

# THE DEVELOPMENT OF A WEB MAPPING SYSTEM AND ITS APPLICATION

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**Keywords:** Web mapping, Neogeography, Mapserver, e-based systems, Web 2, AspMap, Tracking systems.

**Abstract:** Recently, there is increase interest in web mapping applications due to the increase use of mobile application, GPS, and digital mapping. The change in the web-based communities, applications and services, from Web 1.0 “read” only technologies to Web 2.0 “read”, “write” and “build” technologies opened a new heaven for public usage and applications. Neogeography (also called Volunteered Geographic Information), came with the increase interest in online mapping and in using geospatial technologies in diverse applications. The development started by mashing up various web resources to create maps. This has improved the web mapping/GIS services despite some difficulties. The open source initiative came (Minnesota Mapserver, GDAL/OGR, GRASS GIS and PostgreSQL/PostGIS packages), in order to offer a technically competitive and open-source alternative solution to the commercial software for web mapping and GIS system applications. GIS and mapping software companies have developed certain development kits that could be used to build a complete GIS and web mapping applications at a very low cost, They also offer a large wide library to be used in developing GIS applications. In this work, we used one of these applications (AspMap) in order to develop our web mapping software. AspMap is a set of high-performance Web mapping components and controls for embedding maps in ASP.NET and ASP.NET AJAX applications. AspMap gives the ability to generate maps, thematic mapping, routing, vehicle tracking and other features that are generated on the server to make maps fully interactive on the client-side. AspMap provides the functionality needed by the user. In this paper, we present a new web-based system named, JOFAST, in order to provide desktop navigation (shortest path), tracking, locating land parcels, distance calculation, map creation, among others. The system is flexible, efficient, easy to use and cost-effective and it is in use now in the city of Amman in Jordan.

## 1 INTRODUCTION

The second generation of web-based communities, applications and services (Web 2.0) are different in the ways software developers and end users use the Web (Wikipedia, 2008b). The changes are presented in the creativity, the collaboration, and the usage of the Internet and the Web as platforms (O'Reilly, 2005) so the user can generate and distribute the web contents. Neogeography is becoming popular and it is utilizing various web resources to create maps (Wyngaarden and Waters, 2007). This came due to vast amount of public interest in online mapping and using geospatial technologies in different domains.

A mashup is a website or web application that uses contents or services from many sources to create a new service (Wikipedia, 2008a). Map

mashup has great potential to improve and facilitate the development of the future web mapping/GIS services such as participatory GIS and e-government services, navigation and tracking. However, issues related to privacy and ownership protection are still to be solved.

Developing a mashup in general faces many difficulties (Li and Gong, 2008). These include difficulties in integrating the local data into new applications and the way to use it; protection of intellectual property and consumer privacy versus fair-use and the free flow of information (Merrill, 2006). Other kinds of problems concerning security measures in mashups and the integration of map data sources and services with other types of data sources and services.

What is a mashup? Ramsey stated in (Ramsey, 2006) that “most mashups make use of a base map, a

geocoder, and a Web interface.” Pietroniro and Fichter (Pietroniro and Fichter, 2007) defined a Map mashup as a way to combine map data source or service with added information, often geo-referenced to the map data in order to create a new map.

The statistics of various mashups created up to April 2008 shows that the map-based mashup accounts for around (39%) of all the registered mashups. With the decrease of requirements for programming skills and the increased number of mashup editors and creation tools, creating map mashups have become easier to develop.

The Open Source Initiative (OSI) (OSI - Open Source Initiative) for GIS Software such as Minnesota Mapserver, GDAL/OGR, GRASS GIS and PostgreSQL/PostGIS packages, offer a technically competitive and open-source alternative solution to the commercial software. The OSI is growing in popularity in order to provide the solution to web mapping services using open source GIS software (Song et al., 2004). The OSI allows using, modifying and redistributing the software freely. It breaks the cost barriers to using the public spatial data and the GIS tools in building a large-scale GIS system. As long as people have problems to solve and the spirit to share their solutions, open source will continue to grow and contribute to the geo-informatics community (Ramsey, 2002). The development of OSI software needs to control the interaction between OSI software, the performance of the integrated system and the function limitations. The Mapserver is not a full-featured GIS system, but provides enough core functionality to support a wide variety of web applications and can handle a huge Geodata base (Raghavan et al., 2002).

There has been an increase interest in Web mapping application in recent days due to the many features of Web mapping such as increase use of mobile application, GPS, and digital maps.

Most of the available GIS software has already modules for web mapping. Moreover, these software packages offer the possibility to develop web application using their developing kits. Open source program allows the creation of the web applications, but there is no support for such applications.

