividing into the Western Roman Empire, which encompassed the region of Venice, and the Byzantine or Eastern Roman Empire.[19] The Western Roman Empire deteriorated quickly due to the heavy attacks suffered at the hands of the Germanic Tribes.[20] The Byzantines did not suffer the same fate and were able to prosper, and in 533 decided to regain their lost holdings on the apennine peninsula. In 539, the region of Venice was absorbed by the Byzantines.[21]

2.1.3 Transition to Self-Rule

The Venetian navy allowed the region of Venice to gain special favors during the Byzantine reign, since they aided the Byzantine fleet several times.[22] This special treatment allowed for a relatively smooth transition to self-government. During this period Venice mostly functioned out of the island of Torcello as it was the commercial center of the region and most of the refugees lived here.[23,24]

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[13] Madden, 10-12.

[14] Lane, 3-4

[15] Ibid. Madden.

[16] Norwich, 4-5.

[17] Gibbon, Edward, 1781, 583-584.

[18] Norwich, 6-8.

[19] Ott, Justin, 2009, 18-20.

[20] Ibid. 59-60.

[21] Norwich 7-8.

[22] Ibid., 8-9.

[23] Madden, 21-23.

[24] Ibid. Lane, 4.

Figure 2. Paolo Lucio Anafesto, the first Doge of Venice

Towards the end of the Byzantine reign, Venice was one of the few Byzantine colonies that was permitted to select its own leader. The doge, as the Venetians chose to call him, was elected by the people. The first doge elected was Paolo Lucio Anafesto (Figure 2) in 697.[25] At that time, the city was still under Byzantine rule, which limited the power of the Venetian government. The first doges had the power to autonomously lead the city of Venice, but as the city kept evolving, so did its political system.[26]

After the election of the first doge, Venice became mostly independent. Nonetheless, it remained in a transition state from 727 to 811 and was self-ruled under the influence of the Byzantine Empire.[27] In 742, the government established the capital of the city in Lido.[28] After the Byzantines passed a decree in 811, Venice became independent, and named itself the Most Serene Republic of Venice.[29] Unusually for that time, this transition was simple and beneficial to the economy of Venice.

2.1.4 The Birth of the Republic

Once Byzantine rule ended, it became clear that a single doge could not properly govern Venice all by himself. From then on, the city decided to divide their political system. The people created several organizations to help the doge govern the city: The Great Council, the Council of Forty, and the Ducal Council.[30] All of these divisions of government worked together to pass laws and make decisions regarding the wellbeing of Venice on a daily basis. Most elected positions were held by noblemen and had hereditary requirements; it was very hard for the average lower-class Venetian to acquire a position in government. After the separation of the political system, it was the Great Council that voted new doges into office, and not the people of the republic.[31]

2.1.5 The Rise of the Republic

Through the guidance of the Great Council, Venice became a naval and economic power in the Adriatic Sea. The city then moved its capital to Rialto and filled up the islands muddy terrain in order to accommodate more inhabitants. This was done to raise the terrain and

[25] Ibid., 5.
[26] Lane, 87-88.
[27] Norwich, 15-16.
[28] Madden, 31.
[29] Norwich, 24.
[30] Lane, 95-101.
[31] Ibid.

protect the city from high tides.[32] Seeing that it was possible, and that Rialto was the new economic center of the city, people from the area started to build their own islands near the Rialto island.[33] This process is believed to have taken over 500 years. The results of these works can be observed in the map of Venice created by Jacopo de' Barbari in the year 1500. This is one of the first detailed maps of the city of Venice and portrays the geography of the city at that time.

Due to its strategic location as the northernmost Mediterranean port in Europe, Venice became a major economic trading hub during the high middle ages. The city's economic success enabled it to produce and employ many prominent shipbuilders, artists, and glassmakers. These artisans worked tirelessly to make the city of Venice stand out from all others.

Figure 3. The Venetian Arsenal

The Venetian navy was entirely built in the Arsenal, which comprised some of the best shipbuilding schools in Europe. The Arsenal (Figure 3) combined knowledge from the academic fields of shipbuilding and physics to produce its vessels. Therefore, Venice had control of one of the most feared navies in the Mediterranean.[34] In 1592, Galileo Galilei began working with the Venetian Arsenal to improve the structure and speed of the ships.[35]At the height of the city's shipbuilding capability, the Venetian Arsenal had the ability to build one full-sized galley in a day.[36]

The navy brought economic success to Venice. When referring to the shipyard, Frederic Lane said the following, "the advantages of its site fostered also an economy which combined liberty and regulation in ways as unique as Venice's urban arteries and architecture."[37] This shows the massive importance of the navy to Venice. The power the navy had on the economy of Venice can be observed through the fact that they had one of the first banks of Europe, the

[32] Madden, 39-40.

[33] Schlamp, Hans-Jünger, 2009.

[34] Ferreiro, Larrie D., 2010, 231-232.

[35] Ibid.

[36] Davis, Robert C, 2001, n.p.

[37] Lane, 1.

Banco della Piazza di Rialto, which was founded in 1587.[38] This bank allowed merchants to keep funds in Venice for making transactions without the need of physical coins for the first time.[39]

2.1.6 The Golden Age of Venice

Venice's economic success allowed, the Venetian government and some of its noble citizens the luxury of employing many of its great artists, such as Giovanni Antonio Canal, also called "Canaletto", Antoni Vivaldi, and Paolo Veronese. These artists produced many masterpieces. Some of their most famous are *The Wedding Feast at Cana*, which is the largest painting in the Louvre Museum, St. Mark's Basilica, and the Doge's Palace.

2.1.7 The Decline of the Republic

Shortly thereafter, Napoleon Bonaparte and his army took over Venice in 1797 for several months.[40] This invasion was peaceful, since the last doge, Ludovic Manin, and the Great Council of Venice knew they stood no military chance against Napoleon's forces and decided in favor of preserving their city and its people (Figure 4). In October of that year, Napoleon gave the territory of Venice to Austria in the treaty of Campo Formio.[41]

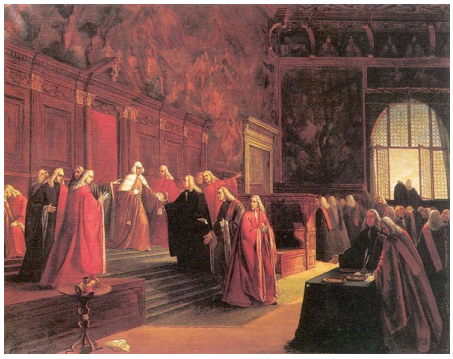

Figure 4. The Great Council Hands the City to Napoleon

2.1.8 Venice under Foreign Rule

During Austrian rule, the Venetian economy suffered greatly from the bureaucratic ruling system imposed by the Austrians.[42] Furthermore, the French had imposed a naval blockade on Venice, which limited the amount of food and resources the city had.[43] This shortage led to an economic collapse, along with epidemics, death, and migration, reducing the population of Venice greatly. The problems Venice had under Austrian rule paved way for Venice to become part of the Italian Kingdom.[44]

[38] Gascoigne.
[39] Ibid.
[40] Ballard, 62-63.
[41] Ibid., 375-376.
[42] Plant, Margaret, 2002, 84.
[43] Ibid.
[44] Ibid.

2.1.9 As a Part of Italy

As a result of the Austrian-Prussian War of 1866, Austria gave Venice to Italy as part of the peace treaty between the nations.[45] Shortly after the peace treaty was signed, Venice agreed to become part of the Italian Kingdom in a plebiscite, which is a vote to change the constitution. In this plebiscite, 647,486 Venetians voted in favor of annexation and only 60 voted against, showing the great interest Venetians had in unifying Italy.[46] After Venice became a part of the Italian Kingdom (Figure 5), the only city that remained independent from Italy was Rome.[47]

Figure 5. The Induction of Venice into Italy.

The Italian Kingdom ruled over Venice from 1866 to 1945. After the fall of Benito Mussolini and the end of World War II, Venice has been democratically ruled as part of the Italian Republic.[48] From this point on, Venice became known mostly for its artistic achievements since it was the home of many prominent artists. The city's renown has led to Venice becoming a major attraction for tourists around the world. Currently, it is estimated that around 60,000 people visit the city of Venice daily.[49] Nonetheless, the city has recently come under scrutiny due to the physical changes of the islands. Most of the city suffers from flooding, and some people fear that several major islands will be completely submerged in the near future.[50] Regardless, the city is known around the world for its famous Murano glass and Burano lace.[51] Although not to the same extent as it did during its golden age, Venice influences the world in many different ways.

2.2 Current Representations of Venetian History

Currently, information on the history of Venice is spread across various print and digital sources. Some of these are primary sources, which are first hand materials from the time period

[45] Gooch, John, 1986, 35-36.
[46] Ibid., 35-36.
[47] Ibid.
[48] Álvarez-Rivera, 2014.
[49] Dorfmann, Jessica, 2014.
[50] Lavanga, Claudio, 2012.
[51]Sciama, Lidia, 2003, 155-190. Hooper, John, 2012.

being studied, and have not altered by interpretation or evaluation.[52] Examples of primary sources include letters, tax records, and birth certificates. Other sources, such as historical books or articles written by scholars, are secondary sources which are abstracted from primary sources. All of these sources can be helpful in piecing together a picture of past events.

In the past, individual historians decided which artifacts are relevant and which accounts are credible and how to interpret them. As a result, history is a representation of past events, not a record of the events themselves. A dearth of perspectives is a major flaw of current historical representations.

Historical information is preserved in both print and digital format. Many older, primary sources are naturally in print format, but recently, some are being converted to a digital format for wider access. Digitized information provides users with tools that print media cannot, as they have the potential to be easily accessible, searchable, and expandable. These tools allow the users greater control over the sources they can find and the ways in which they can use them. The Internet allows users to learn about topics of interest by providing the ability to find supplementary information relating to other sources.

2.2.1 Print Sources of Historical Information on Venice

There are many different types of print sources containing historical information on Venice. These include manuscripts, maps, treatises, chronicles, and thematic history books. Manuscripts are documents which are written by hand. Chronicles are chronological recordings of events during a particular period. Thematic history books are historical works which discuss history by topic. All of these sources portray the authors' personal interpretations of the events being discussed.

An example of a chronicle is the Historical Atlas of Venice, or "*L'Atlante storico di Venezia*." It is a comprehensive collection of Venetian history written by Giovanni Distefano, a historian who has written many works about the history of the city of Venice. The book consists of individual events which take place in the city of Venice or in its former republic arranged chronologically.

The de' Barbari map is an example of a historical map of Venice. It is an enormous woodcut stamp, displaying a bird's eye view of the entire city, including the outer islands such as Murano and Lido.

[52] *Primary, Secondary and Tertiary Sources*, 2015

Venice: A Maritime Republic, by Frederic Lane, details the power of the Venetian navy over the course of the city's history. Lane describes the city's shipbuilding capability as well as its mastery over the sea, which allowed the republic to become an economic power. *Venice: A Maritime Republic* is an example of a thematic history book that follows a specific aspect of Venetian history.

The rich history of Venice is also preserved in the Venice State Archives, a collection of primary sources relating to the governments of the former republic and the present-day city. It has many kilometers of shelving, housing a staggering number of historical documents. These documents span from the origins of the Republic of Venice to the present day. The content of these documents varies widely, from tax information to personal family records. Though these documents are worn with age and use, the Venice State Archives has made significant efforts to digitize and preserve the vast stores of information to the best of their ability, but only a very small fraction have been scanned, and fewer have been transcribed.[53]

2.2.2 Digital Sources of Historical Information on Venice

A group of students from the Worcester Polytechnic Institute (WPI) in Worcester, Massachusetts worked with a program called uScript to digitize some of the manuscripts of the Archives.[54] Their goal was to develop software that would take an image of a document and transcribe it into digital text format; however, the program remains incomplete.[55] Even though the Archives have continued scanning manuscripts using different software, most of the contents of the Venice State Archives exist solely in their original format. The efforts of both the WPI students and scholars at the Venice State Archives demonstrate a key concept of our project: the movement of historical data from a physical to a digital format.

The most well-known digital source of historical information is Wikipedia, an enormous crowd-sourced database on nearly every subject known, including Venetian history. Historically, Wikipedia has been considered a suspect source of information due to its crowdsourcing capabilities. Recently, however, the database has become regarded as reliable, because the sources found at the end of every Wikipedia page validate the information in the article and experts can correct and update errors. Wikipedia has versions of each page it contains written in various languages, and is freely accessible to anyone with access to an

[53] Giovanni Caniato, personal communication, November 17, 2015

[54] Cafferelli, Brian, Nathaniel W. Piper, and Eric B. Sutman, 2008, 22.

