Information Technology, Smart Devices and Augmented Reality Applications for Cultural Heritage Enhancement: The Kalamata 1821 Project

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Abstract. The purpose of this paper is to present the development of a modern web multimedia application named "Kalamata Action Map". The application provides a map based environment for users to exploit the Messenian landscape of the early 19th century thus enhancing our understanding on temporal and spatial interactions of that Era and towards the present. Designed for educational and touristic purposes, using historic material as a starting point "Kalamata Action Map" takes advantage of the intriguing urban surroundings, avoiding the limitations imposed by a closed museum environment. The application will be developed for use over the internet with open access. Data and images of landscape and architectural features, artifacts, everyday life etc. associated with historical information in reference to the War for Greek Independence and the establishment of the Modern Greek State will be integrated in a friendly and enticing way offering a unique user experience.

The application provides interactive maps of the city of Kalamata, serving as an exciting and modern depiction of the historic events that led to the beginning of the War for Greek Independence in 1821. Moreover, and additionally to the various historic, folklore and architectural elements, the application will also include digital representations of artworks and everyday objects and suggested routes for nearby destinations in the Prefecture of Messenia, therefore creating a digital network of interconnecting locations of historic interest, improving their commercial and touristic connections. The use of the application has the potential to serve as a significant reference point both for residents and visitors.

Keywords: GIS · Kalamata · Cultural heritage management ·
Digital applications

1 Introduction

Geographic Information Systems (GIS) in collaboration with location based application software provide a friendly, digital platform for the management and enhancement of archaeological and cultural heritage environments. The work introduces a topobased application using GIS named "Kalamata Action Map" that provides a map based environment for users to view the Messenian landscape of the early 19th century, portrayed by Finlay [1] and Christou [2].

The study area is located in the south west prefecture of Greece mainly Messenia with some references to neighboring areas of Laconia (West Mani) and Arcadia (SW). The application is developed to complement the user experience of visitors to the "Kalamata 1821: Roads of Freedom" website. "Kalamata 1821: Roads of Freedom" is a co-financed by Greece and the European Union project under the program "Research, Creation and Innovation" ESPA 2014–2020. The "Kalamata 1821: Roads of Freedom" project aims to study and exhibit to the wider public, important local parameters of the 1821 era and their interconnections with the present, through roads of history, culture and trade. Emphasis will be given to specific aspects of the 1821 Revolution, which began in Kalamata, highlighting the historic significance and the strong interrelation with the wider area (e.g. preparation for the uprising, economic life of the region, beginning of the revolution, Navarino naval battle), in order to describe the 200 years of history and the historic correlations. By using new vision and multimedia technologies, the project will attempt to interactively depict the historic moments to the citizens/visitors of Kalamata, on a permanent basis.

The project website contains plethora of information in reference to the city of Kalamata, its history, culture, legends, and economy and how they all evolved to the present. The "Kalamata Action Map" application compliments the website offering a spatial and temporal view of this information with images, links, videos etc. Via the "Kalamata Action Map" application users can participate in trails, encouraging users to discover the city though a network of historic buildings and significant landmarks, which will come to life via intriguing storytelling, pictures and Augmented Reality [3]. These insights, historic and cultural, will offer an alternate aspect of the city providing tourists information and motivation to visit buildings, landmarks and sites of historic significance, enhancing cultural heritage and sustainability and making "the Kalamata Action Map" a tool for protecting the routes and scenes where the events of the Greek Revolution took place while promoting Cultural Heritage of the 19th century.

2   The Historical Base

The Peloponnese is one the most restless regions of the subdued Greek areas. Following the failed Orlov revolt in the Peloponnese and later in Crete that began in February 1770 the region remained in an electrified state. In the following years, significant efforts will lead to the liberation of Kalamata, the first liberated city in the occupied by the Ottomans Greece.

In early January 1821 Theodoros Kolokotronis pursued by the Ottomans, arrives in Kardamili to find shelter in the tower of the Mourtzinos (Troupakis) family. In Early February Grigorios Dikaios (aka Papaflessas) arrives in Mani after the Vostitsa meeting with Paleon Patron Germanos seeking allies. On the Ottoman side, Hoursit Pasha the Moras Valesi is transferred with his troops from Tripolitsa to Epirus to assist in the battle against Ali Pasha, the local ottoman ruler who was fighting to gain his independence from the authority of the High Porte, leaving the Peloponnese without sufficient military forces [4].