Other GIS and mapping software have developed a certain development kits, which could be used to build a complete GIS and web mapping applications. Such development kits have low cost and offer a large wide library to be used in developing a GIS application. We used one of these applications, the AspMap, to develop our web mapping software system.

AspMap is a set of high-performance, Web mapping components and controls for embedding maps in ASP.NET and ASP.NET AJAX applications. AspMap gives the ability to generate maps, thematic mapping, routing, vehicle tracking and other features that are generated on the server in order to make the maps fully interactive on the client-side. AspMap provide the functionality you need to turn the occasional visitor to your site into a regular user. It provides functionality to a local government web site, a real estate web site, a navigation website, a vehicle tracking web site, or to a location-based services.

## 2 WEB MAPPING

Web mapping is the process of designing, implementing, generating and delivering maps on the World Wide Web. While Web Mapping primarily deals with technological issues, Web Cartography additionally studies theoretic aspects such as the usability of web maps, the evaluation and optimization of techniques and workflows, the social aspects, and more. Web GIS is similar to web mapping, but with an emphasis on analysis, processing of project specific geodata and exploratory aspects. Web maps are often a presentation media in web GIS. With time web maps are increasingly gaining analytical capabilities. These days both web mapping and web cartography have to deal with interactivity, usability and multimedia issues.

The use of the web as a distribution medium for maps is a major advancement in cartography and opens many new opportunities (real-time maps). A first classification of web maps has been made by Kraak (Kraak and Brown, 2001). He distinguished static and dynamic web maps and further distinguished view-only and interactive web maps. Cartography was restricted to special groups, requiring expensive and complex hard, software, skilled cartographers and geomatics engineers. The cheap and easy transfer of geodata across the Internet have allowed the integration of distributed data sources and opened new opportunities to non specialized general public to join the web mapping world. Hence, educating the general public about geographic analysis and cartographic methods and principles should be a priority.

In this work, we present a website based on AspMap for GIS applications such as navigation, tracking and map creation. We provided the website with Amman city streets network and satellite image

to allow low cost navigation, Tracking and many other functions such as maps, shortest path, and parcel location, for the city of Amman are provided. The created website can provide more added functions for city planning services. Many other important byproducts such as GIS database for the Jordanian roads network, Amman streets network were implemented for the sake of the website application. The database attributes for the application (shortest path, navigation, tracking, etc.) are based on NAVTEQ Data. NAVTEQ has developed exceptionally rich attributes to give life and intelligence to its database. Navigation uses special attribute data for effective navigation. In all, 204 attributes are organized into 14 categories in order to describe the essential qualities of a map, which are needed to provide useful map display, and enable route planning and guidance for tourist information or to advanced driver assistance systems.

We also used the low price handheld GPS receivers to collect POI to be update the existing data.

### 3 THE METHODOLOGY

The methodology includes two important parts which are the GIS and website creation as described below.

#### GIS Creation:

We start by building a GIS for the city of Amman so that it will be posted on our website for the public utilization in navigation, tracking and parcel locating using ARC GIS professional 9.2 software. The flowchart in Figure 1 illustrates the methodology for the design of the GIS data model. Data collection of all types such as shape files, database tables, satellite images, digital maps, and paper maps, was needed in order to be utilized in creating the needed layers (TIN, Raster....etc.).

The data used has info about: (a) Amman topographic map (scale 1:50000) paper map, (b) Amman satellite image and (c) NAVTEQ data.

Next, we built a GIS system as follows.

- **Scanning:** "Conix" scanner 200dpi resolution and (jpg) Format was used at first. After the maps registration, we found large RMS values and distortion caused by the lens of optics, hence, we rescanned the maps using 400dpi resolution, and got satisfying results RMS (1-3 m).

- **Registering:** The coordinates system of maps is JTM, but our project is based on UTM coordinate

standard, so we transformed the control points (grid) from JTM to UTM using the GeoMedia Professional.

- **Digitizing:** We used the ArcGIS (ArcMAP) in the digitizing process to create the needed layers.

- **Editing:** This is meant to edit errors occurred due to digitizing process.

- **Adding attribute Data to Each Layer:** Here, we added the following attributes: (a) Jordan governorates boundaries, (b) ID; Governorates names, (c) Sub-districts boundaries, (d)ID; Sub-district names, (e) Jordan roads network, (f) ID; Jordan roads network names, (g) Amman streets Network, and (h) ID; Amman streets network names, length, speed limit, ramp, etc.

