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Mobile-GIS as a Solution for the Archaeological Survey – Evaluating QField Field Survey in Syria (ʻĀṣūr and Bjamʻāsh)

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Abstract: QField is a mobile version of the desktop GIS program QGIS, customized for the Android platform. The expansion in the use of mobile devices that support the Global Positioning System (GPS) and data collection applications has led to the reliance on the digital recording mechanism, including the use of mobile GIS applications, as it provides broad access to visualization and recording tools, which makes decision-making and interpretation in the field more coordinated and comprehensive through the team. That allows applications to synchronize GIS-based fieldwork between the computer and the phone or tablet. Mobile-GIS eliminates the separation between data capture and a GIS.

Keywords: Archaeological survey, GIS, Mobile-GIS, GIS Collector, QField, Fieldwork, ʻĀṣūr, Bjamʻāsh.

1.0 Introduction

The interdisciplinarity of archaeological research involves an analysis of the data collected in the field, not just systematic excavations and surveys, and if the archaeologists become aware of the specific pitfalls and potentials inherent in the archaeological data and research process, they will be able to harvest the full potential of GIS or any other spatial technology.

Using the geographic information systems in archaeological research is considered a decision- making tool in many situations

and prohibits to a large extent the loss of information or mitigates it, which in turn affects the study of archaeological sites, as it is an important and essential tool that contributes to management, planning, and implementation as well as the protection of cultural resources through Obtaining and preserving data at historical sites.

With the development of work in archaeology, the need for data logging and mapping has increased primarily when used directly at the excavation site, and this is what GIS offers in this field because it allows immediate access to the data collected for analysis and visualization as a separate study and can Combine it with other relevant data sources to help better understand the site and its results.

The survey at ʻĀṣūr and Bjamʻāsh sites in Ṣāfītā provides a case study for the program utilization. The performance of the program is evaluated about

- Preparation and pre-processing of the data
- Data collection and fieldwork
- Data export and processing.

This paper aims to present the definition of GIS and Mobile-GIS as one of the technologies increasingly used in archaeology and its multiple uses in the archaeological field, the most important applications used in archaeological fieldwork, and the main benefits of using the Mobile-GIS such as saving money, boosting data accuracy, Real-time location intelligence, Synchronizing changes offline, etc. with a case study in Syria (Ṣāfītā: ʻĀṣūr and Bjamʻāsh).

2.0 What is GIS?

A Geographic Information System (GIS) is a technological tool whose function is to deal with and extract geographic data. The information system contains organized elements that work together to perform the system's function. These elements include the geographic data of the system center and the information derived from it, Software that stores, retrieve, analyzes, manipulates, and represents data and information, Hardware used to run this software, Methods used in the analysis and processing of such data, and finally, individuals, both those responsible for the management of the system and users of its products.

If we want to describe the history of the use of GIS in Archaeology, it was a big start in the 1980s and early 1990s, followed by severe criticism in the late 1990s, to coming back again strongly in the late 2000s, to be currently, an

indispensable research tool for dealing with spatial data in Archaeology.

And what helped its development is the availability of high-performance portable computers and modern topographic instruments (total stations, GNSS receivers, laser scanners) capable of acquiring and georeferencing data of the excavation area, GIS applications have also continued to evolve up to now with the entry of the new techniques and start using the satellites and sensor devices.

Therefore, the application of a GIS is a very useful tool in archaeological sites, which provides many possibilities to the users, such as a connection between all the types of spatial information in one digital map. Thus, it is possible to create a database linking spatial data information to documents or photos (subject data), which any user can access, even if he does not have comprehensive knowledge of such programs.

3.0 What is Mobile-GIS?

Mobile GIS is a miniaturized version of a GIS system, it contains the same major components of desktop GIS (hardware, software, data, applications, and users), but with distinct differences, whereas the components of Mobile GIS are mobile devices as hardware, light GIS software, limited data, and special applications.

A location-based service (LBS) is considered an approach to mobile GIS, a general GIS description that relies on geographic data to locate specific locations of interest. Smart mobiles are characterized by the GPS function, connecting to the Internet and searching freely for the desired location.