The Ottoman authorities in Kalamata suspecting efforts of revolution from the Greeks send their families away to find safe haven in near castles. Locally, the "Voevode" of Kalamata, official ottoman ruler, Souleiman Agas Arnaoutoglou calls for conference with the Greek authorities, ("Proestoi"), to discuss his concerns. They reassure him for their loyalty and having spread rumors about outlaws wandering in the region, they propose that he reinforces his guard of only 150 Ottoman soldiers with capable Greek men from Mani.

In the middle of March 1821, a large supply of ammunition arrives to the small harbor of Almiros from Smyrna, one of the largest commercial ports in the Ottoman Empire, sent by the "Philiki Eteria" (Society of Friends), a secret organization faithful to the revolution. Papaflessas informs his allies and Nikitas Stamatelopoulos, aka Nikitaras, and Christos Papageorgiou (aka Anagnostaras), are summoned to the harbor to move the shipment safely. With the assistance of villagers and mules the ammunition was transported from the harbor to the Monasteri of Mardaki outside the Taygetos Mountain village of Megoloanastasova (modern Nedousa). ("Dromos Baroutiou"-Road of Gunpowder) In order to transport the shipment Papaflessas received customs documents from Petrobei Mavromichalis, Greek ruler of Mani who was occupied with his family for many years in commercial transactions, involving him in the scheme.

The fact that the shipment during the transportation was escorted by armed men, drew attention of Ottoman authorities. The "Proestoi" were summoned for interrogation and explained that it is a simple shipment of olive oil but due to the constant attacks from outlaws, armed forces are required to escort all goods transports. They also convinced Arnaoutoglou during the audience that he must take action to protect them and the Messenian region which is under his authority.

The events escalate quickly after that audience; Arnaoutoglou summons Petrobei Mavromichalis to send reinforcements and the latter jumps to the call sending his son Elias and 150 trained in war Maniates to protect the castle. Elias Mavromichalis convinces Arnaoutoglou that the incoming threat of Kleftes is too strong to be fought off by 150 Ottoman soldiers and 150 Maniates and that he must call for more troops from his father. Arnaoutoglou takes this advice seriously and immediately calls for more reinforcements from Mani. That was the signal for the Greek troops gathered in the small harbor of Kitries to take over the city.

Already on March 17th 1821 the Maniates of Tsimova (Modern Areopoli) had risen the revolutionary flag. Approximately 2000 Maniates of "Western Sparta" headed by Petrobei Mavromichali, the Mavromichalis clan, the Mourtzinous and Christaioi families and Theodoros Kolokotronis approach the city from the South East taking over the hills surrounding the castle.

At the same time from the west and the north, Greek forces from the neighboring villages of Messenia approached the city under the lead of Papaflessas, Nikitaras and Anagnostaras. From the Taygetos villages of Sabazika (modern Akovos) and Megoloanastasova the forces moved in to Mardaki and from there west to Velanidia.

From Sitsova (modern Alagonia), Tsernitsiova (modern Artemisia) Mikroanastasova (modern Piges) with the others from Megaloanastasova and Sabazika together marched south to Dipotama and Tourles, hills around the castle of Kalamata. At the same time men from Lada and Karveli moved to Ai Lia and met the other forces from Taygetos at Dipotama on their way to Kalamata. All routes and paths connecting Kalamata with its rural region were taken over by Greek revolutionary forces leaving no way out.

Elias Mavromichalis announces to Arnaoutoglou on March 23rd 1821 that the castle of Kalamata is surrounded by Greek forces and the wisest thing for him to do is to resign. Arnaoutoglou realizing the situation surrendered and the city of Kalamata was liberate on the same day.