- **Creating the Road Network:** By using GIS (Asp map) and the needed attribute data we created the road network (see Figure 2) for the website and the application of navigation and tracking. AspMap always loads the road network into memory before doing any calculations.

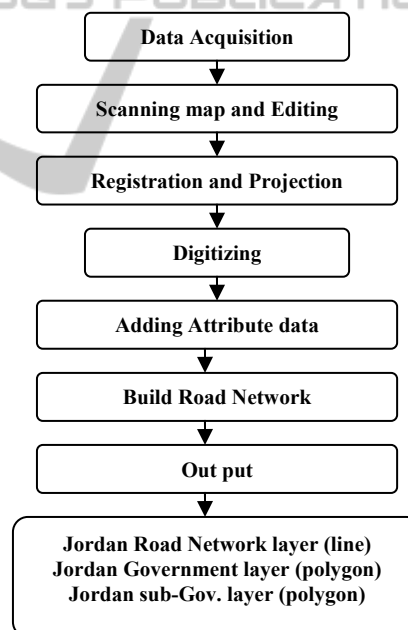


Figure 1: Flowchart of the GIS Methodology.

- **Output Layers:** The created GIS had four basic layers which are: Jordan Governorate Layer, Sub district Layer, Jordan Roads Network Layer, and Amman Streets Network layer

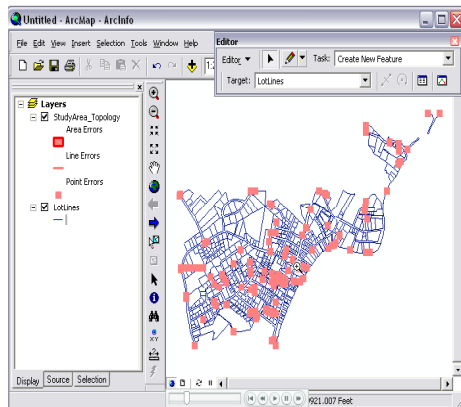


Figure 2: Jordan Roads NetWork.

Start out going North on CURREY RD towards PHILLIPS RD (View)	1.03
1. Turn LEFT onto PHILLIPS RD (West) (View)	1.69
2. Turn RIGHT onto STEVENSON BRIDGE RD (North) (View)	1.51
3. Turn RIGHT onto COUNTY ROAD 95A (North) (View)	0.81
4. Turn RIGHT onto RUSSELL BLVD (Southeast) (View)	0.84
5. Turn LEFT onto COUNTY ROAD 96 (North) (View)	0.08
Arrive COUNTY ROAD 96	
Total Estimated Time: 7.3 minutes Total Distance: 5.96 miles	

Figure 3: Summary of the Quickest Route Report.

#### 4 WEB MAP (JOFAST) CREATION

This is the second and important part of our work. We designed a web site and name it (JOFAST), for Navigation and Tracking applications. The purpose is to serve interested groups, in their geomatics applications at a low cost in a low income country.

We tried to provide our website with some needed and available navigation and tracking functions, in addition to locally needed functions such as parcels location. In the following we will present the different functions:

- **The Shortest Path Function:** For this procedure, we need to select the start point, the end point (using drop-down menu), the unit distance (Miles, Kilometers), the strategy to find Route by typing (Quickest, Shortest), and optional select projection type. Then we click on “find route.” Figure 3 presents the obtained results. If we click on (view) this road will be displayed on the map (Figure 4).

-**Tracking:** Vehicle tracking and navigational systems have brought GPS applications to the life of the public. Automatic Vehicle Locating System (AVLS) (Al-Bayari and Sadoun, 2005), Vehicle Tracking and Information System (VTIS), and Mobile Asset Management System (MAMS), offer an effective tool for improving the operational efficiency and utilization of vehicles. Simple Tracking systems present the concept of tracking systems and works as a simulator to demonstrate to users the meaning of a tracking system and how it works along with its advantages and effectiveness (Figure 5).

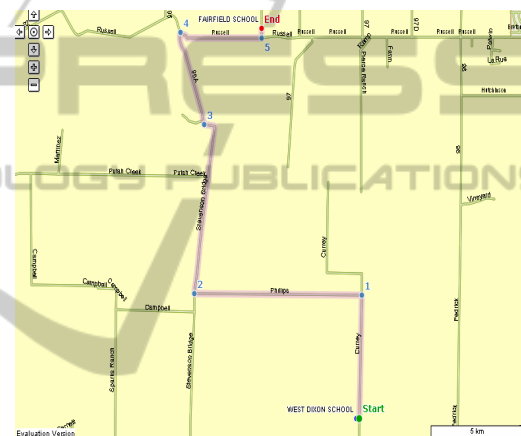


Figure 4: The Shortest or Quickest Route Map.