The expansion in the use of mobile devices that support the Global Positioning System (GPS) and data collection applications has led to the reliance on the digital recording mechanism, including the use of mobile GIS applications, as it provides broad access to visualization and recording tools, which makes decision-making and interpretation in the field more coordinated and comprehensive through the team.

Many applications operate the GIS on mobile phones and serve various disciplines in field surveys, and the most important of these applications (ArcGIS Collector and QField QGIS) that characterized by smooth handling within the application and the desktop software with the ability to collect geometric data (points, polygons, lines, and polylines) to fulfill most research needs.

4.0 ArcGIS Collector

It is an application from ESRI that needs an ArcGIS license and ArcGIS Online account to use, and for archaeological fieldwork, using the application needs some important steps:

Prepare: Design the layers, create a map in your online account with a basemap, then download that map to the Collector app on the mobile device, and finally record and collect data.

Collect: The Collector can operate in two modes: online by loading the map directly from your ArcGIS Online account via WiFi or mobile data (the syncing occurs in real-time) or offline by downloading a section of the map to the collector for offline editing (after the finish of recording in the field, it can sync of the downloaded map, uploading all edits to their respective layers in ArcGIS Online). Used for Android and IOS.

5.0 QGIS QField

It is an open-source QGIS version of ArcGIS Collector with a very simple interface. One advantage of QField is that all data preparation takes place on your desktop GIS and there is no need to upload anything to an online account. This eliminates many of the problems of the ArcGIS Online transfer process but that means it is essential to pay attention to the QField online documentation about where should store the project folder on the mobile device, at first, we have to prepare the data on the map using the QGIS desktop, package it for QField using QFieldSync which is enabled in QGIS 2.18, and then transfer it to mobile devices with a cable.

QField gives the users full control by allowing projects to be synchronized via USB cable as through the Internet via Wi-Fi or a mobile network connection. Used only for Android.

6.0 The Fieldwork using QField QGIS Application

This research is based on the use of the application of GIS (QField) in mobile devices in the areas of ʻĀṣūr and Bjamʻāsh in Ṣāfītā, Syria, with the aim of a field survey of the lands where archaeological finds are expected to be found.

The project coordinate system falls into World Geodetic System 1984 (WGS 84) UTM zone 36N, EPSG:32636. But before describing the fieldwork stages, I will outline some information about the two fieldwork areas in Ṣāfītā:

6.1 ʻĀṣūr

The town (with its old name ʻĀṣūr, which is still in use by the locals of the area) is

located in the village of ʾAyn al-Jurn in the Ṣāfītā region of Tartous Governorate in Syria. It is an archaeological site that did not has the attention of historical sources, but it obtained the attention of the Syro-Hungarian mission (SHAM) in 2002, where they put the first picture of its history, which was under the control of the Crusaders around 1110, then it was subjected to many Islamic attacks in the

Figure 6.1: The fieldwork area in Safita (ʿĀṣūr and Bjamʿāsh) QGIS map, by the author

12th and 13th centuries and then the large parts of it have destroyed due to earthquakes, the last and most harmful one was in 1202. The mission relied on information about the presence of ruins of an ancient church in the area dating to the Byzantine period, where they found near the expected site remains of a medieval tower (Figure 6.2), many late antique and medieval pottery, tombs, and cisterns.

6.2 Bjamʿāsh

Bjamʿāsh village is located in the Safita region, a defensive tower was found in the north of it, which is supposed to date to the medieval period, this type of structure is generally called "Byzantine reused" and dates back to the middle of the 4th century around 430/AD and reused in the Ottoman period, and after the survey of SHAM in 2002, it was found that the tower was Crusader and its facade and entrance had been robbed. It is a rectangular

structure built of medium-sized limestone that was below ground level and later reused as a tower building above the ground. This confirms that it was two successive layers in height. This tower was directly connected to the Safita tower, according to the optical communication system that was available in that era, which was the smoke and fire system (Figure 6.3). Archaeological surveying in these areas relied on the use of the QField application (QField is a mobile version of the desktop GIS program QGIS, customized for the Android platform). Before the archaeological survey process, a database must be created using the GIS desktop in order to collect various data, whether spatial, digital, sketches, or others, so the advantage of using this database, in the end, is the ability to create queries capable of merging information from two or more tables and displaying them in one table.