[55] Ibid.

Internet connection. This database is a great representation of the benefits of digitally formatting information for use on the Internet.

The most significant digital sources besides Wikipedia are e-books, or books published on the Internet, as well as scholarly articles. While digitized texts are a good source of information, they suffer from inefficiencies because they do not take advantage of many of the opportunities that digital media provide. Scholarly articles are generally written on a narrow topic, making them less useful for a user with a casual interest in Venetian history.

2.3 Limitations of Current Methods of Information Storage

Some sources of information about the history of Venice create barriers for those who want to research it. These include issues with accessibility, expandability and comprehensiveness. Different sources suffer from different combinations of these issues.

2.3.1 Lack of Accessibility

Manuscripts are difficult to access. A great number of documents in the archives are worn and fragile. The archives also generally limits access to just students and scholars, which makes it difficult for the average person to view these documents. Additionally, it can be difficult for students to travel to view manuscripts in person. Early manuscripts are written in Latin, Veneto, and Italian. Not everybody can read these languages, creating another barrier for those who want to peruse the documents. Like other print sources, manuscripts suffer from distribution limitations.

Usability and interactivity are other aspects that must be considered when looking at a source's accessibility. Users cannot actively engage print content, as they cannot easily search, select, compare, or combine content from print sources to suit their research interests. Due to the lack of interactivity of print media, it is not possible for them to automate searches or filter content. Although books have an index which tells readers what pages contain certain information, readers must still search through the book manually to find the correct pages. Even the digitized sources in the Venice State Archives have this issue; many of them are simple image scans, as opposed to transcribed text, and cannot be searched easily.

2.3.2 Lack of Expandability

Many current sources of Venetian history are not expandable or updatable. Printed sources cannot be updated with new information unless they are republished. Only Internet

sources, like Wikipedia, and news sources, like *Il Gazzettino*, can be considered expandible sources of Venetian history.

Expandability is an important quality to include in a source of information. Any source might have errors in its content, or need to be updated with new information as time progresses. Sources that are updatable are capable of including historic events as they occur. Any good source should be expandable in order to continually expand its wealth of information and to account for the constant expansion of history.

2.3.3 Lack of Comprehensiveness

A comprehensive source of Venetian history is contained in the Venice State Archives. The archives houses a huge amount of primary sources of information relating to the history of the City and its republic. Outside of the archives, certain written works, such as *L'Atlante Storico di Venezia*, attempt to provide a comprehensive chronology of events. However, even this one-thousand-page atlas has pre-selected certain events of history to include and exclude. Most other printed historical works, such as textbooks and thematic history books address only a small portion of the city's history or a specific theme.

Currently, information about the history of Venice on the Internet is fragmented. It is rare to find a large online database or library dedicated solely to Venetian history. Websites such as Wikipedia have attempted to collect large repositories of Venetian history in one location; however, the information is presented as blocks of text, which is unappealing to readers. The information contained in these large websites also suffers from a lack of granularity. Most of the information contained therein is a large-scale abstraction of what actually occurred and there are few references to manuscripts or other primary sources of information. As a result of these problems, it is uncommon for web sources to provide a strong basis for detailed research on the topic of Venetian history.

2.4 Timelines as a Solution to Information Barriers

Taking into consideration the limitations of current approaches discussed above, creating a comprehensive, expandable, and accessible online source of information on the history of Venice is a worthy goal. Timelines are a common form of infographic used to display organized information in chronological order and are a particularly effective format for portraying historical data. An online application can store an enormous amount of data. A timeline can also provide the user with an intuitive conceptual model, organized information, and extra web-based tools. These qualities are useful and important for any source of information used for educational purposes.

A timeline that is a representation of a digital database is easily extensible. As time progresses and history is formed, new knowledge can be conveniently added to the application. Furthermore, old information can be quickly updated. Changes to the data can quickly propagate throughout the entire world thanks to the widespread usage of the Internet.

Another important benefit of using a timeline as a form of presenting data is its format. Most historical information is given in book format. Books are often arranged using block layout, which can appear daunting. A timeline contains many visual aspects that draw the attention of the intended audience. A visual representation of where the reader is relative to other historical events is convenient. The digital nature of the timeline allows history to be portrayed in several different media, such as images, text, and videos, which capture and retain the attention of the audience.

2.5 Best Practices for Timeline Design

A well designed timeline should be clear in content, easy to navigate and use, and provide easy access to additional information with external links. A timeline also needs to be able to search and filter a range of primary and secondary sources, as well as multimedia. There are several “best practices” in design which are achieved by many timelines already online. Best practices for interface design are illustrated by existing timelines, such as the BBC British History, Anne Frank, and September 11th Attack timelines.

The BBC timeline portrays the entire history of Britain from the year 6,000 B.C.E. until present day. The Anne Frank timeline portrays events that relate her life to the Holocaust around the second world war. Finally, the September 11 timeline talks about the events that occur before and after the tragic events that occurred at the New York City World Trade Center on that day. These timelines illustrate key features of interface design, and display functionalities that the group thought either added to or detracted from the application.

In general, a good practice in interface design is one that helps to create a flexible interface where users can control what they want to see. This provides the users with the interactive and engaging experience that is necessary to foster learning. It can be challenging to include helpful organizational features, like preset time eras and filters, without taking control away from users, so any practice that helps achieve this balance is desirable.

2.5.1 Users Need to Recognize that it is a Historical Timeline

In his book, *Don't Make Me Think*, Steve Krug, an expert on interface design, states that a user interface must be intuitive, so that users do not need to think about how to use it.[56] When designing a timeline application, it is imperative that usability and functionality are considered. However, this is not useful if users cannot determine where to click or what key to press to achieve the desired functionality.[57] It is more important for a designer to create an interface that enables users to find all the functionality that is implemented than it is to implement more functionality. It is necessary that users can not only find the functionality, but intuit how to access it. Intuitive design can be achieved in several ways.

It must be obvious that a timeline is a timeline. If it looks like a slideshow, for example, then users will find it much more difficult to infer its functionality. One of the primary ways that a timeline can be visually set apart from other applications is by including a horizontal axis along the bottom of the application on which dates are displayed. Since in graphs people have a long tradition of placing time below corresponding data, placing the axis at the bottom of the screen and displaying details above it is a natural indication of time ordering.[58] All of the timelines previously mentioned have a slider on their axes to indicate what point on the timeline the user is viewing. A slider is an example of intuitive design; it is easily recognizable as a way to navigate the application.

An intuitive design must position and advertise the features present. Not only do users need to figure out what a particular button does, but they need to notice that the button exists. Few users will have the patience to search for a feature that may or may not exist.[59] It must be clear how to use a design element. If it is meant to be clicked, that must be clear. If it is meant to be dragged, that too must be evident. Good design is necessary to ensure that people can guess the correct usage of each element on the screen, preferably on the first try.[60] Furthermore, each element must perform its function well, in a way that makes the user's experience better and easier.

2.5.2 Users Need to Digest Information in a Manageable Way

A general rule for creating content designed for human use is to ensure that the information is broken down into usable segments. For a timeline, especially one that spans a

[56] Krug, Steve, 2006, 11.

[57] David C. Brown, personal communication, September 24, 2015

[58] Ibid. Brown.

[59] Krug, 8.

[60] Baecker, R. M., Buxton, W. A. S., Greenberg, S., & Grudin, J. (Eds.), 1996, 881.

long time range, this means not only dividing the historical information into discrete events, but dividing the events up in an organized and predictable manner.[61] There are several ways to do this.

The most important part of the timeline is its content and how its content is portrayed to users. If there is too much text, users will see the timeline as dense and will not use the application. Nonetheless, the makers of the timeline must be certain that they have enough information about each event to allow each entry to stand alone.

As seen in Figures 6 and 7, the BBC timeline and the Anne Frank timeline display a line or two of text to show users what the event is about.[62] They then give users the option to learn more about the event. They can do so by clicking on the particular event of interest. When clicked, a window opens in the middle of the event showing more information and links to related information. This method avoids a cluttered application while still providing detailed information.

Figure 6. The BBC Timeline[63]

[61] Robbins, Jennifer N., 2006, 396.

[62] Anne Frank Museum, 2010

[63] British Broadcasting Company.

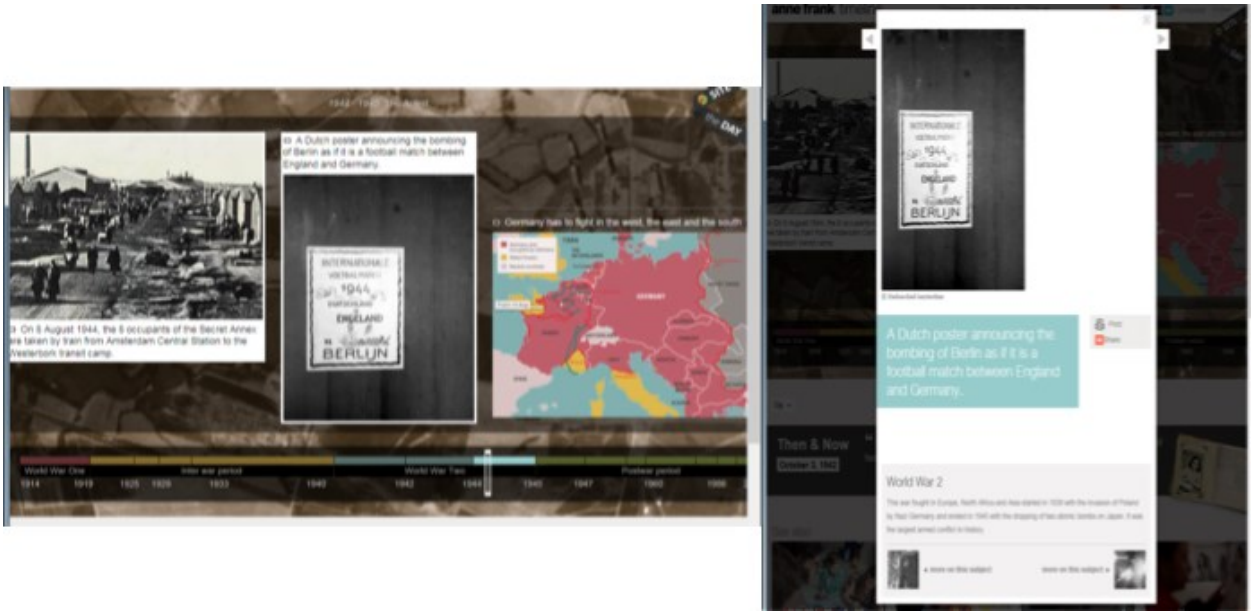

Figure 7. Anne Frank length of event entry.

Another way to group information manageably is to introduce different levels of zoom, as shown in the BBC timeline (Figure 8). At the outermost level, users can see a large overview of the time periods of British history. At the inner zoom level, users can now click on separate events, clearly denoted by the white dots, in order to read specific information about those events.

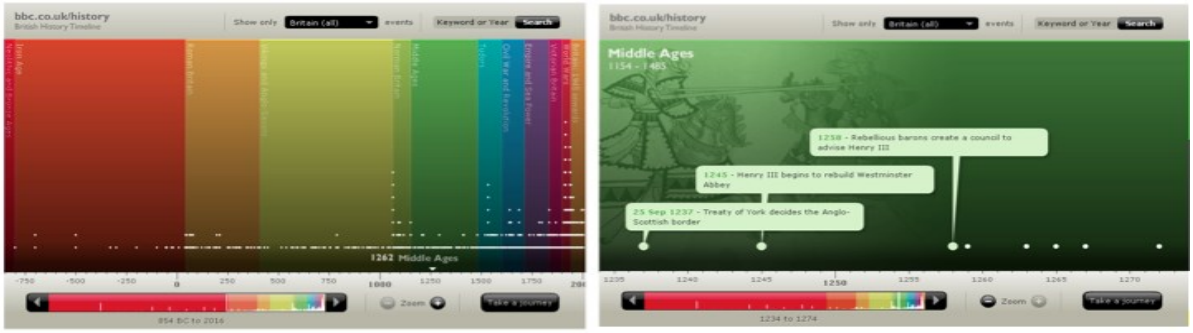

Figure 8. BBC zoom capability as a means of grouping information.

