

Smart Cities, G.I.S. and the Phenomenon of Piracy

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Abstract

This article describes the ways a smart city can use Geospatial Information Systems (G.I.S.) to promote its history, focusing on the phenomenon of piracy. Specifically, definitions are given regarding the concept of Smart Cities and their correlation with G.I.S. Then an analysis is made concerning the ways in which historical phenomena, such as piracy, can be visualized using G.I.S. through the creation of interactive maps, 3D models and animated maps. References to historical facts are also presented in order to understand the need of creating such cartographic compositions to highlight aspects of history, that few know and even fewer have studied, especially in Greece. Moreover, we present the ways in which cartographic compositions can be demonstrated in the coastal settlements and the islands that were pirate strongholds. Finally, we show ways that these cartographic compositions can be hosted on a website, giving the possibility to access the information from all over the world, emphasizing the importance of highlighting local history.

1. Introduction

1.1 General Instructions

A smart city is a city that uses new technologies to create a more efficient and sustainable environment. Part of the new technologies that can be used for this purpose are the Geospatial Information Systems (G.I.S.). Nowadays, G.I.S. have evolved so much that they can not only display data on maps, but also offer the possibility of using movement to create more complex and animated cartographic combinations in which more information can be found in an attractive way. In the science of history, the need to represent phenomena such as battles, ships routes or army campaigns, the location of fortresses, the lands that the empires had conquered etc. has always been an issue. Another issue related to history is the way to represent and visualize historical events not only to children but also to adults in a more attractive and practical way. Maybe the solution to this is the use of G.I.S. through different types of digital maps that can be created. These maps can be hosted on websites in order to be used through monitors at main points in a city, such as in archaeological areas, in schools to make lessons more interactive and enjoyable and in a variety of other places as an implement to show historical events related to a city.

The phenomena of piracy and privateering have concerned humanity since ancient times and have made a decisive contribution to the course of history, having influenced civilizations at a political, cultural, geopolitical and residential level. These historical facts are so important that should not remain in obscurity, so that people can get to know their history better, explain archeological findings and understand aspects of modern societies that have their foundations in periods when piracy flourished. In this way we can easily understand the chosen locations of the modern settlements and the way many of these settlements have been evolved from the coastal ones that were built in the period of the 16th and 17th centuries. We can also learn that pirates, corsairs and their strongholds did not only exist in the Caribbean Sea, as many studies and movies have showed, but intense pirate activity has been taking place for many centuries in the Eastern Mediterranean from Greek pirates and their strongholds in Greek coastline, until the Greek Revolution in 1821.

Nowadays is essential to highlight historical facts, such as piracy, utilizing modern forms of technology. Thus, in the context of developing a smart city, GIS can contribute not only to provide useful information about the city, such as its urban boundaries and the location of schools and fire hydrants, but also to provide digital interactive mapping of these historical facts that makes history an interesting and accessible process for the public.

2. G.I.S. as a Means of Highlighting the History of Piracy

According to the European Commission (2019), a “Smart City” is “a place where traditional networks and services are made more efficient with the use of digital solutions for the benefit of its inhabitants and business. A smart city goes beyond the use of digital technologies for better resource use and less emissions. It means smarter urban transport networks, upgraded water supply and waste disposal facilities and more efficient ways to light and heat buildings. It also means a more interactive and responsive city administration, safer public spaces and meeting the needs of an ageing population”, even though a majority of terms for “Smart Cities” have given.

Some interesting approaches to “Smart Cities” are the following: “Smart cities have high productivity as they have a relatively high share of highly educated people, knowledge-intensive jobs, output-oriented planning systems, creative activities and sustainability-oriented initiatives (Kourtit et al., 2012)”.

“Smart Cities initiatives try to improve urban performance by using data, information and information technologies (IT) to provide more efficient services to citizens, to monitor and optimize existing infrastructure, to increase collaboration among different economic actors, and to encourage innovative business models in both the private and public sectors (Marsal-Llacuna & López-Ibáñez, 2014)”.