Figure 6.2: Burj ʿĀṣūr (ʿĀṣūr Tower)

Figure 6.3: Bjamʿāsh Tower

Therefore, I set up the map and created the important layers (point, line, or polygon) to add the points or to draw the plans or any other data I want to collect

from the field on a QGIS desktop (Figure 6.4), converted and uploaded it to the mobile device, and then in the field, it allows us to view the map, creating GIS layers in a format suitable for smaller screens and simpler to manipulate devices Portable so that I can add data points in the field using the device's GPS (Figure 6.5).

While working in the field, the application helps us to collect a variety of data regarding the type, date, coordinates, and description with the possibility of taking a picture or a video (Figure 6.6.1). We can work on QField as on QGIS where we can query for layers and get the information on each of them. All points were determined through the internal device of the Global Positioning System (GPS) as this survey does not need more accuracy. Nonetheless, in other situations where higher data accuracy is required, any other GPS device (e.g., GNSS, Total Station) can be used to increase the precision. After the survey, we will import the data to QGIS Desktop through the Sync from QField, display it on the map, and analyze the data afterward (Figure 6.6.2).

7.0 Benefits and Drawbacks of Using QField in an Archaeological Survey

The mobile field application is beneficial, which satisfies the desires of field workers as it can replace paper maps printed in the field and act as a dynamic map, with links to office map layers, reducing time and costs, and workforce.

Our work was based on collecting data for the archaeological finds that can be found in the desired location, whether pottery, bones, structures, etc. with the aim of documenting the area and finding out whether it is essential to carry out excavations and what type of finds exist and their importance as well.

Since the season was short and we did not have enough time to study the area in the usual or routine way, we tried to apply mobile GIS to reduce the time and cost of hiring more archaeologists to survey the site quickly, therefore the data is collected in the field and digitized in various layers, whether it is points, lines or polygons, with the required information from the name of the area, point name, number, type, date and a picture of the location as

it was found or the structure and any other information, the platform must also contain basemaps such as Google Satellite, Open Street Map, Orthophotos, etc. All this information is what we prepare on the QGIS desktop before going out to the field and this made preparing for the fieldwork easy and fast as we work on the program in any other project. Still, the difference is that we export these layers to the QField application using the