It is possible to break large periods of time on a timeline into smaller time periods. By doing so, it is possible to make it easier for users to focus on the particular era that is of interest to them. Users can simply scroll directly to a desired time period and begin looking at information at that section of the timeline without being forced to search through the entirety of the timeline. This approach is especially useful for scholars, who often focus their research on one specific time period. An additional consideration when dividing the timeline is the

consistent representation of these segments. Consistency can be achieved by using background images or color schemes for specific periods or particular intervals of time.

Many existing timelines divide events into smaller groups. The BBC Timeline, for example, has multicolored backgrounds, which differentiate the time periods, as shown in Figure 9.[64] These time periods are logical divisions of British history, and make it visually appealing by adding color to the timeline. They make it easier for users to find particular events given the knowledge of the time period in which it occurred. Moreover, the BBC timeline allows the user to zoom in on these time periods, which adds to the navigability of the timeline.

The 9/11 Timeline, however, makes a very different use of timeline divisions. It has only one division, which is located at the most significant event on the timeline, which it uses to indicate a massive shift in tone from the build-up to the aftermath of the attack on the World Trade Center in New York City.

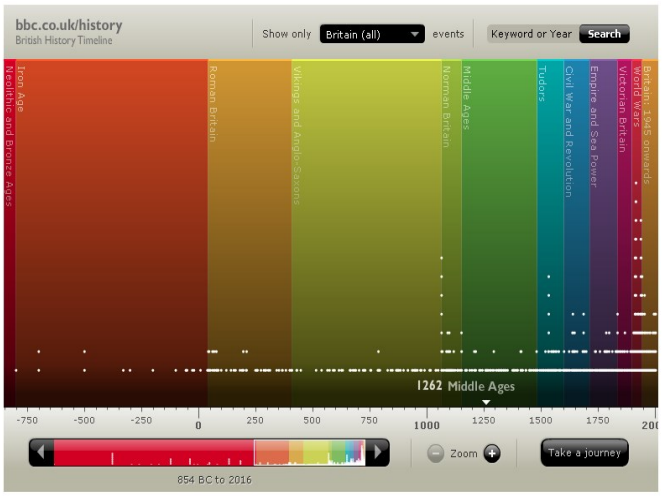

Figure 9. BBC time period divisions

2.5.3 Users Need to Search According to Their Interests

Another way to break up content on a timeline is through the use of filters, which allow users to view only events which pertain to a topic of interest. This method is useful if users want to look up not a time period but a specific subject of research at a time. Users can then choose what content is displayed. A filter greatly narrows down the database by taking out information that does not relate to the user's interests. The ability of this database to be searchable provides another opportunity to narrow information.

As seen in Figure 10, the BBC British History Timeline gives the user the ability to filter by country.[65] As soon as the user selects any of the filter options the amount of information in

[64] British Broadcasting Company.

[65] Ibid.

the timeline greatly narrows, making it easier for users to look at information that relates to their specific interests.

Figure 10. BBC timeline filter and search capability.

Timelines generally give the user the ability to search for specific events. The BBC timeline does this by allowing the user to write a "Keyword or Year" they want to investigate further. When the user searches, it opens a window with the events relating to the search term entered in chronological order. Similarly, the 9/11 timeline (Figure 11) allows its users to search it, but limits its search capability to only multimedia files, such as pictures, videos, and sound bites, and not to actual written events.[66]

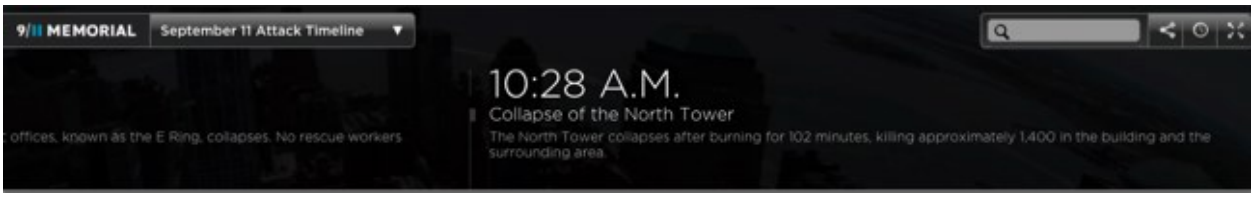

Figure 11. 9/11 timeline search capability.

The third way to limit the content displayed is by allowing users to peruse only major events by hiding less important events. This technique is crucial because different people seek different levels of detail in their research, and some users have only a casual or passing interest in a topic. In order to avoid deterring potential users, this stripped-down presentation approach must be the default, in order to be effective, with additional information displaying only on request.[67] Because researchers are interested in this granular content, it must be provided by the application in some form when requested. However, it is difficult to decide which events are more important than others without introducing the bias of a specific point of view.

2.5.4 Users Need an Immersive Experience

Once the application is recognizable and searchable, techniques for holding users' attention can be considered. The inclusion of multimedia content, such as sound clips, videos,

[66] National September 11 Memorial and Museum, 2015.

[67] D. C. Brown, personal communication, September 24, 2015

and images, can be used to add a degree of immersion; however, it is important not to include media which are unnecessary, since doing so adds distractions to the content and makes it less attractive.[68]

Multimedia content is engaging and helps users learn and remember information more easily.[6970] That is why visuals, sound, and animation are often used in digital media. The Anne Frank and 9/11 timelines contain a collection of images and videos which provide more information about the events they represent. The Anne Frank timeline displays maps, photos, and excerpts from her famous diary. The 9/11 timeline has sound bites and quotes from those involved in the catastrophe. Overall, all of these different multimedia enrich the applications, allowing them to provide a more immersive experience. They engage the user more effectively than a text-only application, and add to the amount learned by the user.

2.5.5 Users May Want More Information

Another important consideration is the inclusion of internal and external links. Internal links could help users navigate the timeline. External links provide a way for users to find more information that is related to, but outside of the scope of the timeline. External links allow an application to be an entry point for research on a topic of interest.

The BBC Timeline has external links to other places within the BBC website, providing easy access to more information than the timeline itself should display. Additional content comes in multiple formats as well, such as historical articles, biographical articles, and interactive educational games.

[68] Hartson, Rex & Pyla, Parda S., 2012, 799.

[69] Gutierrez, Karla., 2014.

[70] Kouyoumdjian, Haig., 2012.

3 Methodology

The team's mission was to portray the history of Venice in a new way, through a digital timeline. The team wanted the application to be accessible, comprehensive, and expandable. The team sought to portray the history of Venice, from the 5th century to the present day, supplemented with different media and research tools to immerse the user in the application. In the future, experts on the subject of Venetian history should be able to expand the timeline. Another of the team's goals was to allow users and not only historians to decide which historical events are important. Over time, the application could become a powerful research tool for tourists, students, Venetians, and historians alike. The objectives for the project were as follows:

1. Create an accessible timeline application
2. Populate the application with historical information from *L'Atlante storico di Venezia* and *L'Enciclopedia storica di Venezia*, including text and images.
3. Enable future expansion of the application by others.

A timeline is composed of discrete, chronological events. To create a timeline it is important to first design an interface and then to populate it with historical content and various forms of media. When designing the interface, the group looked at other timelines in order to determine what features and layout are most intuitive and achieve the desired functionality, as discussed in Section 2.5. To populate the timeline with historical information, it was necessary to parse *L'Atlante storico di Venezia* into JSON (JavaScript Object Notation) format, which is used for storing information digitally. To include various media, such as maps, images, and paintings, we drew content from the Venice cartography application, *L'Atlante storico di Venezia*, and *L'Enciclopedia storica di Venezia*. Finally, the group worked on adding capability to allow future groups and historians to expand the scope of the application.

3.1 Creating the Timeline Application

The creation of the timeline application was the result of several efforts in research and software engineering. These tasks can be categorized into the following three phases: the design phase, the development phase, and the polishing phase.During the design phase, the group researched existing timelines and, based on these, created a matrix of features, a list of use cases, and mockups. This step was followed by the development phase, wherein the group produced a feature-complete prototype of the application. In the polishing phase, the group refined a finished application from the application prototype. The tasks relating to the creation of the application were as follows:

1. Design a conceptual model (Design Phase)
2. Develop prototype versions of the application (Development Phase)
3. Polish the application (Polishing Phase)

The team also made special considerations for the use of the application:

4. As a research tool
5. As a tool to democratize the way the application portrays history

3.1.1 The Design Phase

During the conceptual design phase, the primary objective of the team was to prepare for the act of writing the code, which would make up the application. It was necessary to clearly define what functionality the application would have in its final form before beginning development. Failure to define the application in its entirety could have lead to wasted time during the development phase, which happens as a result of the technical team spending valuable person–hours developing an application feature that is unwanted, inefficient, or detrimental to the overall design. In extreme cases, weeks of work can be wasted. The design phase of the application was necessary to attempt to mitigate these problems.

The first action the group took to achieve this step of the design was to research the topic of general interface design for usability. We discussed general principles of usability with Professor Brown, from the Computer Science department at WPI, and we reviewed literature by interface design expert Steve Krug. The group identified desired functionality. It wanted users to navigate through the information in the application easily and to immerse themselves in the application through the use of multimedia, expand the database, and use the application more than once.

Once the group identified the desired features for the application, it looked at high-quality examples of interactive timelines that already exist on the Internet to see what design features that would be necessary. From this research, the team generated a spreadsheet, shown in Table 1, containing as row labels the name of each interactive timeline we found on the Internet. As column labels, the team listed important functions that were found in various pre-existing timelines. These functions included such elements as divisions by time period, popups, scrolling, pictures, and links. The spreadsheet was then filled in describing how the sites the team looked at achieved or failed to achieve success with different tools and designs. The

resulting spreadsheet gave the team a range of options from which to choose when designing our application.

Table 1. The Empty Matrix

Example:	Divisions by Time periods:	Length of Event Entry first observed:	Pop-ups:	Scrolling:	Pictures:	Filters/ Searching:	External Links:	Internal Links:	Zoom Capability:	Sound Effects:
Anne Frank Timeline										
9/11 timeline										
BBC British History timeline										

Through research during the design phase, key functionalities of the application were identified. The team filled in the matrix above with information from several specific timelines. These included the Anne Frank Timeline, the September 11 Memorial timeline, and the BBC British History timeline. These timelines all displayed positive attributes that the team thought could be beneficial to our application. The matrix helped as a tool to assist in the creation of use cases for and mockups of the application and as a reminder of how a timeline application can fail. The completed matrix is shown in Table 2.

Table 2. The Completed Backgrounds

Example:	Divisions by Time periods:	Event Entry first observed:	Pop-ups:	Scrolling:	Pictures:	Filters/ Searching:	External Links:	Internal Links:	Zoom Capability:	Sound Effects:
Anne Frank Timeline	Yes	Two sentences depicting the event with no date.	Yes, portray more information about events.	Yes, by utilizing the timebar.	Yes, regarding events.	N/A	Yes, to youtube videos.	N/A	N/A	Yes, observed when moving along the timeline.
World Trade center and 9/11 timeline	No	Time, title and no more than 150 characters depicting the events.	Yes, portray more information about events.	Yes, by using the scroll functionality .	Yes, regarding events.	Search functionality with suggestions.	Yes, to youtube videos.	N/A	N/A	Yes, sound files of important speeches.
BBC british	Yes	Date, and a sentence	Yes, portray more	Yes, by utilizing the	Yes, as backgroun	Yes, allows you to filter	N/A	In the pop-	Yes, two levels one	N/A

history timeline		describing the event.	information about the event.	timebar and scroll functionality .	d and in some events.	by region of britain and a simple search box.		ups, to other pages of the BBC	that shows the periods and the other the events.	

To achieve the Conceptual Design of the application, the team pooled its research to generate mockups, which are drawings of potential layouts for an application, and use cases (Appendix B), which are detailed maps of actions users can take and their results. Both of these were used to define the appearance and functionality of the application. The use cases gave the group an idea of how the application would function while the mockups gave an idea of how the application would appear. They allowed the technical team to determine what code must be written.

The first mockup (Figure 12) displayed a timebar in the middle of the page, with dots above it, marking events, and sized proportionally to their significance. Below the timebar were event panels, which contained the text of a selected event. Enormous arrows were located on either side of the time bar to allow the page to be scrolled, while function and navigation buttons were placed at the top of the page.