3   The Application

Since the first major connection of mapping to a specific event, that took place in 1854 when Dr. John Snow connected the cholera spread in London by mapping the way the epidemic moved spatially, visualizing data spatially has developed into its own scientific field. In the 1960s mapping was digitized, coordinates were stored on mainframe computers, and map graphics were the output via line printers. By the 1980s GIS had evolved into a multileveled tool available to a vast number of scientific fields. By analyzing data through space and time, either it be population fluctuation, property allocation or crisis prediction, GIS offered a unique spatial visualization. Archaeologists acknowledged quite early the role of GIS in data collection and management and in the 1990s GIS turned into a significant tool for archaeologists providing spatial and temporal analysis of the archaeological information and later on combined with remote sensing and modeling technologies. GIS in collaboration with location based application software provides a friendly, digital platform in a technologically innovative manner for the management and enhancement of archaeological and cultural heritage environments thus enhancing our understanding on temporal and spatial interactions [5, 6]. Through mixing digital technologies, web applications and GIS with the field of Cultural Heritage Management, the upcoming field of virtual – digital cultural heritage emerges. The use of technological means to present, sustain and conserve cultural heritage, whether it be visualization strategies, teaching tools or marketing features, is achieved through the integration of modern technology with existing tools [7].

In the case of the Kalamata 1821: Roads of Freedom project, "Kalamata Action Map" focuses on the city of Kalamata and its surrounding villages in a maximum radius of 60 km. This wide area includes the western Mani villages, east of Kalamata, as well as the villages west of Kalamata, such as Messini, Eva, as well as the Taygetos villages to the north. The maps for the application where created using GIS software,

ArcGIS. In order to correlate between the 19th century landscape and the present geography two historic maps of the area were used. These maps provided a base for villages and city names as well as road networks of the early 19th century, and the means to create trails, transportation routes and to determine the "hidden" routes used before the revolution. Many such pre-revolutionary roads can be recognized even today in the area at the foot of Taygetos mountain overlooking the Kalamata shoreline, the Messenian Gulf (Fig. 1).

Fig. 1. Southern Greece, with the adjacent Islands, A. Arrowsmith (1828) [II] [8]

The routes, trails and points that were imported to ArcGIS create an image of communication, commercial networks and transportation routes. By placing these historic points on a modern map of the area an alternate aspect of the world is laid open to the user. Routes following historic roads and trails for commerce or even for the march to the liberation of Kalamata can be relived and visited. These routes offer users the opportunity to physically follow the footsteps of the past incorporating visual aids such as pictures, paintings, videos etc.

From the development of the maps used, based on the bibliography, the Greek forces taking action in the March 23rd events, moved through coarse terrain in the area surrounding Kalamata. The largest distance was covered by the Mani clans 57.8 km via Kardamyli to Kalamata. The liberating forces surrounding the Castle and Center of Kalamata holding defense lines at Tourles Hill 560 m NE, Koumari Hill 710 m N, Nedontas Bridge 350 m W and Fragolimna Hill 245 m SE (Fig. 2).
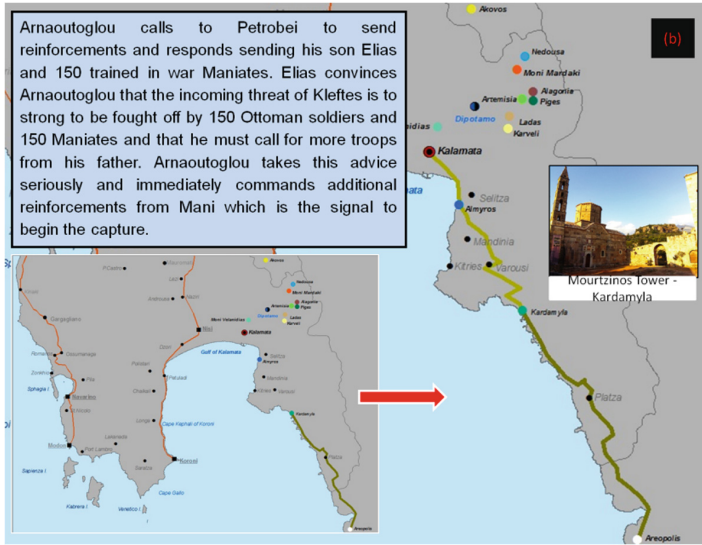
Fig. 2. Screen portraying the route the Maniates followed to Kalamata.