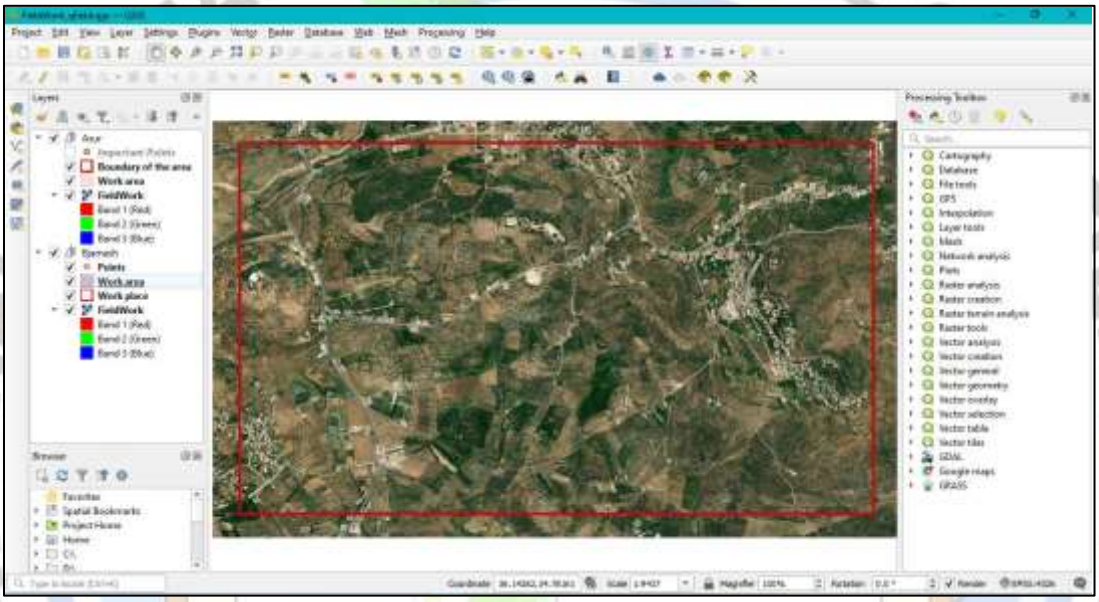

Figure 6.4: Creating the layers on a QGIS desktop.