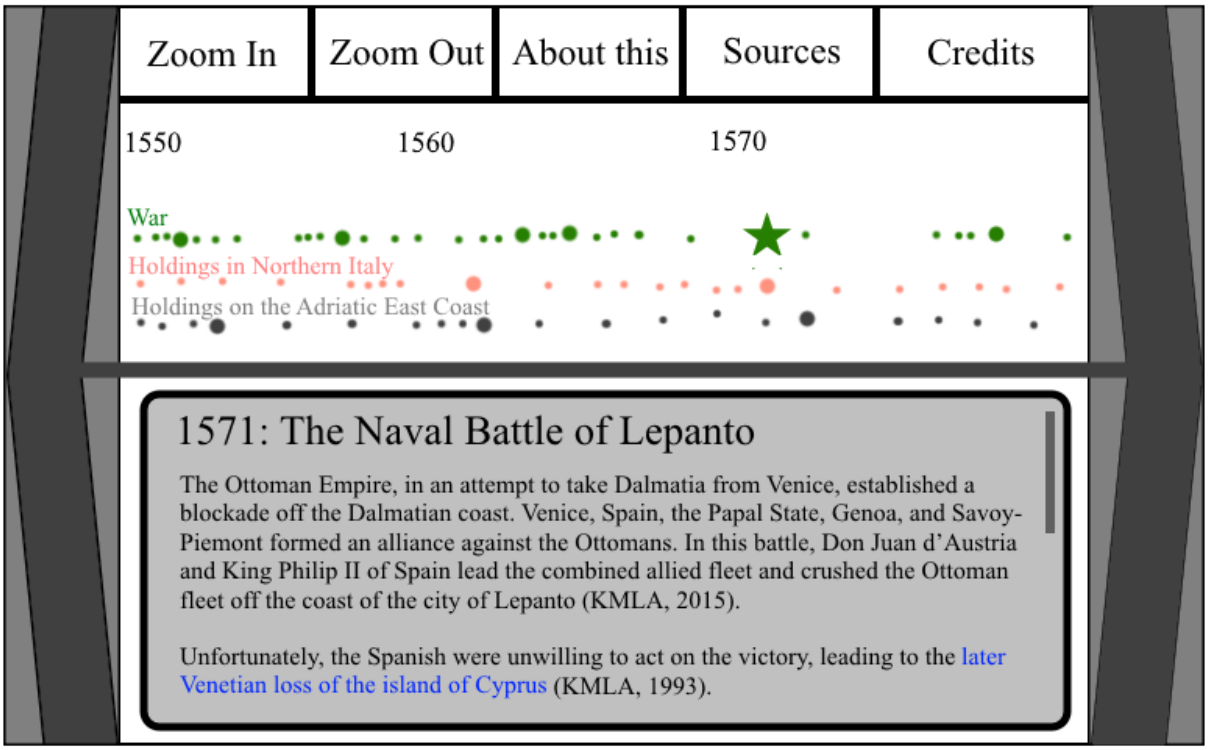

Figure 12. The First Mockup

The second mockup (Figure 13) depicted a more traditional layout structure in which the history of Venice was placed chronologically in content panels, aligned side by side, in the center of the application. As the main focus of the application, the content panels were given a central location on the screen. The timebar was moved, therefore, to the top of the application. At the bottom of the application, filter, zoom and search capability tools were shown.

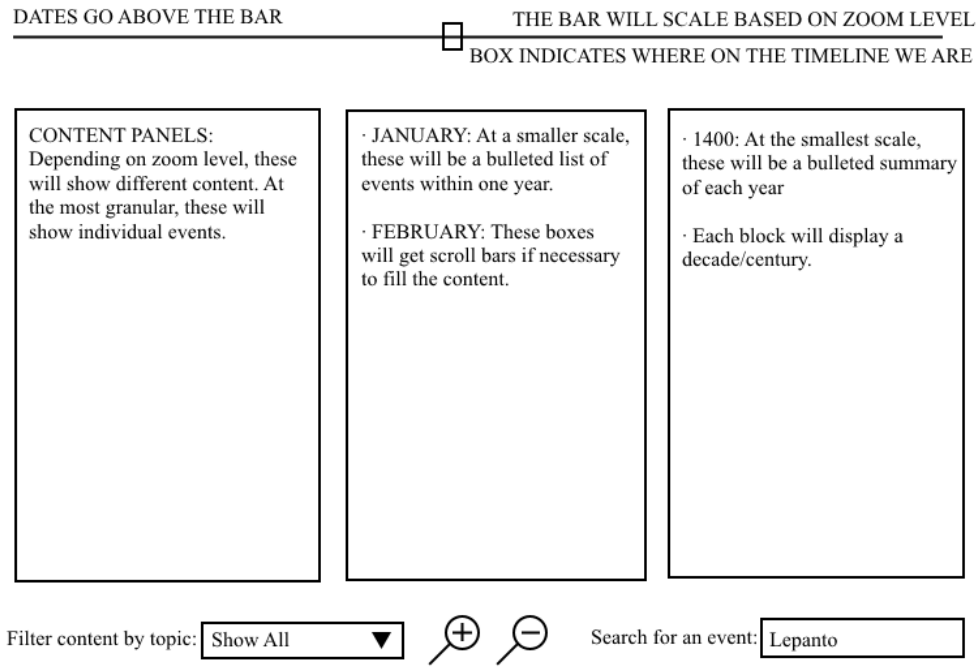

Figure 13. The Second Mockup

Use cases, such the one shown in Table 3, gave the group a sense of the functionality attached to each feature present in the mockup. They helped the team develop a list of features to be implemented. Most of the use cases translated directly into code during the development of the application. A use case is defined technically as a discrete transition of the application from one consistent state to another. This means that a use case describes a particular state of the application and a user action, and describes the result of that action.

Table 3. Example Use Case.

Search Bar
1. User enters characters into the search bar 2. User hits enter (is a search button necessary?)

3. Application filters the content in the event bar to display information relevant to the search
Before: All Content Panel types are being displayed on the timeline.
After: Content Panels pertaining to the search are the only panels present and the filter content drop down box is displaying that search results are the current filter.

The design phase was divided into the following tasks:

1. Research general interface design for usability
2. Research other relevant timelines
3. Create application mock-ups
4. Create use cases

3.1.2 The Development Phase

The development phase was focused on creating an application prototype that was feature-complete, which means that all features of the application were in place. This phase was a necessary step during the project, because it produced a functioning version of the application.

The web application produced by this project was developed with a combination of HTML (HyperText Markup Language), CSS (Cascading Style Sheets), JavaScript, NodeJS, and Ruby. HTML is a markup which can be used to show the relationships between content on a web document. CSS is a method used by web developers to adjust the placement and formatting of content on a web page. JavaScript is a client-side scripting language that is frequently used for web development. NodeJS and Ruby are server-side scripting languages.

The team utilized the functionality provided by the AngularJS library, which is a system developed by Google that provides shortcuts for many different aspects of JavaScript. The group utilized Firebase, an online database management system that allows for collaborative editing of data. For managing revisions to the codebase, the team used Git, which allows users to maintain old versions of the codebase in case problems occur, and GitHub, which is an online host for Git repositories. Using these tools, the group was able to include desirable features identified through the creation of the matrix and achieve the look and functionality that was outlined in the use cases and mockups.

The team developed a fully-functional prototype, shown in Figure 14 below. Through this prototype, the team was able to organize the information it contained accessibly. Several features and functionalities were implemented to achieve this goal. Accessibility was achieved through the search functionality, the bookmark feature, and the Google Translate widget embedded in the page. The timebar, zoom levels, and the random events feature also allowed the application to be more accessible.

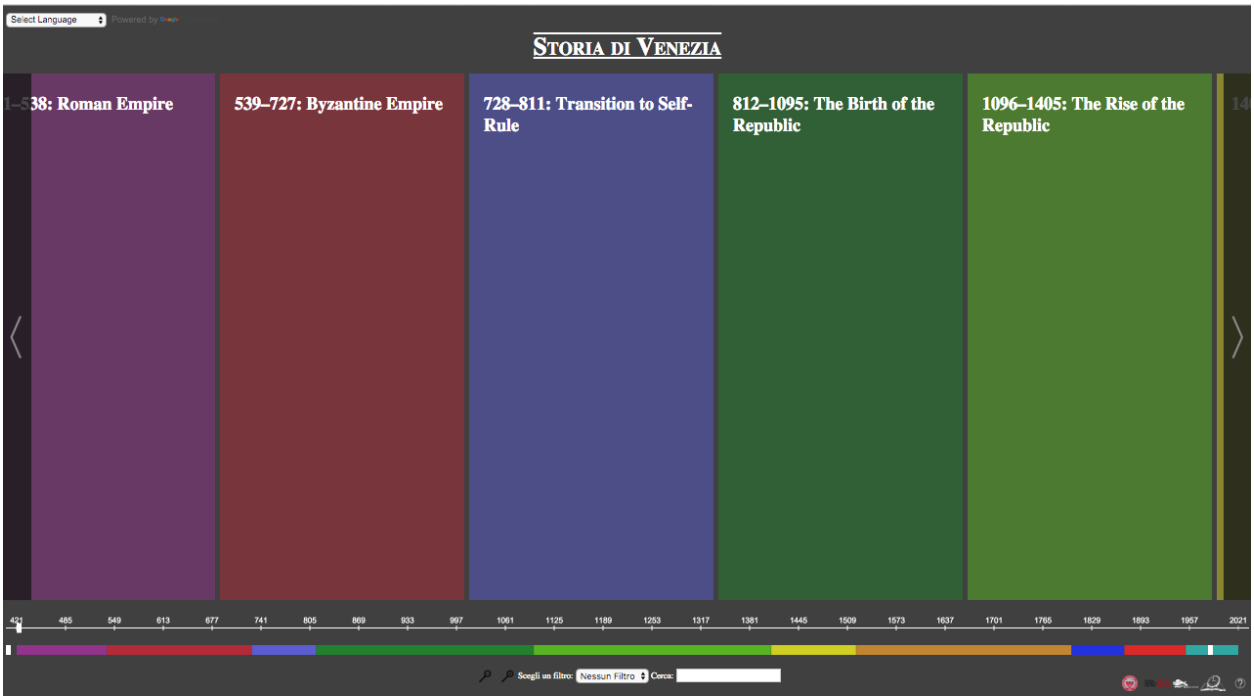

Figure 14. The Prototype Application

The prototype developed needed to be fully populated, so data were extracted from *L'Atlante storico di Venezia* and *L'Enciclopedia Storica di Venezia*. Populating the application also allowed the group to preview the functionality and affordances of the application. The population process will be discussed in Section 3.2.

The development phase consisted of the following tasks:

1. Create a Git repository for the source code
2. Develop the web app prototype
3. Populate the prototype with event information

3.1.3 The Polishing Phase

During the polishing phase, it was necessary to finalize the look and feel of the application. Throughout the polishing phase, the team instituted a feature freeze, which meant that no new features were to be implemented, and all coding work from that point forward was to be spent on bugfixing and aesthetic design. This was useful because it prevented the team from half-implementing features at the last minute. Once all the functionality was added to the application, the group started looking at ways to make it more intuitive for the average user. The group upgraded the timebar, bookmarks, and search capability.

To polish the timebar the group connected the sliders on the bottom bar to create a box that could be resized and added arrows in the sliders to provide an affordance that they can move in or out. To improve the top timebar the group decided to show the years in regular increments to facilitate the viewer's understanding of the timebar. The timebar is shown in Figure 15.

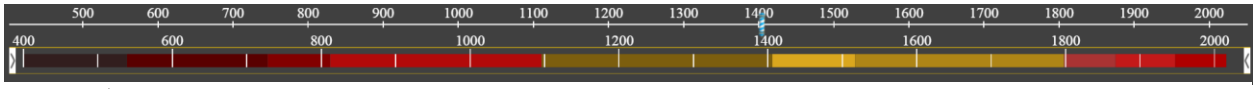

Figure 15. The Time Bar

The group also moved the search bar and bookmark menu to the top left corner. It was determined that users would find the top left corner of the page to be a more intuitive location for a search box. To reduce clutter on the page the bookmark menu was hidden on page load. To view the bookmark menu users must select the bookmark option located just to the right of the search bar.

To improve the aesthetic of the application as a whole, a new color scheme was selected during the polishing phase. The chosen color scheme included grey, shades of red, and gold. The new palette correlates to the red and gold colors on the Venetian republic's flag. The title was redesigned to include the republic's lion and the content panels were updated to display a section of the republic's flag on top. These changes were made to further develop the application's Venetian theme. The theme at the end of the Polishing Phase is visible in Figure 16 below.