"Kalamata Action Map" presents points of interest situated on a basemap providing the platform for additional information regarding the spatial data to be presented. The integration of the GIS spatial analysis to the website was realized using HTML, JavaScript and CSS (Cascading Style Sheets) for web applications. Specifically, open source libraries were incorporated into the website's HTML code for the app page. CSS provides the necessary stylization for the pages (colors, background, alignment etc.) and Leaflet's open source JavaScript library provides the necessary tools for the map implementation. Leaflet supports most mobile and desktop platforms, the libraries used where adapted to the parameters needed for the "Kalamata Action Map".

```
<html>
<head>
 <title> Καλαμάτα 1821 - Δρόμοι Ελευθερίας </title>
 <metahttp-equiv="Content-Type"  content="Text/html;
charset=ISO-8859-7" />
 <metaname="keywords"  content="Kalamata1821, Kala-
mata, history" />
 <meta name="description" content="..." />
 <meta name="robots" content="follow, index" />
 <meta  name="copyright"  content="Laboratory of Ar-
chaeometry     -     University    of    the    Peloponnese
(http://ham.uop.gr/en/research/labs/archaeometry)" />
 <meta    name="author"    content="vayiap@gmail.com
(Vayia Panagiotidis)" />
 <link rel="stylesheet" href="leaflet.css" />
 <script src="leaflet.js"></script>
```

```
  </head>
  <body>
   <center>
          <table id="logo_menu" width="90%">
          <tr>
                  <td><img  src="images/logoK21.jpg"
style="width:89px;height:78.5px;"></td>
                  <th  style="color:#6699ff;  font-
family:Arial; font-size:22px;">Ιστορία</th>
                  <th><a  href="culture.html"  tar-
get="_self" style="color:#6699ff">Πολιτισμός</a></th>
                  <th><a
href="traditionalpaths.html"          target="_self"
style="color:#6699ff">Διαδρομές</a></th>
                  <th><a  href="events.html"  tar-
get="_self" style="color:#6699ff">Δράσεις</a></th>
          </tr>
          </table>
   </center>

   <center>
          <div id="mapid"></div>
   </center>
   <br>
   <center>
          <div                        id="espa"><img
src="images/logoESPA.jpg" height="10%"></a></div>
   </center>

   <script>
          var              mymap              =
L.map('mapid').setView([37.040, 22.117], 14.5);

   L.tileLayer('https://server.arcgisonline.com/ArcGI
S/rest/services/World_Imagery/MapServer/tile/{z}/{y}/{
x}', {maxZoom: 18}).addTo(mymap);

          var  marker_1  =  L.marker([37.04458266,
22.11402595]).addTo(mymap);
          mark-
er_1.bindPopup("<b>ΙερόςΝαόςΑγίουΙωάννη</b><br><a
href='images/thumps/           ai_giannis.html'
target='_blank'><img       src=images/ai_giannis.jpg
height=20%></a>").openPopup();

          var  marker_2  =  L.marker([37.04429066,
22.1162169]).addTo(mymap);
          mark-
er_2.bindPopup("<b>ΙερόςΝαόςΥπαπαντήςτουΣωτήρος</b><br
><a   href='images/thumps/  naiskos_ypapantis.html'
target='_blank'><img  src=images/naiskos_ypapantis.jpg
height=20%></a>").openPopup();
```

```
            var   marker_3   =   L.marker([37.0435481,
22.11302076]).addTo(mymap);
            mark-
er_3.bindPopup("<b>ΙερόςΝαόςΑγίωνΑποστόλων</b><br><a
href='images/thumps/          agioi_apostoloi.html'
target='_blank'><img   src=images/agioi_apostoloi.jpg
height=20%></a>").openPopup();

            var   marker_4   =   L.marker([37.046354,
22.116767]).addTo(mymap);

    marker_4.bindPopup("<b>ΚάστροτηςΚαλαμάτας</b><br><
a        href='images/thumps/kalamata_castle.html'
target='_blank'><img   src=images/kalamata_castle.jpg
height=20%></a>").openPopup();
    </script>
    </body>
</html>
```

[Excerpt from code written in History.html file]