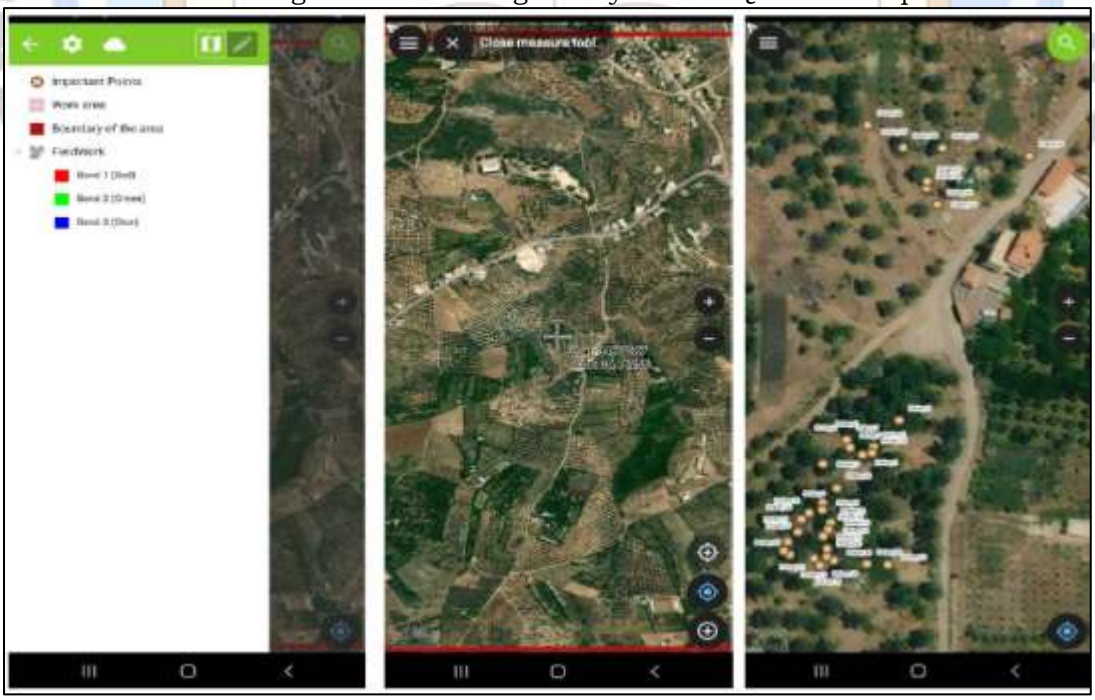

Figure 6.5: QField interface showing the active layer

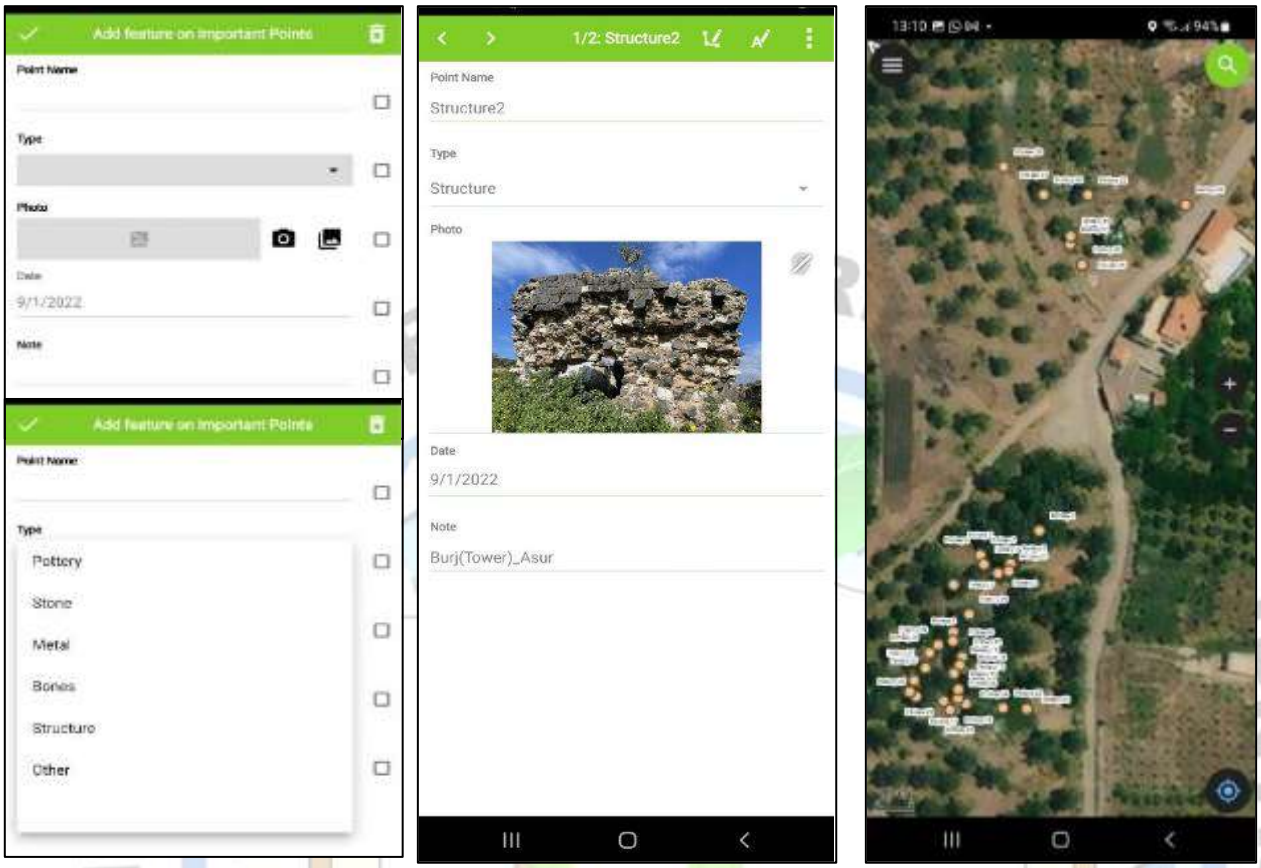

Figure 6.6.1: QField Android App

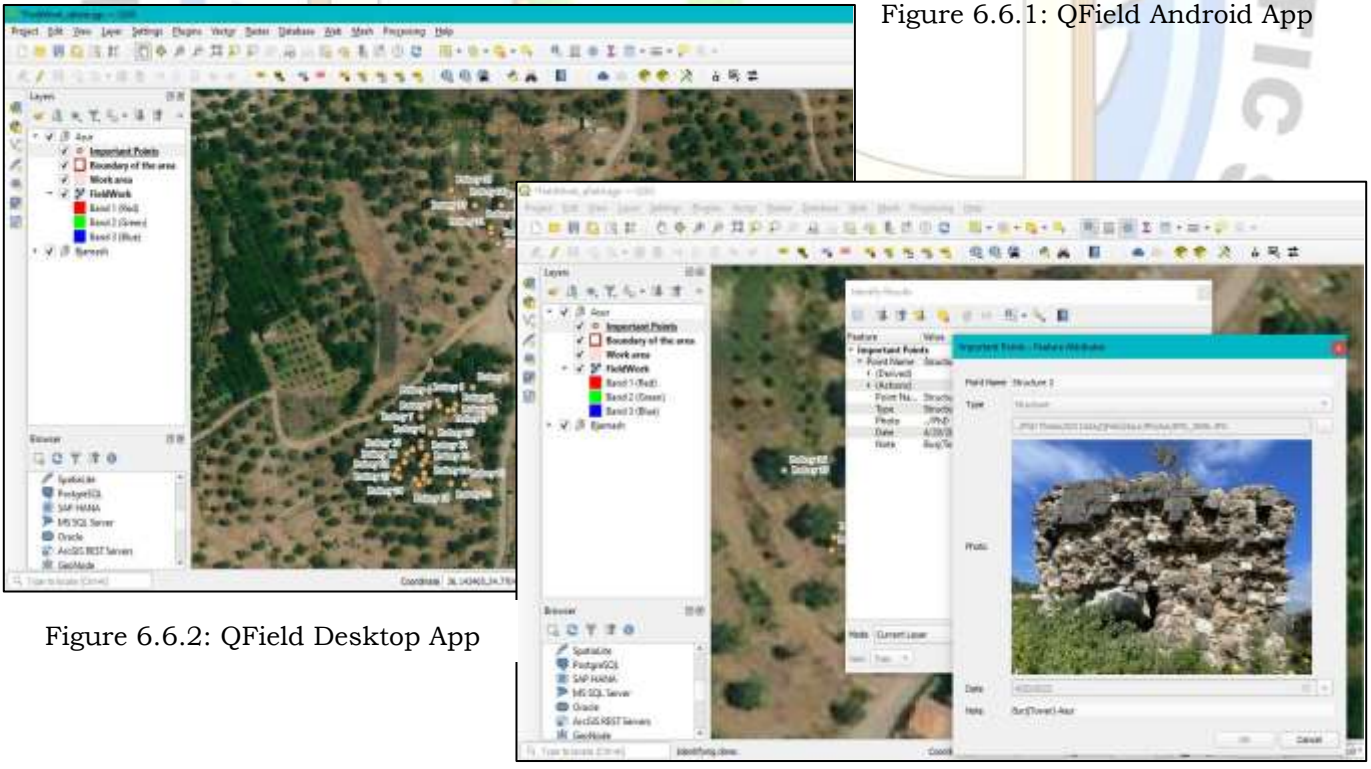

Figure 6.6.2: QField Desktop App

Figure 6.6: Examples of the survey using QField

QField Sync component or simply by copying the data folder to the mobile phone, after the survey, we also copy the collected data using the QField application to the computer and import it to QGIS Desktop through the Sync from QField and display it on the map and analyze the data afterward.

These processes contributed to accelerating the data collection process and reducing the time of work in traditional paper documentation and eliminating the need for additional human resources as a data entry and reorganizing and transferring information to the computer again as it is electronically present automatically and also reducing the error area that could occur during this process.

However, some drawbacks may limit the work of these applications in some cases, one of these problems is related to the lack of the Internet, as this affects the accuracy of the data, we collect using GPS and affects more in the case of using GNSS, besides to the need for keeping the screen and the GPS active during the fieldwork will reduce battery life.

Furthermore, working in some densely green areas that are not prepared in advance for fieldwork affects the accuracy of the data, especially in cases of drawing sketches or maps due to the inability to see the ground of the site clearly, and this is what we suffered in the areas of our research because the work was in the spring and the sites were not equipped to excavate, it was only to study the area initially.

Conclusion

GIS is not simply a computer software package, but a continually expanding set of technologies. Geography, time, and culture are key factors in the development of historical events, which is what archeology is looking for. Therefore, the results of archaeological studies are rich in spatial information, and a GIS can store, process, and integrate multiple data sets, and finally, display the data so that the user can visually understand it, making complex analyzes of landscapes possible with high accuracy using the latest technology. Thus, GIS can be considered a cost- effective, accurate, and fast tool. Currently, archaeological excavations are stricter with a limited budget and time. Therefore, the role of GIS and the advantages of its products, especially open source, and pocket applications such as QField, which have a

distinctive role in facilitating work more and increasing accuracy, cannot be ignored.

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