“The application of information and communications technology (ICT) in the context of future cities is often indicated by the notion of smart city (Lombardi et al., 2012)”.

“Smart cities (SC) have changed radically, since the initial appearance of the term in literature in late 1990s due to the impact of disruptive technologies and new forms of interaction in the everyday life (Moustaka et al., 2018)”.

“The concept of the smart city is far from being limited to the application of technologies to cities. In fact, the use of the term is proliferating in many sectors with no agreed upon definitions (Albino et al., 2015)”.

The above indicative approaches show that technology is nowadays an integral part of Smart Cities, which are inextricably linked to innovation. Also, the term "Smart Cities" now seems to be part of many different fields without having a single definition. Instead, multiple definitions arise depending on the applications and uses that are being discussed in each case. Therefore, a smart city can also be a city that uses new technologies, such as Geographic Information Systems (G.I.S.) to highlight its history. In this way it is possible to inform citizens about the local history and cultural heritage and it is also a means of attracting and informing tourists.

Geographic Information Systems (G.I.S.) have evolved today as a part of the digital solutions that smart cities need. A G.I.S. is designed to digitize, store, manage, analyse and display data from the real world (Goodchild, 2000). They are also compatible with both vector and raster data (National Geographic Education). “Geospatial data and geographic information systems (GISs) are essential components for building smart cities in a basic way that maps the physical world into virtual environment as a referencing framework. On higher level, GIS has been becoming very important in smart cities on different sectors. In the digital city era, digital maps and geospatial databases have long been integrated in workflows in land management, urban planning and transportation in government. People have anticipated GIS to be more powerful not only as an archival and data management tool but also as spatial models for supporting decision-making in intelligent cities (TAO, 2013)”.

Digital cartographic creations can be either static maps, interactive maps or animated maps (Ogao & Kraak, 2002 and Roth, 2013). The use of 3D models for the purpose of representing historical events, archaeological finds, cultural monuments etc. is also common using various methodologies (Centofanti et al., 2014 and Castro et al., 2021). These options offer the chance to present maps in a variety of ways that are easily accessible to public. In this context, interactive maps, animated maps and 3D models can visualize historical events as well. As already has been indicated in the summary, a website hosting such maps and allowing a more comprehensive analysis of historical facts, such as piracy, it would be a useful and practical solution. To prove this, a website has been created that includes an interactive map, an animated map, 3D models and details about the phenomenon of piracy.

3. Visualising Piracy Through G.I.S.

As it follows from the previous analyses, a smart city can be a city that provides information through services that are based on new technologies. This information can be addressed both to the citizens of the smart city and to those who visit it. Thus, providing information about historical facts related to the city, such as the phenomenon of piracy especially in coastal cities and islands, can be a reason for attracting tourism.

The following sections analyse the above example focusing on the way G.I.S. can highlight piracy in a Smart City.

3.1 Creating a Website

A website has been set up that attempts to combine cartography, G.I.S. and the history of piracy. The website is entitled www.piratecartography.com, which automatically indicates its content. In this website, the user will find a section with details about strongholds, such as:

- geographical descriptions from cartographers in the 16th and 17th centuries,
- the reasons that the specific locations were used as pirate strongholds,
- the names of the most famous corsairs and pirates that acted at these strongholds,
- current information about the strongholds and
- maps and engravings relevant to each location which were created in those centuries.

In the website there is also a section with the biographies of pirates and corsairs, a section with information about the ships that were used at this time period including relevant images and a section that contains the biography of famous cartographers at that era. There are also two other sections that you can find videos, articles, conferences and reviews of relevant books. Animated maps with the routes of famous pirates are included in the website. In the section that contains pages with details for the strongholds, there are also 3D models embedded to help the user visualize the information. The interactive map with all the strongholds can be found on the main page.