Our tracking function operation can be summarized as follows. (1) Auto-refresh which means updating the location of the car every interval chosen by the user. (2) Interval to receive location update info which means the update time used to receive location of a car (0.5 sec) means receive location info by (SMS or GPRS) every 0.5 sec. Our tracking system is based on the dynamic layer (GeoEvent function). A GeoEvent is a moving object. Examples include vehicles, aircrafts, and satellites systems. If the user wishes to track and display on the map. Then the GeoEvents in the Animation Layer may be refreshed without reloading the map image. The user can utilize the animation Layer and **GeoEvent** objects to track and display the location of a vehicle in real-time.

JOFAST is our designed website system (Figure 9) for desktop Navigation systems (shortest path); Tracking Systems (simple tracking) and Parcel Searching for the city of Amman in addition to data for the entire world published using AspMap. The

dynamic website, which is connected with an access database, has ability to publish video. It has been used by several groups in Amman.

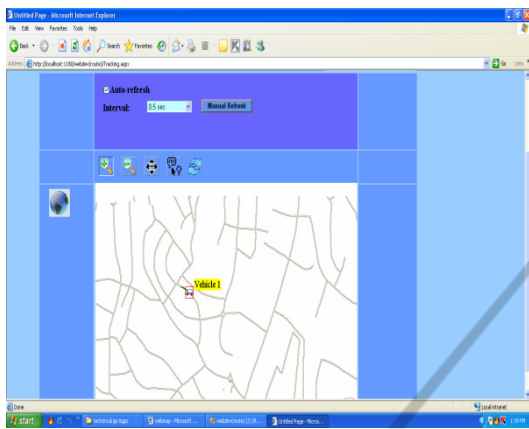


Figure 5: A Simple Tracking System.

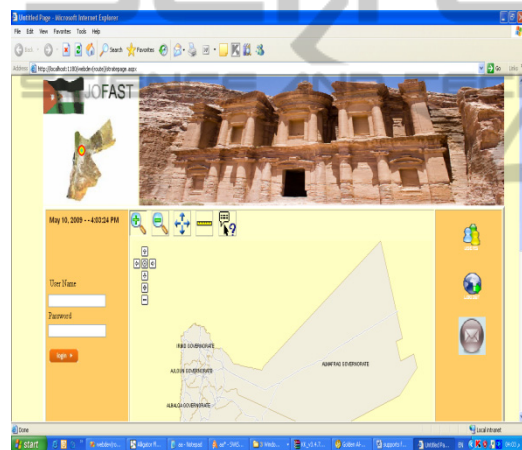


Figure 6: JOFAST Website.

**Website Requirements:**

The major Software requirements are: Operation system, Windows XP service pack 3 Minimum configurations, Pentium, 2.2 GHz, 1GB RAM, Window Server 2003, Frameworks 3.5 and File System. Hardware requirement is any local area network. The website has the ability to define the shortest path, display a map with multiple layers (cities, roads, rivers and boundaries) and display locations stored in a database in addition to navigation and tracking functions.

Functions of the website include the followings.

- **Desktop Navigation:** Figure 7 presents the navigation system in Amman as an application (Shortest path). This webpage includes the type of projection used; Asp Map provides a large number of projections.

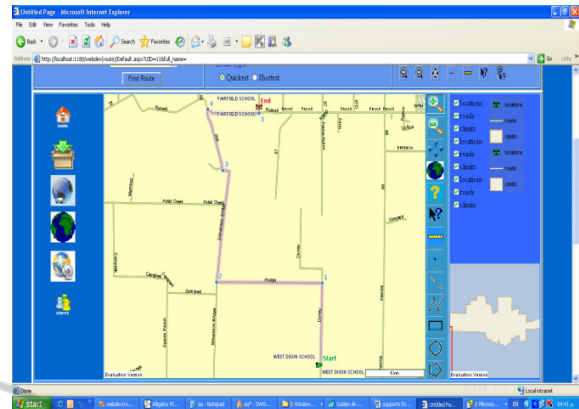


Figure 7: The Desktop Navigation.

**- Tracking System:**

The system is based on receiving the signals from satellites by GPS receivers fixed on the vehicle and connected by a GSM modem. The mentioned hardware sends the acquired data by a Short Message Service (SMS). The SMS carries certain information about the geographic position of a certain vehicle to the control center. Figure 8, presents a tracking system as a simulator on the web site (simple tracking).