Figure 16. The Finished Application

The polishing phase comprised the following tasks:

1. Fine-tune functionality
2. Refine the application's aesthetic to develop a venetian theme.
3. Bugfix the application

3.1.4 Special Considerations for Democratizing History

The application was designed in order to contain multiple zoom levels. These levels show more important events as the user zooms out. For this reason, it was necessary to determine how the application would choose which events were shown at lower zoom levels. As part of the group's effort to democratize history, the team set up code to automatically count the number of times users view specific events. These numbers could then be used to determine which events users had found more interesting in the past, and thus which events users were likely to find interesting in the future. In order to ensure that the history presented by the application is democratic, the following steps were taken:

1. Provide functionality for counting the number of times each event has been opened
2. Use those data to decide what content to display on lower zoom levels

3.2 Populating the Application

In order to create a comprehensive source of historical information about the history of Venice, the timeline was populated with content from primary and secondary sources. The main source of information for the application was *L'Atlante storico di Venezia*, a secondary source of information. The group also linked the timeline to primary sources from the Venice State Archives.

The timeline was made appealing to users by including multimedia content, such as maps, pictures, and paintings. Through the use of maps, users will be able to determine the location of specific events. With the use of pictures and paintings, users will have a visual representation of the event. These different types of multimedia allowed users to interact with and immerse themselves within the timeline.

3.2.1 Parsing *L'Atlante storico di Venezia*

In order to populate the timeline application with a base set of data, it was necessary to convert *L'Atlante storico di Venezia* from its current digital form as a PDF (Portable Document Format) into a machine-readable format. The team used the *Text Extraction Toolkit*, by PDFlib, to extract text from the PDF files. The team then developed a parsing algorithm, written in Ruby, that understood the general format of the resulting text document and was capable of reading the document's contents line by line. The parser converted the document into JSON, formatting it by date, location and content. The following steps were taken to write this parser:

1. Convert the PDF file currently containing the atlas into a more usable plaintext file.
2. Develop the parsing algorithm.
3. Run the parsing algorithm on the plaintext file.
4. Check the quality of the results and make manual corrections.
5. Incorporate the information into the application.

3.2.2 Parsing *L'Enciclopedia storica di Venezia*

In order to supplement information parsed from *L'Atlante storico*, the team converted *L'Enciclopedia storica di Venezia* into a digital format. Once again, it was necessary to create a parsing algorithm. However, the output from the encyclopedia was much different than that from the atlas. Instead of breaking the written work into events by date, the encyclopedia was deconstructed into articles by topic. Many of the articles spanned a large period of time and were associated with multiple events of the timeline. Once the encyclopedia was parsed into articles by subject, the team then added the resulting files into Firebase. A third algorithm was developed to match the encyclopedia entries' titles to the text of the atlas. This algorithm was

used to automatically create links within the event pages' content already in the application. Both of the algorithms written in this step were also developed using ruby. Parsing *L'Enciclopedia storica di Venezia* consisted of the following steps.

1. Convert the PDF file currently containing the encyclopedia into a plaintext file.
2. Develop the parsing application.
3. Run the parsing application on the plaintext file.
4. Check the quality of the results and make manual corrections.
5. Create the link generating algorithm
6. Run the link generating algorithm on the JSON data from the Atlas

3.2.3 Integrating Morphological Information Depicting Location

The Venice Project Center (VPC) has documented morphology through the use of maps and geographical information system images that visually demonstrate the physical transformation of the islands from the year 1100 to the present day.[71] Our team decided to utilize the VPC's Cartography application to display the exact location of the events obtained from *L'Atlante storico di Venezia*. In order to extract these locations, the parsing algorithm for the atlas was upgraded to search for keywords such as "*chiesa*," which means "church." Event locations are displayed as a link at the top of the popup which brings the user to that location in the cartography application, if the location is defined. Our team divided the morphological aspects of the project into the following tasks:

1. Extract the location of events from the information gathered from the parser
2. Display a link in the application to the VPC's cartography application

3.2.4 Incorporating Images and Paintings Depicting Events

Venice has an extremely rich history with regard to art, especially paintings and architecture. As an educational application about the city, our application should incorporate these works of art in some form. The team inserted images and paintings which depict specific historic events. The iconography adds an additional sense of immersion to the application by holding the user's attention. The images used in the application were obtained from the public domain and *L'Atlante storico di Venezia*. Once obtained, the images were linked manually in each event in the JSON file. Art was included in the application following these tasks:

1. Gather images and paintings corresponding to Venetian historical events.

[71] Chines, J., Eoff, E., Reynolds, A., & Weis, A.

2. Add images' and paintings' web addresses to the JSON files.
3. Implement the display of these images in the timeline application.

3.3 Expandability

The history of Venice spans over 1500 years and includes far more information than could be gathered within the scope of the project. Additionally, Venice remains an active city which continues to create new history every day. In order to allow the application to continue to be developed after the project was completed and to grow into a live source of historical information, it was necessary to create tools that would help users contribute to the site and scripts which could potentially automate this process in the future.

1. Create a login/signup function for historical experts to register as contributors.
2. Create a form usable by these experts to add events
3. Create a script that imports data from an RSS (Really Simple Syndication) feed
4. Implement functionality for the addition of Primary Sources

3.3.1 Login

To prevent malicious users from causing problems in the application, it was necessary to require that anybody wishing to edit the dataset obtain login information through the VPC. After this step is complete, they can add new events to the application by using a form which the team provides. If an authorised user finds a flaw in one of the preexisting events they can click the flag button and submit a written error report the VPC. The Venice Project Center will be able to revert changes made to the Firebase dataset in case the application breaks. This was accomplished through the following tasks:

1. Implement a login button through Firebase.
2. Create an "Add Event" form.
3. Create a revert function to prevent the application from breaking.

3.3.2 Automation of Primary Sources

History is living and develops everyday. To account for the continuous expansion of historical events the team implemented application functionality which reads information from an RSS (Really Simple Syndication) feed and automatically generates new events. The project used a feed from the city of Venice. RSS events will have date and content. To automate the inclusion of RSS data the team developed a server-side script in NodeJS which can be run daily. Including automated events involved the following steps:

1. Include an RSS feed from the city of Venice
2. Develop a script to extract information from this feed
3. Save RSS events in the application.

3.3.3 Inclusion of uScript Transcribed Primary Sources

The majority of primary sources about Venetian history are contained in the Venice State Archives. The team enabled the application to be expanded manually by primary sources. Manuscript events contain a date, their contents, and a picture highlighting the section of the text which was transcribed. Primary sources from the Venice State Archives were obtained from the VPC. Primary sources were included with the following steps:

1. Identify various manuscripts which would be relevant to our application
2. Include these manuscripts, both image and text, in the application in the same format as other events.

4 Results and Analysis

In order to create an accessible, comprehensive, and expandable source on the history of Venice the group created a timeline application, shown in Figure 17. It portrays the history of Venice in an interactive, intuitive, and detailed manner, giving the user the ability to search a comprehensive amount of information. Through the use of these features, the application is a valuable research tool. To this end, information from several different sources was incorporated into the application, and the team provided for the continued growth of its content by users and automated systems. The final form of the application is a compilation of historical information which allows users to decide which parts of Venetian history are most important.

Figure 17. The Finished Application

4.1 Accessibility of the Application

As explained in Section 2.3, much of the information about the history of Venice is not easily accessible. By making our application accessible through the web, the team made available such information to anyone with access to an Internet connection. Even though it is easy to find, the application must also be easy to use in order to provide accessibility. Since the timeline houses over 6,000 events, users need to be able to traverse the information fluidly and intuitively. To provide usability the team added functionality to navigate, search, portray, translate and organize its content. Through the use of these functions the team created not only a valuable research tool, but a method to democratize Venetian history. These features are highlighted in Figure 18.

Figure 18. The Finished Application, with its Several Features Marked.

A timebar (1) was included to allow users to navigate to a specific location in time. The time bar was separated into two bars in order to help users figure out their position in Venetian history. The bottom bar displays the entire time scope of the events in the timeline and segments it into the following eras: Roman Empire (400-538), Byzantine Empire (539-727), Transition to Self-Rule (728-811), the Birth of the Republic (812-1095), the Rise of the Republic (1096-1405), the Golden Age (1406-1516), the Fall of the Republic (1517-1797), Venice under French and Austrian rule (1798-1866), Italian Kingdom (1867-1946), and Italian Republic (1947-to present day). Each of these time periods is denoted by a unique color in the timeline. A color-coded timeline enables users to recognize which period an event occurred in by looking at the color of the content panel. Color coordination helps the time bar orient users on the timeline.

The top bar indicates the current position of the user in time with a blue slider. Users can drag this slider or jump to a specific point in time to navigate the timeline. The upper bar displays a subrange of dates selected by white sliders on the bottom bar. When a user moves one of the sliders on the lower bar, the top bar updates in real time animating to the left or right to indicate the change. The top time bar also displays a consistent time interval which adjusts itself to an appropriate increment for the selected range. As an alternative to the time bar, the team implemented two scroll boxes on the side of the application (2). These scroll boxes allow users to traverse the timeline by hovering or clicking on them. Arrows were included on these boxes to help provide the affordance that the page can be scrolled.

To enable users to locate information quickly the team added search functionality (3). When the user enters a number into the search box, the application will search for only the events that happened in that year. If words are entered, a content search of event descriptions is performed. Each of these functionalities allows users to navigate to events on a specific topic by filtering the events displayed. Through the use of bookmarks, discussed in Section 4.1.2, users can also filter content in a customizable way.

The information contained in the application is viewable in content panels (4) located side by side throughout the application. Each content panel represents a different event. When users click on a content panel, the application produces a popup with the full text of that event along additional information, as shown in Figure 19. These popups give the user the opportunity to access more information about particular events. In these popup panels, the user will have the ability to click on links containing encyclopedic information, obtain a citation of the event, and share specific events using a hyperlink. The text of the pop up also contains links to encyclopedic content to provide additional information to the user. When clicked encyclopedia entries appear in another popup panel at the side of the original one. These links are described in Section 4.2.2.

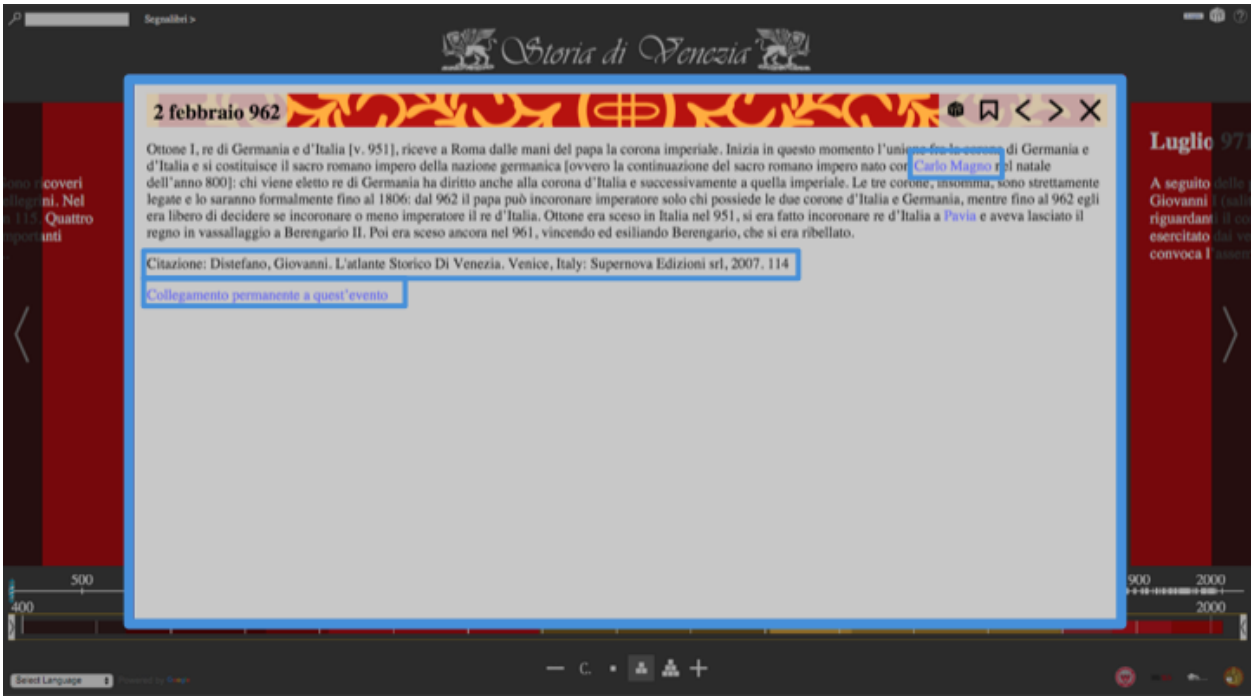

Figure 19. The Infopanel, with its Several Features Marked

To accommodate a vast variety of users, the team included a translation widget (5), located in the bottom left corner of the interface. This widget is powered by Google Translate

and it allows users to translate the content of the page from Italian to a language of their preference, allowing our application to be accessible to those who do not speak Italian.