3.2 Interactive Map

In the Eastern Mediterranean, and more specifically in Greece, almost every coastal settlement and island became a pirate base at some point over the centuries (Κραντονέλη, 1991). In the period of the 16th and 17th centuries, piracy flourished in the Greek seas, since Greece is a crossroad of three continents. Thus, there were many Greeks who ended up to piracy either for revolutionary or for livelihood reasons. Typical examples are Ioannis Kapsis, Petros Lantzas, Hairentin Barbarosa, Ioannis Fasidonis and many more who were looking for a better future through piracy and privateering (Κραντονέλη, 1991). The difference between piracy and privateer is that the pirate acts for his own benefit, while the privateer is authorized by a kingdom to engage in piracy against its enemies that are in state of war (Γουργουρίνης, 2020).

The coastal settlements have common characteristics but also great differences depending on their geomorphology and their geographical position in accordance with the commercial routes that were formed at that time. The relationship that each of the settlements had developed with the pirates was also a crucial factor. For these reasons there are settlements that were grown at distance from the sea in order to protect themselves from enemies and pirate raids, such as Astypalaia, Patmos, Syros etc., while other settlements were grown near the port, such as Paros, Naxos, Mykonos, Kythira etc. (Μπελαβίλας, 1997). There was no settlement that managed to protect itself completely especially from pirate raids, however, these raids had probably different effects depending on the location of the settlement. For example, the coastal settlements often maintained good relations with the pirates, as for instance they allowed the sale of booty or slave markets. The sale of booty, the slave markets as well as the fact that pirates and corsairs usually got married with local women and created families were some of the main characteristics of the areas that became pirate strongholds. Coastal settlements also had the advantage of being able to have more direct and faster sales (Μπελαβίλας, 1997).

In the Eastern Mediterranean, three commercial routes are observed, the Asia Minor, the Cycladic and the Balkan. These routes were defined by naval's experience. The captains always tried to find the safest way to sail by avoiding the strong sea currents. As for example, in the case of Rhodes there are strong and reversed sea currents, so as the sailors were returning from Alexandria, they preferred to sail parallel to the coasts of Lebanon and Antioch in order to avoid this difficult passage and reach calmer waters. The Asia Minor route, although it was a route close to the coasts which helped sailors not to lose their course as they were able to have visual contact with land, was one of the most dangerous because it passed between the rocky coasts and reefs of Asia Minor. The Cycladic route seemed to be particularly dense as it includes many islands, such as Milos, Paros, Naxos etc. Most of them became major commercial centres as well as famous pirate strongholds (Μπελαβίλας, 1997).

At that time captains used to sail according to their observation of capes, bays and lighthouses, while they were also relying on their monitoring of winds, sea currents and tides. At night, when it was almost impossible to have visual contact with land, they used the stars for guidance. Therefore, night sailings were avoided as much as possible. Night stargazing was based more on the observation of the pole star which indicates the position of the North, mainly for the purpose of correcting the course (Ρωσσικόπουλος, 2009). In 1537, it seems that the nautical compass was developed. At that time, sailors used both the compass and the portolans for their guidance. The accuracy of the maps contained in the portolans was the best possible for the time, but it required either very experienced captains to avoid the dangers, or captains who knew safe routes in order to protect the ships from shoals and rocks. Experienced captains knew how to recognize the bottom of the sea and thus they could navigate safely even close to the coast. Sailing became much more difficult in cases where the captains had to sail to the island complexes, such as in the Cyclades (Μπελαβίλας, 1997).

The morphology of the islands and the location of the settlements in addition to easy access to clean water and fresh food were significant factors that made a place ideal for a pirate stronghold (Μπελαβίλας, 1997). Ports with shallow depths were a deterrent factor because only small ships and boats could approach. Reefs and rocky coasts were also a limitation. Therefore, easy and safe access to the port or shore was one of the reasons for using a location as a stronghold. Most islands offered more than one ports (Millo et al., 2006). Several islands had sandy beaches where sailors or pirates could pull their vessels ashore and repair them after naval battles or corrosion due to exposure to sea salt. Furthermore, sheltered ports in which ships could be anchored and protected from stormy seas and strong winds were important reasons not only for pirates who chose them as anchorages, but also for sailors who used them as safe naval stations in their journey (Μπελαβίλας, 1997). Journeys at those ages could take whole months to reach their destination in the Eastern Mediterranean (Ρωσσικόπουλος, 2009), since the ships were wooden with sails or even oars.