Our approach to presenting the liberation of Kalamata through the Action map comprises of a base map centered on the castle of Kalamata and its surroundings were the city center was, before, during the ottoman occupation and the years after the liberation. As the city was fortified most of the houses, of the small rural type one next to another following the ground shape, some of them still inhabited today, were enclosed within the fortification. Economic improvement from the 18th century established a Greek "elite" that built great luxury houses outside the walls, such as the tower-house of Panagiotis Benakis, a rich and powerful man who had a significant role in the Orlov revolt. After the failure of the Orlovs, his tower-house was demolished by the Ottomans, but not his family chapel "Taxiarchaki" still existing in the Mavro-michali Square. Another important building of that period, located south of Ypapanti church near the castle, shows a typical rural architecture were small blocks of stones are bind with any kind of material in an asymmetrical way. The house belonged to the Korfiotaki family and later became the residency of the local Ottoman ruler Souleiman Arnaoutoglou. After the liberation, the square of Ayioi Apostoloi chapel became the city center were today all celebrations for the liberation take place and were a lot of neoclassical buildings of that era still remain [9].

The Map is organized into four sections or themes, History, Culture, Routes and Activities (Fig. 3). Each section includes its own map with selected relevant points and their connection. Points are initially collected using GPS and include the locations in the area that have been selected to present the story of Kalamata from the four different aspects. The points are clickable; on first click a balloon window appears containing a thumbnail and short description of the site. Additionally, the points work as hyperlinks to other pages where relevant information regarding the location and visual aids are presented [10, 11].

Fig. 3. Screenshot "History" tab "Kalamata Action Map"

The "Culture" section provides a compact review of the areas that play a part in molding Messenian culture from the 19th century to the present. A visitor can learn about ceremonies, traditions, trade and financial practices etc. Similarly, the "History" tab provides historic information of the period (Fig. 4). "Routes" and "Activities" are innovative features, creating in the first case actual networks connecting points of interest depending on the visitor's interests. For example, if someone wanted to hike the route the Mani clans followed from Kardamyli to Kalamata they would check into this page and click Kardamyli which in the Routes page is linked to the trail from Kardamyli to Kalamata as travelled in March 1821. "Activities" will provide insight over the area's map on events, concerts, reenactments etc. all connected to the Kalamata 1821: Roads of Freedom project.
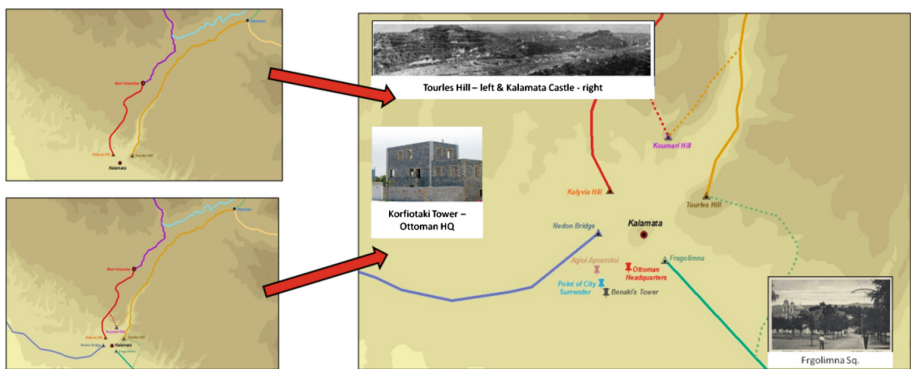

Fig. 4. Screen presenting the routes from Taygetos, West Messenia and East (Mani) and forces that surrounded the city.

4   Future Aims

Presented above is the evolution of the topobased application as initially given in short at the 42nd International Symposium in Archaeometry [12]. The implementation focused on only the GIS maps and the data they produced such as distances covered by the Greek revolutionaries. The goal is to create an overall application that will contain the data previously mentioned but will also incorporate further visual and simulative digital tools. Images will be enhanced with 360° image viewer, augmented reality for specific uses for example people praying in the Ayioi Apostoloi chapel or a view of the castle gate. Documentation will be enriched from the results of the historic research of the Academic team of the Kalamata 1821 project.

The potential seems endless when using digital technologies in cultural heritage. The Kalamata 1821: Roads of Freedom project aspires to become a paradigm for relevant projects not only in projecting historic information but by making that information come alive and make the reader, visitor, and student part of the experience.

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