The group used zoom functionality (6) to decongest the timeline. This feature allows users to view more or fewer events. Higher zoom levels contain more events and lower zoom levels contain fewer events. To determine which events are present in each level the group implemented a "float-up" functionality as described in Section 4.1.1. This system allows the application to provide the most important pieces of Venetian history as defined by all users.

On the top right of the page (7) there are three major tools; the random event button, the add event button, and the login button. The random event button allows users to quickly jump to a randomly selected event. This interactive element allows users to discover bits of history they did not already know about. In order to gain access to the add event button, which will be explained in Section 4.3.1, users must obtain login credentials through the VPC.

4.1.1 The Application as a Tool for Democratizing History

History is usually portrayed through the views of a single individual or a small group of people who select, organize, and interpret historical data and determine what is important. To avoid imposing one person's opinion on what events to show any user, the group implemented a "float-up" feature. "Float-up" events enable the users to democratize history.

Events in the timeline keep a count of the number of times they have been viewed. Counts are then processed by an algorithm that filters events and displays them at the correct zoom levels. The algorithm calculates the number of views an event must have to be over a certain percentile threshold, and thereby can extract the most important events. The application shows the top 2% and top 6% of events as the first two zoom levels. To demonstrate this functionality, the events shown in each zoom level were selected at random at first, but as soon as people start using the application, these levels will be adjusted based on user behavior. This process is visualized in Figure 20 below.

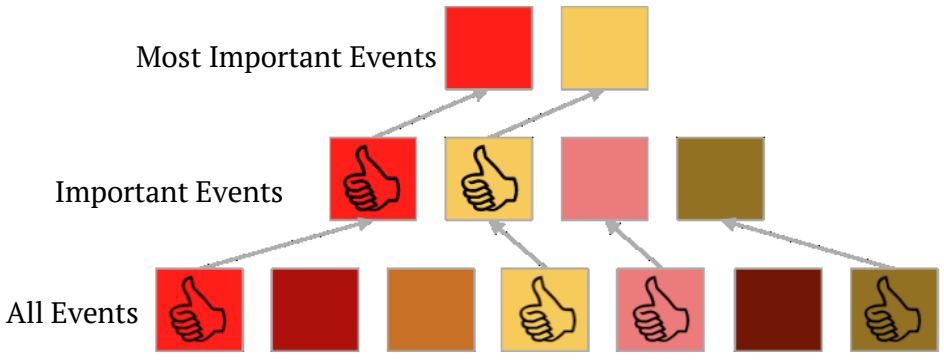

Figure 20. Visualization of "Float-up" Events

4.1.2 The Application as a Research Tool

One of the main goals of the application is to provide a comprehensive resource for scholars and students who are studying the history of Venice. Therefore, it was necessary to include several research tools in the application. These tools included external links, event bookmarks, and event citations.

To assist with research the team included more detailed information about events in their corresponding popups. External links relating to the event were included in this information. External links could take users to other websites or additional information that has relevance to the currently viewed event. In this way, users can easily explore and discover more about the subject they are researching.

It is important that the timeline allow users to save citations. In research, having a reliable citation is very important. Because our application is simply a collection of data from other sources, any information within the application must be cited to show that it is credible. Our team inserted citations at the bottom of each event.

Figure 21. Bookmarks.

During research, it is important to save sources for later reference in order to find them and review them again as needed. In an application with large amounts of data, there must be a way to mark individual pieces of information so that they are easy to find again. Furthermore, it

must be possible to mark all data points relevant to a specific topic of research. The team used local storage, files saved on the user's computer, to allow users to save events they wish to be able to access again as a bookmark. This bookmark appears as an icon on an event in order to make it stand out from events without a bookmark, as shown in Figure 21 above. Bookmarks also function as note cards on which users can leave personal notes about particular events. These notes are available to the user who added them, even after leaving the site. Bookmarks can also be sorted into groups by users. Bookmark groups can be exported for personal use along with their associated notes and citations.

4.2 Comprehensiveness of the Application

In order to make our application comprehensive, the final application contains data from several different sources. The team included event and image data from *L'Atlante Storico di Venezia*, and encyclopedic data from *L'Enciclopedia Storica di Venezia*. These data are intended as a base set of events that will be expanded in the future through both manual and automatic means.

4.2.1 Parsing *L'Atlante Storico di Venezia*

The team was able to successfully use the Text Extraction Tool by PDFLib to output event data from *L'Atlante Storico di Venezia* in plaintext format. Once the group was able to obtain information in plaintext, a parser was created that automatically organized the contents of the atlas into JSON format. The parser was able to abstract and format 6,231 JSON objects that correspond to entries in the atlas. These entries, or events, contained the year and date the event occurred, the description of the event, and, if available, the location of the event. A process that summarizes this is shown in Figure 22 below.

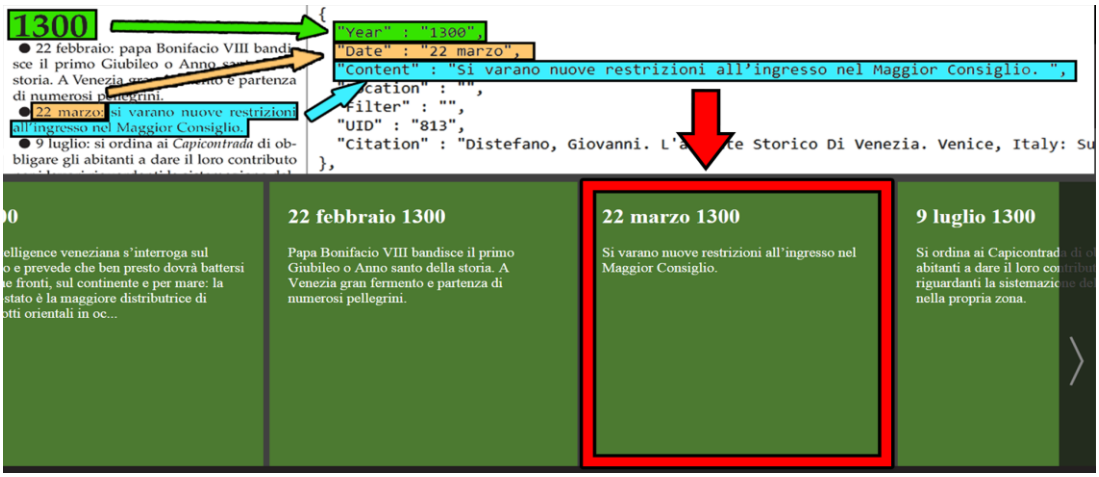

Figure 22. Visualization of Data Parsing

4.2.2 Parsing *L'Enciclopedia Storica di Venezia*

As with the atlas, the group used the Text Extraction Tool by PDFLib to output articles from *L'Enciclopedia Storica di Venezia* in plaintext format. The group then created another parsing algorithm, similar to the one created for *L'Atlante Storico di Venezia,* that extracted the title of an article and its contents and arranged them systematically into a JSON file.

After the group obtained the information in JSON format, it created another algorithm that matched the article titles of *L'Enciclopedia Storica di Venezia* to text in the events of *L'Atlante Storico di Venezia.* The link generator allowed the group to create links between the two sources and show additional encyclopedic information in each event of the timeline, which was displayed in an additional popup that would show only when the link was clicked, as shown in Figure 23.

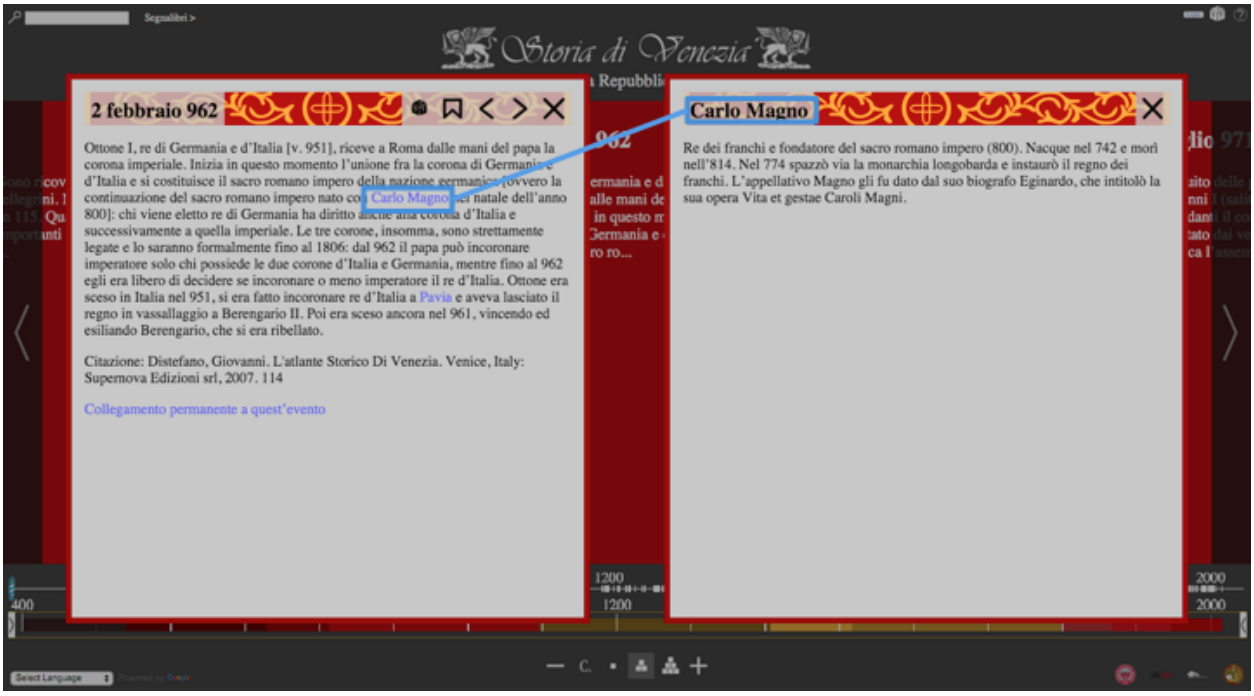

Figure 23. The Encyclopedia Pane

4.2.3 Incorporating Images and Paintings Depicting Events

By using the Image Extraction Tool from PDFLib, the group was able to pull out all of the images from *L'Atlante Storico di Venezia*. Unfortunately, due to technological limitations and lack of some image descriptions, none of the images were initially matched with the text events or subjects they depicted. There was no accurate way to distinguish where one image description ended and the next began. The descriptions also did not match properly with the images. To solve this problem, the team went through the PDF version of the atlas and

manually matched each image with an event, assigning them to an appropriate event. These images were then portrayed in both the content panels and pop ups, as shown in Figure 24. Images were also taken from public domain sources on the World Wide Web.