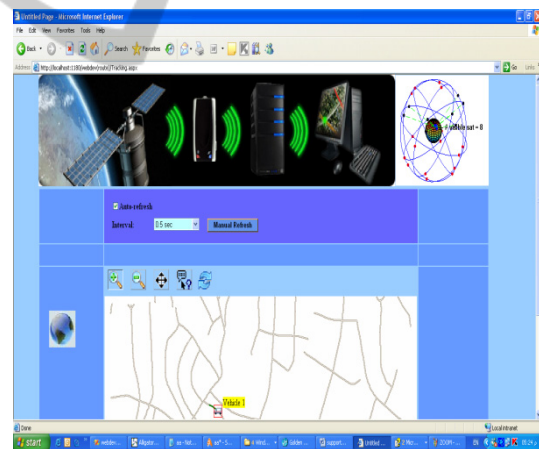


Figure 8: The Complete Tracking system.

Asp Map allows you to display locations of moving objects without reloading the page or the map image (ASP Map uses AJAX to update the locations). The locations should be updated in a Refresh Animation Layer event handler. After the Refresh Animation Layer event handler is executed, further processing of the page will be stopped and the locations will be sent to the browser. To track the location of a vehicle, you need to set the Enable Animation property of a Map control to True position. Use the Animation Interval property to set

an update interval. Add an event handler for the Refresh Animation Layer event. Add the current location of a vehicle to the Animation Layer object of the Map control. You can display the previous movements of the vehicle as a line using the Path property of the GeoEvent class. If the current location of the vehicle is outside the map, you can move the map to a new position using the “Center At method.” After that, you can set the “Need Refresh Map” property of the Refresh Animation Layer Args class to True. This way, the map image will be refreshed without reloading the page. Auto-refresh means update location of the car every interval you choose. The tracking system uses dynamic layer (GeoEvent function). A GeoEvent is a moving object you wish to track and display on the map. Examples of geoevents are vehicles, aircrafts, and satellites. GeoEvents in the Animation Layer may be refreshed without reloading the map image. The user can use Animation Layer and GeoEvent objects to track and display, for example, the location of a vehicle in real-time.

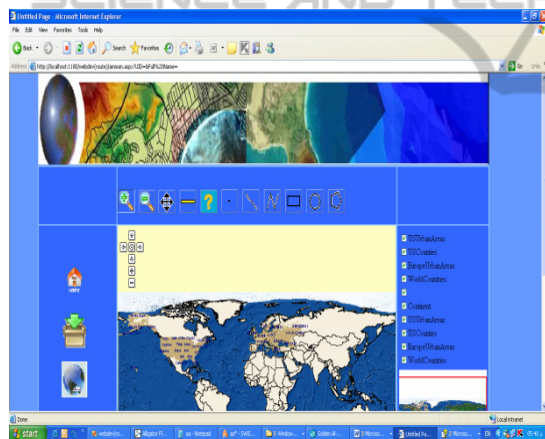


Figure 9: Publish World maps.

### - Parcel Searching

Parcel searching for Amman area means that the website has the ability to search for any parcel and label it in Amman area. If we selected, for example, the parcel number 011200900000296 and click find, the system will zoom into the parcel target and display information about this parcel; see Figure 10.

## 5 CONCLUSIONS

Web mapping and related technologies are developed to enable the normal public to get into the web mapping technologies with simple formation in

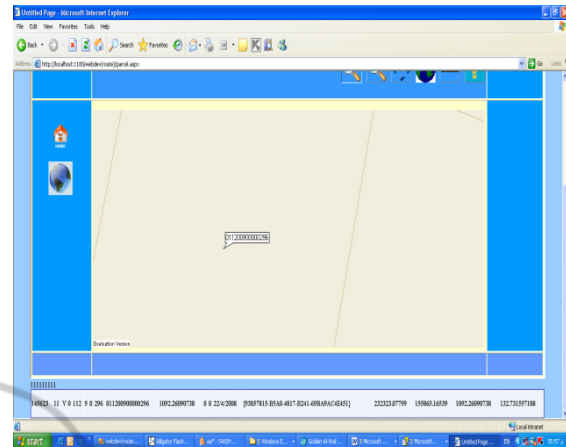


Figure 10: Parcel search in Amman.

cartography and programming skills. This paper presents a system for web mapping based on AspMap component. The map service is a WMS compliant map server that uses a technically competitive solution to serve a large-scale GIS database on the Web. This successful development shows us once more how easy to develop software for local service. JOFAST is a web site (started 2009) to provide different services such as navigation, tracking, parcel searching in the city of Amman and Map creation services in a cost-effective manner.

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