As an example of the way that an interactive map can be used in a smart city to provide historical information about piracy, we created an interactive map with ArcGIS Pro and ArcGIS Online. This map shows the pirate and corsair strongholds in the Eastern Mediterranean and mainly in Greece during the 16th and 17th centuries. The map's geodatabase contains four layers of data, specifically for the needs of the representation of the strongholds. The geodatabase consists of two feature datasets based on the centuries we study (16th or 17th century). Each of

these datasets consists of two layers, either Christian or Muslim pirates. In each layer, the strongholds were digitized accordingly with the above two separations (century and religion), using different symbols for each century and different colours for each religion, i.e. flag for the 16th century and pins for the 17th, green colour for Muslims and red for Christians. The colour of the symbols has been chosen according to the flag each religion was using at that time.

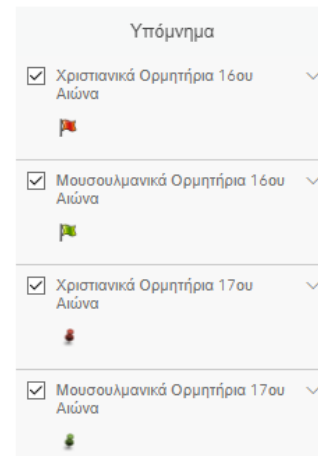


Image 1. Map's Legend

One of the features that makes a map interactive is the ability to click on each of the strongholds and have a new pop-up window providing extra information. By clicking on each of the symbols, a window appears in which there is information about the name of the stronghold, the island or the coastal settlement, the nationality of the pirates who used it as a stronghold, additional details if necessary and in some cases a link that leads to the section of the website that refers to the particular stronghold. Furthermore, in most cases an image (engraving or old map) related to the base station is attached.

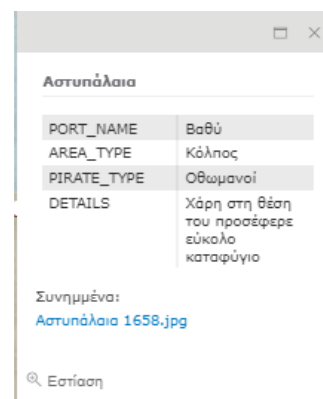


Image 2. Example of the pop-up window of a stronghold

G.I.S allow the use of basemaps and layers in order to create a more realistic result. Therefore, the specific feature was utilized and layers related to the land and the sea were added. Some characteristics of the layers, such as brightness, intensity, saturation, borders etc. were formatted. Layers with the texture of crumpled paper were also added in order to give the sense of an antique map.