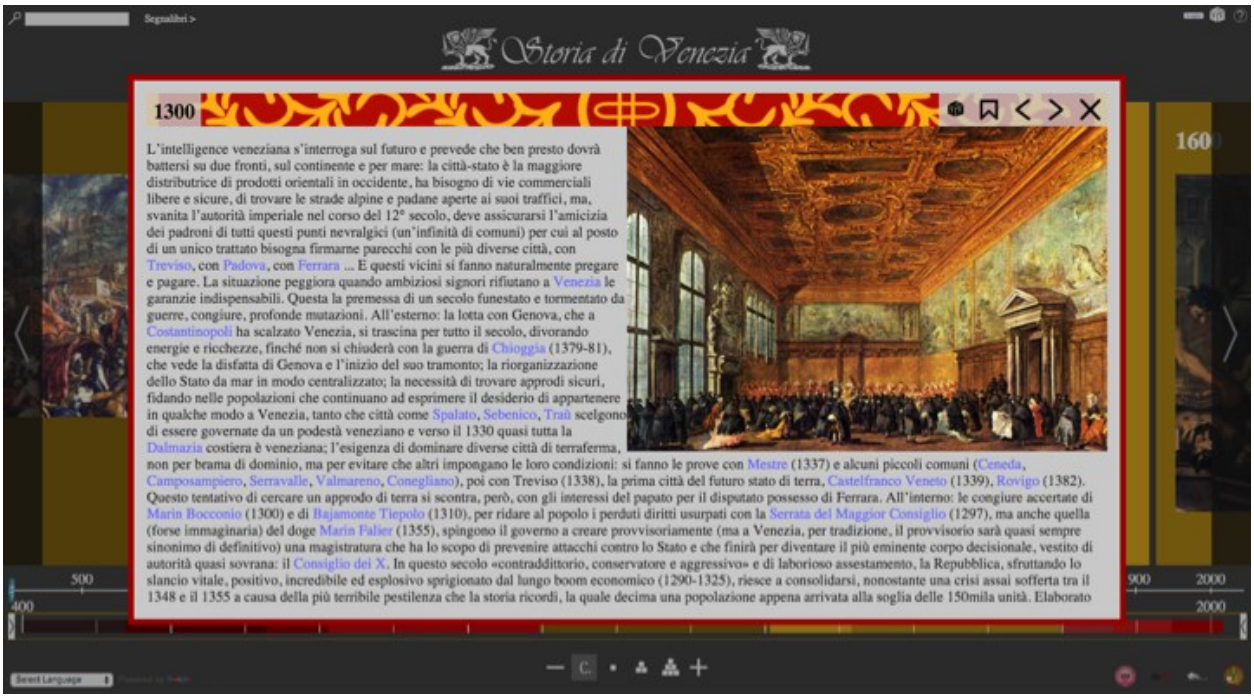

Figure 24. An Infopanel Containing an Image

4.3 Expandability of the Application

An important aspect of our application is that it is expandable. Once the team is finished creating the database, it will not stop growing. The group created an add event form that allows anyone with login credentials to add a new event to the timeline. The group also wrote a script to automatically parse new events from an RSS feed from the city of Venice. The team also hopes that, through applications like uScript, manuscript data from the Venice State Archives can be included in the application.

4.3.1 Allow Users to Add New Events

To make our application easily expandable, the team created an add-event form that allows authorized users, approved by the VPC, to add new events to the timeline. Figure 25 shows the add event form, which includes date, location, description, and citation fields. Once an approved user submits the form, a script will automatically format the data into JSON, upload it to firebase, and display the content in the application. In order to avoid the addition of false or malicious content, the VPC will give login credentials to only certified users that they trust.

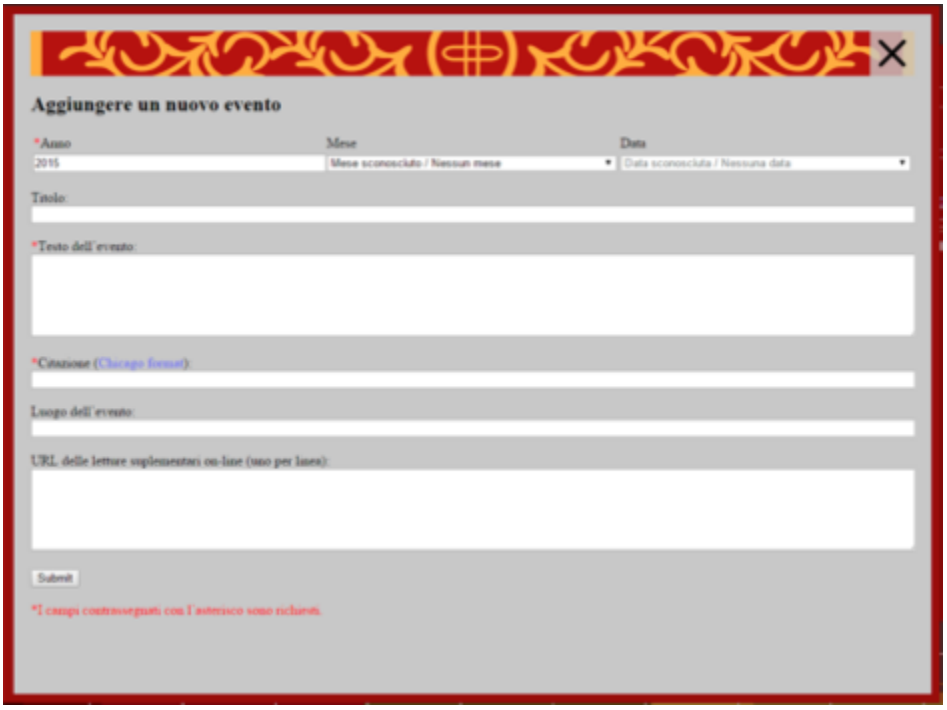

Figure 25. The Add Event Form

4.3.2 Automating the Addition of Current Events

As well as providing a way to manually add events, the group looked for ways of adding current events to the timeline automatically as soon as they occur. The group turned to RSS feeds from the city of Venice to obtain this information. To periodically add information from this RSS feed, an algorithm was developed. This algorithm is able to extract the date and the description of each of the events in the RSS Feed and format them into JSON. Once these data are received they are automatically uploaded to Firebase and an event in the timeline will be created.

4.3.3 Inclusion of Transcribed Manuscripts

The group looked to add primary sources of information to the timeline, through the addition of manuscripts from the Venice State Archives that were transcribed with uScript, which takes an image of the handwritten pages and attempts to parse them into plaintext. Once uScript is fully functional and can automatically transcribe large numbers of manuscripts from the Venice State Archives, the team hopes they will be automatically formatted into JSON similarly to the events taken from *L'Atlante Storico di Venezia* and inserted into the timeline through Firebase. Manuscript events have pictures of the manuscripts from which the events are taken. These pictures will highlight the specific region of the manuscript that is transcribed and shown in the event. In order to demonstrate this capability, the team manually included

some manuscripts that were already transcribed and portrayed them the same way uScript could in the future, as seen in Figure 26.

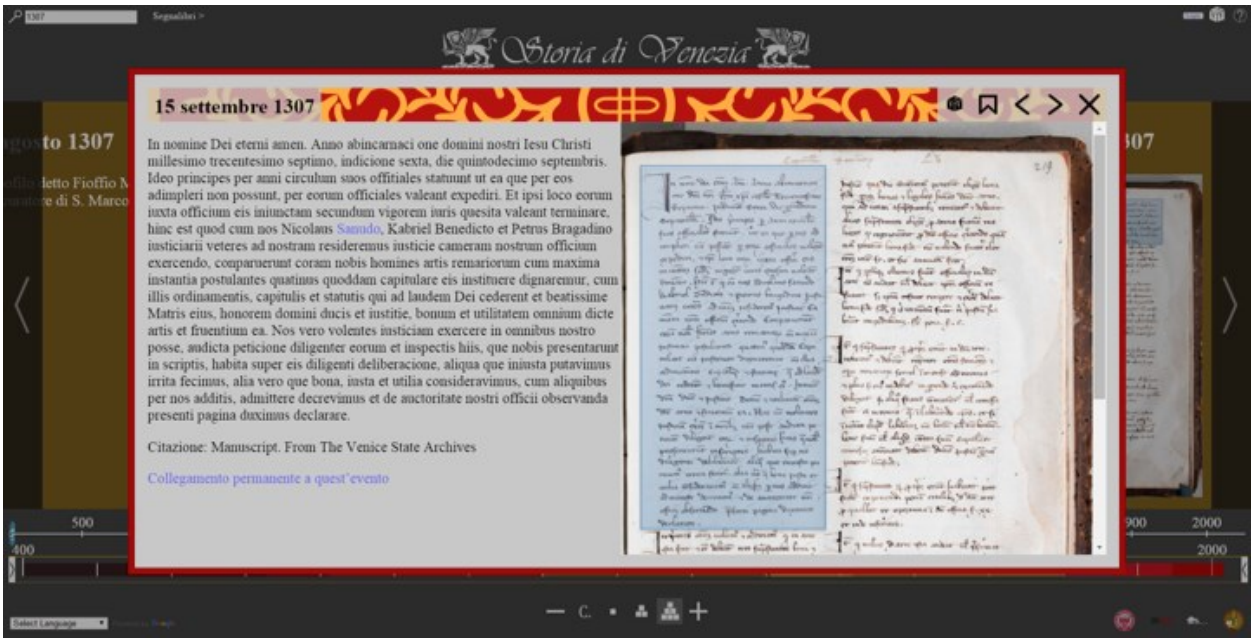

Figure 26. An Event Extracted from a Manuscript

5 Conclusion and Recommendations

Our application has made it possible for the average user to access, organize, and interact with historical information about Venice all in one location, making it easier to conduct unique research on Venetian history. Through the application, information about key events in Venetian history, images of artwork, and links to encyclopedic information are now accessible to anyone with access to an Internet connection.

The team also laid the groundwork for moving some of the primary sources in the Venice State Archives into the application, as well as functions to enable connections to external secondary sources like scholarly books, journals, and articles. Although this first version of the application has only been populated with basic building blocks, it has the advantage of being accessible, comprehensive, and expandable. The basic design is visually appealing and interactive, allowing users to have an immersive learning experience.

The application allows users to connect various events and analyze the history of Venice on their own and is a unique and "democratic" approach to historical research. In this way, the application has the potential to change the way people look at the history of Venice and open the door to a deeper understanding of the city.

5.1 Recommended Additions and Changes to the Site

The application developed considerably from the original mock up. It looks more appealing and contains many features the team originally had not considered, such as bookmarks, a random event generator, and automatic expansion. However, in software development, sometimes it is necessary to be realistic about the features that can be reasonably achieved within the given time frame. Other desirable features we thought of were unachievable due to the project's scope, and will need to be addressed by future developers. The features and functions discussed in this section would be greatly beneficial to the application in the future.

5.1.1 Internal Links

To improve ease of navigation through the website, internal links would be a beneficial addition. Internal links could be used in any event text that contains a mention of a different event. Clicking on the link would take users to that event. This method of navigation would be

an easier way to find more events relevant to the user's interests. These links would be a separate color than, or somehow visually different from, external links.

5.1.2 External Links

As users discover events on the timeline that interest them, they will naturally want to learn more about that particular event. Sometimes, the information provided is not enough, but there are other sources that address the topic in more detail. If another source is found on the topic or event, a link should be added into the event text that will take users to that source. Users can then further their research using several new sources, making our application just the start of a more focused search.

5.1.3 Translation Improvements

The application currently has a Google Translate widget embedded in the website, which provides translation of all of the content into many different languages. Unfortunately, the translator is not perfect, and many grammatical errors occur when using it. It also fails completely when attempting to translate Veneto. Using the translation function also does not work in conjunction with the search function; it is not possible to search the timeline in languages other than the original Italian. Future work on the application could involve incorporating a different translator that allows for searching in other languages, or an improved translation that eliminates some of the grammatical errors present.

Some websites, such as Wikipedia, work around the issue of web based translation errors by providing an actual, non-processed translation. There are different versions of each Wikipedia article for different languages. The separate versions are fluently written, and are not literal translations, but they do capture the spirit of the material, which is a common goal for good translation.They are alternative versions of the article in a different language. Translating the articles in this manner makes them more coherent and sensical than a web-based translation function, but it requires a large amount of time and effort, since actual translators have to rewrite the material.

5.1.4 Integrating Morphological Information Depicting Location

Through the use of the parser created to extract information from *L'Atlante Storico di Venezia*, the group was able to obtain the location of some of the events in the timeline. Potentially, these locations could be converted to geographical coordinates and located in a historical map with the correct morphology of the island at the time. The VPC has already created a cartography application that could serve this end. Unfortunately, that application is insufficiently robust to be used for this purpose at this time. Locations could be displayed in

the content panels and popups. In order for users to look at that location with respect to the whole city, they could click on the map and a zoomed out version would show. Figure 27 is an example of a format that a popup could use.

The group was only able to obtain locations of events related to churches from *L'Enciclopedia*, so the location data in the application is incomplete. Other potential Venetian locations of importance include bridges, bell towers, and islands. If these locations are found within events, it is possible to add the location data. Expanding the number of events with location data leads to a more cohesive and consistent timeline, and provides users with even more information. As the location data in the timeline is produced in collaboration with the VPC's Cartography application, any improvements to the Cartography app will also improve the timeline. In particular, if more maps are added to Cartography, more maps and thus more locations will be available to connect events to within the timeline. One instance where extra maps would be beneficial is with an event that corresponds to a battle or war. As battles were not fought in Venice, additional maps are needed to properly display the location of the event.