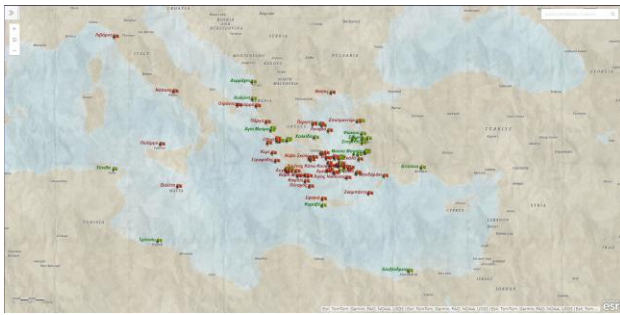


Image 3. Screenshot of the interactive map

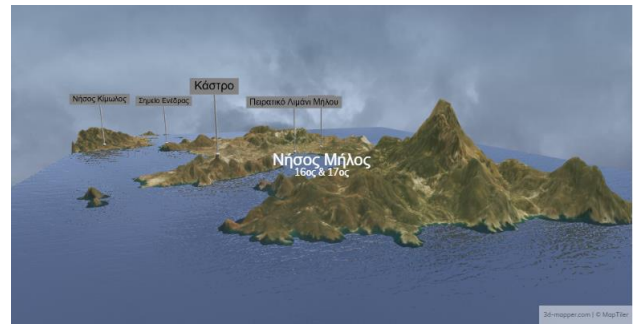


Image 4. Screenshot of Milos 3D model

In this map we see that coastal settlements, such as Alexandria and Tunis in the African Continent, were famous pirate strongholds of Barbary pirates. In the west, Malta was one of the most well-known Christian strongholds which was under the rule of Knights of Malta since 1530 when they were expelled by the Ottomans from Rhodes (which was their previous stronghold from 1308 to 1523). Also, well known strongholds in Italy were Palermo, Naples, Livorno and Otranto. In the north-west of Greece, there were strongholds, such as Dyrachio, Avlona and Himarra. In the Ionian Sea, in these two centuries we study, most of the islands and coastal settlements were Christian strongholds. In the islands of the Aegean Sea, we observe many Christian strongholds, while we notice that over the centuries these islands passed from Christian pirates to Muslims or vice versa, with strongholds such as Milos, Kythira, Antikythira etc. that hosted pirates of all nationalities and religions. On the coasts of Asia Minor, Muslim strongholds can be observed, counting the power of the Ottoman Empire, with typical examples being Attalia, Fokaia, Smyrna (Κανακάρης, 2021).

3.3 3D Models of Strongholds

A 3D model helps the user to understand the area where the stronghold is located and the ability to add on the 3D model the proper labels, which indicates main points of the stronghold. The 3D models have the advantage to be zoomed in and out and to be rotated as well. In addition, backgrounds can be added to make more realistic representations and data, like the heights or the bathymetry. Furthermore, satellite images can be used as a basemap to give a sense of reality. In the 3D model of Milos, the clear sky and the calm sea have been used as a background in combination with the basemap of satellite images. Labels have also been added to highlight significant points on the island, such as the main port, the castle and a spot commonly used for ambush.

Multiple techniques can be used to create a 3D model of a stronghold. Indicatively, altimetric and bathymetric data from official sources can be used, or approximate data can be used in combination with website animation software and plug-ins. Image 4 shows a snapshot of a 3D model created with the second method mentioned, as this particular visualization aims at an approximate presentation of the island of Milos and the locations of the port, the fort and the castle of the island that were used at that time period. This model gives the ability to rotate in the three axes x,y,z and the ability to zoom in/out.

During the 16th and 17th centuries, Milos was a commercial and pirate center. Its morphology made it difficult for ships to approach it. If the captain was not aware of the passage, he could easily hit the ship on the reefs and rocks, since the entrance to the bay, where the port is located, is a narrow passage with steep sides (Μπελαβίλας, 1997). Nevertheless, Milos' central position on the Cycladic route combined with its weather-protected port in the gulf, pointed out the island as a commercial center. The settlement was built in a short distance from the port and visible to passing vessels. The main port, Adamas, was not the only safe bay as there were many others, where all kinds of ships could safely dock. In many parts of the island there were springs with drinking water, while food such as grain, wine, etc. was produced. Also, the island provided enough wood useful for repairing ships as well as minerals used for weapons. (Μπελαβίλας, 2021).

In Milos, the locals had developed close relations with the pirates as the last ones used to sell their spoils and booty. This was another reason for pirates of all nationalities to resorting there (Κανακάρης, 2021). In fact, it is not surprising that the island of Milos was an independent pirate state for three years (1677-1670). The pirate responsible for the achievement of Milos becoming the first independent Greek state after the fall of Constantinople, is Ioannis Kapsis. Kapsis ruled Milos with his wife who was born there (Κραντωνέλη, 1991 and Καριζώνη et al., 2010). Milos was under Venetian rule from the time of the Fourth Crusade until 1561 when it passed to Ottoman rule. Several attacks have been recorded on the island and this is considered the main reason for the existence of castles, one of which was built in the 17th century, although in general the island's castles were either abandoned or inhabited depending on the prevailing conditions (Μπελαβίλας, 1997).

Descriptions of the islands have been recorded by cartographers, travel explorers and naval officers at that time. Antonio de Milo created an Isolario with all the islands of the Eastern Mediterranean. Its main characteristic is the detailed description of Milos with the ports, the bays and all the features that a captain should avoid or take into consideration for a safe approach to the island (Millo etc, 2006).



Image 5. Map of Milos by Antonio de Millo, πηγή: Millo, A., Agathou, E. and Tselikas, A. (2006) Antonio Millo Isolario. Αθήνα: AdVenture Publications

The ability of 3D representation of a location for those who have not visited it, gives a different perspective and helps the comprehension of historical phenomena and descriptions. It also enables the comparison of information provided by images, maps or descriptions.

3.4 Animated Maps

In general, a variety of representations can be made in the animated maps related to the phenomenon of piracy. It is possible, for example, to make a cartographic presentation showing the routes followed by pirates and corsairs during their lifetime or the most remarkable places they visited. Indicatively, the route of the famous Corfu pirate, privateer and spy Captain Petros Lantza has been represented. In this route, only the main places that are referred to his biography and his acts appear. Such places are his hometown Corfu which he visited many times over the years, Parga where he served as a governor, Sopoto, Delvino, Sayada, Agia and Margariti, areas where he launched a raid in order to liberate from the Ottoman rule. The following image shows a snapshot of the animated map of Lantza's course created via ArcGIS Pro:

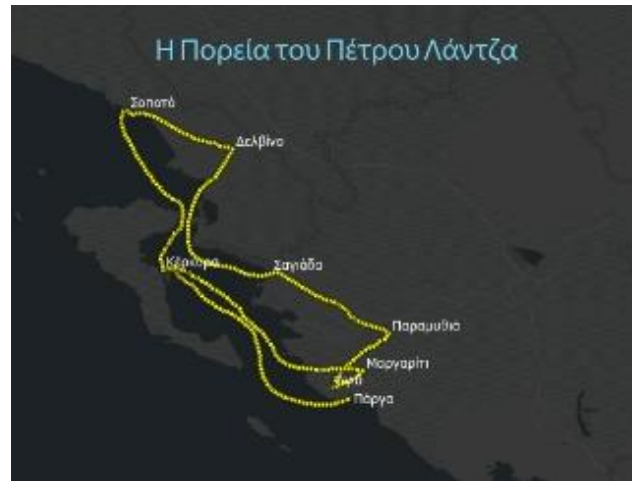


Image 6. Screenshot of the animated map

Petros Lantza was a nobleman from Corfu who acted both as a corsair and a spy. During the war between the Ottomans and the Venetians, he supported the Venetians with his naval skills. He organized raids on coastal castles and forts and sank many Ottoman vessels. Those actions had a significant impact on the Naval Battle of Lepanto that took place in 1571. After this Naval Battle, the Venetian authorities appointed him as a governor of the coastal city of Parga. But a defamatory letter that accused him of a secret collaboration with the Ottoman Empire, made Lantzas to escape to Napoli. In the letter, the malignants claimed that he was a traitor and that he was buying ammunition from the Spanish in order to sell them to the Ottomans. Thus, in the following years, Petros Lantzas undertook service for the Spanish Crown as a spy. His mission was to observe the Ottoman and the Venetian fleet. In addition, he was entrusted with organizing the ammunition, supplies and spies to Epirus, Constantinople and other parts of the Ottoman Empire (Λάσκαρις, 1955).