Figure 27. A Mockup of an Infopanel Containing Morphological Data as Displayed in the VPC Cartography Application.

5.1.5 Optimizing the Process of Drawing the Time Axis

Presently, the draw function of the time axis code runs in O(n) time, where n is the number of events being displayed. This means that the number of processes that must be run to draw the time axis is linearly proportional to the number of events, within a rounding error for

large numbers of events. Since the application has many events, this means that it runs very slowly on the highest zoom level. There may be ways to optimize this function in order to make it run in constant time. Future developers should look into this.

5.2 Populating the Application with Additional Information

The majority of the current information in the application is taken from the books *L'Atlante Storico di Venezia* and *L'enciclopedia Storica di Venezia*, both written by Giovanni Distefano. Additionally, the team has implemented the capability of adding information automatically through an RSS feed and manually through an add event form. Regardless, as with any historical source, the application should pull from as many sources as possible to be as accurate as it can. Thus, it is important that the application remains a constant work-in-progress, continually being updated with new information, or updating incorrect events.

Part of the new information used to further populate the application should come directly from the Venice State Archives. Future teams should work on ways to use uScript to obtain manuscripts with transcriptions and expand this application with that information. These manuscripts provide in-depth and detailed descriptions of day-to-day events of Venetian history. Since Venice is a living city, teams should look at ways of adding the records that the Archives are currently collecting into the application. Similarly to the RSS feeds, this will enable the application to contain the current history of Venice.

Due to technical limitations, the team was unable to provide an interface by which users will be able to upload images to the timeline application alongside their new events. This would be beneficial because it would address the dearth of images presently on the application. As mentioned in Section 2.5, images assist users in remembering information, and are thus important in creating an immersive and engaging experience.

5.3 Adding More Research Tools

The bookmark functionality introduces the ability to personally save events for later use. With the addition of internal and external links, the application could become not just a source of historical information, but a starting point to continue research using other sources as well. Throughout the course of research and development, the team encountered several features that could be useful as potential research tools. However, they require significantly more time than the group could afford.

The first of these features is an improved search function. Some search engines, such as Google, have the ability to detect what users are typing and provide suggestions. In some cases,

there is an option to autocomplete the words in the search. Autocompletion is a convenient function for users, as they can get to what they are looking faster. Search suggestions also provide another convenient function: spell check. If users do not know exactly how to spell what they are looking for, the search suggestion will help them and show them the correct spelling. Another improvement to the search function would be to allow for misspellings. When users accidentally misspell their search, the application would instead ask them if they meant the correct spelling. This allows users to navigate more easily.

Another useful addition would be improvement on the citation system. The current system requires users to download their bookmark group, then pick out the citations from each event. Users can also copy and paste directly from the content panels. It would be beneficial to users if they had the option to export citations directly, and perhaps even choose the format they need. An improved citation functionality would be separate from the bookmark system, instead of the combination that exists currently.

5.4 User Testing

User testing helps establish whether the application has the desired characteristics of ease of use, navigability, and functionality. Testing also provides an insight into ways in which the application may be used after future development. Due to time constraints, the group was unable to put the application through user testing. For such an application, a process known as iterative design is recommended. Iterative design involves user testing, then using feedback from the tests to improve the application. This process is repeated until user testing produces satisfactory results.

To accomplish user testing, the team suggests an observational testing method described below:

1. Participants are to be seated in front of a working copy of the application and asked to acheive a short list of tasks, such as “Navigate to information of the Battle of Lepanto,” “Navigate to information about Paolo Lucio Anafesto, the First Doge, without using the search bar,” “Use the timeline to find the island on which the last Doge, Ludovico Manin, was crowned,” “Use the timeline to find a painting by Paolo Veronese,” “Find the encyclopedia article on Marin Faliero,” and “Navigate to the foundation of the Republic of Venice.”

2. While the participants attempt to interact with the application, a tester should sit behind the subject. During the observation period, the tester should take notes on how

each subject used the application and how long they took to accomplish each task. The tester should be allowed to ask questions of the user about what he or she is trying to do at the time. The tester should be allowed to give advice on how to use the application only when the participant gets stuck. If a question is asked or advice is given, it should be recorded in the observation sheet.

3. After a test session concludes, the participants should be asked to fill out a short survey (Appendix D). Data collected during user testing should then be used for further polishing of the application.

With the addition of iterative user testing, as well as improved functions such as links, translation improvements, and location data, the team believes that the application will become even better. It will continue to provide users with an accessible, comprehensive, and expandable source that will cater to their interests and research goals. The history of Venice can find a new home in our timeline, where many will be able to see and appreciate it.

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Image Sources

Figures 1, 2, 3, 4, 5: Wikimedia Commons
Figures 6, 8, 9, 10: British Broadcasting Company
Figure 7: Anne Frank Museum
Figure 11: National September 11 Memorial & Museum

All other figures were produced for this project by the project team.

Appendix A: Timeline Matrix

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Example:	Divisions by Time periods:	Visual entries with more than 4 sentences describing the event:	Timeline Style: Vertical or Horizontal	External Links:	Internal Links:	Sound Effects:	Pictures:	Zoom Capability	Filters/Searching	pop-up windows/ extra information	scrolling	Link:	Other
2	Anne Frank Timeline	Yes, it is divided into 4 time periods. Each period has a different length and some of them have their own divisions inside the time period.	No, the information visible to the viewer is just a couple sentences long. If the reader wants to find more about certain events it expands the description.	Horizontal	YES, to youtube videos and to main articles about important events.	No	YES, movement of paper.	YES	No	No.	Yes, the viewer can click on an event and a pop-up window will show more information pertaining this event.	To move around the Timeline the vier can either click and drag across the scrin or use the timeline bar to move around the timeline. He can also click in the specific time period he wants and the bar will move to that time.	http://www.annefrank.org/timeline#!/	Each event has a picture.
3	Formula 1 History	NO	NO	Vertical	NO	No	NO	NO, it has drawings.	No	NO	No	Viwer must use the scrolling bar on the side to get from one point to anohter.	http://www.aformulaonehistory.com/	
4	Computer History	Yes, it is divided in 10 year spans.	NO	Vertical	NO	No	NO	NO, it has drawings.	no	No	No	Viwer can either use the scrolling bar or he can click on the sideline bar which allows him to move between times.	http://www.akita.co.uk/computing-history/	Events are very precise
5	Ages of treasure Timeline	Yes, it is divided by time eras that represent how the world evovled.	NO	Horizontal	NO	NO	NO	YES	No	No	Yes, the user clicks on an event and this pops up a new window with more information regarding the event.	Viewers use a scrolling bar at the bottom to move through the timeline.	http://www.bbc.co.uk/history/interactive/timelines/treasure/index_embed.shtml	
6	British pavilion in Venice	No	YES	Horizontal	No	NO	NO	YES	no	no	no	The viewer has to click on a specific year in the time line to move from one year to another he can not scroll through it.	http://venicebiennale.britishcouncil.org/	
7	World Trade center and 9/11 timeline	NO	Yes	Horizontal	No	No	Yes, sound bits of speeches.	YES	No	NO	Yes, the user clicks on an event and this popops open a window on the side wiht more information regarding the event.	In a touch friendly server the user can swipe across the screen, but in other computres the timeline can ge scrolled by moving the mouse to either side of the page. To go foward in time the user moves the mouse to the right side of the page and to go backwards in time to the left side of the page	http://timeline.911memorial.org/#FrontPage	Short description withthe ability to expand on it. Sound is made with soundbits of certain events.
8	Metropolitan Museum of Art Heilbrunn Timeline of Art History	YES	NO, but the viewer has the opportunity to read extra informaiton regarding the article if they wish.	Horizontal	NO	NO	NO	NO	no	no	no	no	http://www.metmuseum.org/toah/ht/?period=06&region=eust	
9	BBC british history timeline	Yes, it is divided by time periods that represent important periods of the history of England.	NO	Horizontal	YES, to other pages from the BBC outside of the timeline.	No	NO	Yes	Yes, this Timeline has two zoom options. One that shows the entire timeline in one view and another that shows a 35 year span with all the events that happen in this time frame.	Yes, by different places in Britain and by wars, kings and queens, women rights, and slavery.	Yes, the user clicks on an event and this pops up a new window with more information regarding the event.	The user can either use the bar in the timeline to move from one time to another or just drag across the background of the timeline.	http://www.bbc.co.uk/history/interactive/timelines/british/index_embed.shtml	Events can expand and suggest other similar events.

Link to the Google spreadsheet:
https://docs.google.com/spreadsheets/d/1Svl3ji7fQOCE0klR_s0aEpkuTE894vQ-c-laoLc3g3Y/edit#gid=0

Appendix B: Use Cases

Search Bar
4. User enters characters into the search bar 5. User hits enter (is a search button necessary?) 6. Application filters the content in the event bar to display information relevant to the search
Before: All Content Panel types are being displayed on the timeline.
After: Content Panels pertaining to the search are the only panels present and the filter content drop down box is displaying that search results are the current filter.

Zoom in
1. User clicks the zoom in button 2. Application updates scroll bar to zoom in and event bar to display more events
Before: Only major events are displayed on the event bar. The navigation bar's box is a certain size.
After: More granular Events are displayed in the event bar. The navigation bar's box is smaller than before.

Zoom out
3. User clicks the zoom out button 4. Application updates scroll bar to zoom in and event bar to display less events
Before: Only major events are displayed on the event bar. The navigation bar's box is a certain size.
After: More granular Events are displayed in the event bar. The navigation bar's box is larger than before.

Filter content
1.User selects the filter content dropdown menu 2.Options for filtering are displayed on the dropdown menu 3.User selects which filter is desired from the list 4. Application filters the content in the event bar to display information relevant to the filter selection
Before: The event bar displays content panels relevant to the current filter selection
After: The event bar displays content panels relevant to the new filter selection

Panel Selections
1. User selects an content panel by clicking it 2. Window pops up which displays more information on the content in the content panel 3. the background is greyed out
Before: Normal state, no popup
After: A popup is shown with information about the specific event

Time Bar Selection
1. User clicks a location on the time bar 2. The event bar scrolls to the events which occurred at the new time bar location
Before: Events bar shows events relevant to the old time bar location.
After: Events bar shows events relevant to the new time bar location.

Internal links in popup boxes
1. User clicks an internal link in a popup box 2. The current popup closes 3. The event bar scrolls to that event 4. The popup for that event opens
Before: The initial popup is showing and the events bar is scrolled to the initial event
After: The new popup is showing and the events bar is scrolled to the new event

Back button in popup boxes (greyed out if first popup)
1. User clicks the back button 2. The current popup closes 3. The event bar scrolls to the last event 4. The popup for that event opens
Before: The initial popup is showing and the events bar is scrolled to the initial event
After: The last popup is showing and the events bar is scrolled to the last event

Close button in popup boxes
1. The user clicks the close button 2. The popup closes
Before: A popup is shown with information about the specific event
After: Normal state, no popup

Navigation: VPC
1. User clicks the “Venice Project Center” button 2. The Venice Project Center website opens in a new tab/window.
Before: Normal state

After: Normal state / The VPC site is now open

Navigation: Supernova
1. User clicks the “Supernova Edizioni” button 2. The Supernova website opens in a new tab/window.
Before: Normal state
After: Normal state / The Supernova site is now open

Navigation: Sources
1. User clicks the “Sources” button 2. The sources webpage opens in a new tab/window.
Before: Normal state
After: Normal state / The sources page is now open

Navigation: The Story of Venice
1. User clicks the “The Story of Venice” button 2. The Story of Venice website opens in a new tab/window.
Before: Normal state
After: Normal state / The VE15-CHRON site is now open

Navigation: About the timeline
1. User clicks the “About the Timeline” button 2. The About web page opens in a new tab/window.
Before: Normal state

After: Normal state / The VPC site is now open

Appendix C. Survey for Future User Testing

1. Was using the application a pleasant experience?
2. Did you find the material contained in the timeline to engaging?
3. What aspect of the timeline caught your attention the most?
4. Did you find it difficult to access the information you were looking for?
5. Did you use the zoom buttons to navigate the timeline?
6. Did you use the navigation bar to traverse the timeline?
7. Did you use the search bar to navigate the timeline?
8. Did you use the filters menu to navigate the timeline?
9. Rate this application on a scale from one to five.