Along his life the intelligent corsair led piratical raids against Ottoman and Venetian ships, which caused great tension between the Spanish and Venetians. His aggressive activity provoked the wrath of the Venetians, who often vainly plotted his assassination. His restless spirit led him to Constantinople to engage in a series of secret operations. In the year 1608, he devised a plan to assassinate the Ottoman Sultan by offering him a gift containing explosives. But his attempt failed because he was betrayed by the Venetians spies. Thus, he died in 1613 in Naples (Χασιώτης, 1970 and Ιωάννου, 2000).

Generally, although Captain Lantzas had chosen the pirate life, and usually those who chose it had a short life due to illnesses, and battles, he managed to live to the age of 83 and have a hectic, dangerous and adventurous life. Also, he had his own family (wife, a daughter and a son) and he was in danger many times due to the fact that he served either the Spanish or the Venetians depending on his interests and the attitude they held towards the Ottomans. However, he was always against the Ottoman Empire and managed to survive and eventually die from natural causes (Γουργουρίνης, 2020).

On animated maps, such as in Image 6, the user can observe on the screen the areas described in the study as dots that appear repeatedly one by one. This composition can be exported to a .gif file. In this way, the user can follow step by step the areas that the historical figure visited.

4. Practical Use of Website and Maps

The advantage of hosting all the information and maps on a website is that anyone can have access in this information from their home, having only an internet connection. This capability serves an easy and quick spread of information throughout the world. In this way it is possible to arouse the interest of people to visit the areas presented not only from Greece but also from countries abroad, such as America, in which the phenomenon of piracy flourished in the Caribbean and has emerged through Hollywood movies and series, China and the Scandinavian countries that have shown strong pirate activity over the centuries. Consequently, spreading historical information through an online platform is an easy and affordable way.

In the coastal settlements, such as Sounio, Piraeus, Nafplio, Mani, Methoni, Koroni, etc., but also in the island settlements, such as Milos, Paros, Naxos, Astypalaia, Mykonos, Mytilini, Thassos, Kefalonia etc., monitors that support touch screens could be added. The monitors or video walls could be located within the archaeological sites in halls appropriately configured with the theme of piracy or in external areas. Suitable sites or even thematic parks could also be created near beaches that were pirate strongholds or near ports or even close or inside the castles associated with the coastal areas and coastal settlements, which were used in those times by the inhabitants of the area in order to protect themselves from pirate raids.

Visitors have the ability to browse the website, the maps and related videos through monitors. Depending on the location it could also be possible to access all the information related to piracy in that particular place. For example, a visitor to Milos could have access to the interactive map of the strongholds focusing on this island and the locations that were a pirate base. They could also have direct access to the 3D model of the island observing the way the island looks like today and browsing it via a touch screen. Visitors could also have access to historical information concerning the island regarding the phenomenon of piracy, as for example which pirates operated on the island and how they acted, what the characteristics of the island are, descriptions of the island's geomorphology and settlements that have survived from the study periods etc. This information could also be presented on a large screen in the form of a video or even with posters.

These places could be visited by locals and tourists in the context of entertainment and getting familiar to history and by schools and universities in the context of education. It is also given the opportunity to organize conferences and speeches with professors of cartography, archeology and history referring to piracy. Furthermore, events and theatrical performances for both children and adults can be organized. The knowledge of the history of each place is not only the outcome of reading books, but also of participating to interactive and more pleasant activities. Visiting the locations offers a different perspective and contributes to a better and easier understanding of facts.

5. Conclusion

The creation of digital, interactive, animated maps and 3D models gives a majority of information in an easy and fast way. It can also be a useful and effective educational tool and an enjoyable way to learn more about history. The phenomenon of piracy and pirate strongholds have great historical, political and cultural interest. As they have a decisive impact on human history and society, it is useful to be highlighted with every possible way. Cartographic compositions capture pirate activity

as for example in the Eastern Mediterranean, point out the factors that contributed to the evolution of coastal settlements and explain the reasons they were chosen as pirate strongholds.

Generally, GIS visualize aspects of history in many ways and in combination with the new means of technology can create a truly impressive result that will attract people from all over the world and of all ages both to the knowledge and to the places where so many historical events took place, especially in Greece.

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