

Design and implementation of a platform for location-based services: a case study of GIS of archaeological and handicraft of Fez Medina

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Abstract

The location-based services (LBS) allow users on the go with access to geographic data from micro-laptops, tablet PCs, personal digital assistants (PDA). These services refer to technologies GPRS2 UMTS3 and can use data on the spatial location of GPS devices in map. This paper presents a platform dedicated to the Medina of Fez, which will be an addition to the Moroccan strategy of development of handicrafts and tourism, called 'Vision 2015 Craft' [1] and 'Vision 2020 tourism'[2] which aims to raise Morocco among the 20 leading tourist destinations. The map used is of the Medina of Fez in SVG, with the language J2ME and J2EE technology.

Keywords : Localisation Based Servie, GPS, J2EE, J2ME, SVG.

1. INTRODUCTION

The location-based services(LBS) has great potential in identifying points of interest to the location on a map as desktop applications or mobile. The design and implementation of these services target geolocation in combination with geographic information useful to provide relevant content to users on the site.

The generalisation of the rich map geographic information in real time meets the needs of specific users [3].

This platform can provide the following services : information on archaeological sites and artisan of the Medina and other information as the query.

This platform will be divided into client and server side. The client side of this software platform is developed on the basis of the following : SVG and JSR179 JSR226 based mobile for mapping, GPS and J2ME. The server side is developed by XML, J2EE, and MySQL.

Fez is known worldwide for its long history, its historical heritage and crafts, culture, where she wowed millions of visitors in recent decades, tourism has continued to grow(almost 1 million visitors per year) has become an important economic factor.

The extension of this type of technology to bring tourism benefits the local economy.

The Medina (old city) of Fez was founded in the eighth century, it was the first site of the country declared world heritage by UNESCO in 1981. Its architecture is particularly rich; archaeological area and crafts, bazaars, mosques, madrasas, tombs and palaces

This document is divided into four sections are organised as follows: the introduction, Section 2 gives a brief explanation of LBS technology and its implementation in the Medina. Section 3 announces the location technique. Section 4 describes the techniques used, the final section detailing the architecture and functions available in the system and finally the conclusion.

2. THE LOCATION BASED SERVICES (LBS)

The location of a mobile agent is one of the important issues of modern mobile communication system.

Location-based Services(LBS) are services to provide information stored in a database. This information can be created, compiled, selected, or filtered in the light of the current location of the mobile user. In each mobile currently the information delivery service has become indispensable. LBS allows us to find the geographical localisation of the mobile device is the GPS coordinates (latitude and longitude), and offer services based on this location information is the current place in the map.

You can now have a mobile device presents the map data where the user will always be the center of the map and the new standards of data vectors will improve and streamline the transfer of map data to a mobile user.

The development of mobile technology has had a significant impact on services and other human activities such as tourism-related activities. Understanding of market opportunities in tourism and the increased demand facing the mobile

business can make the technique of a localisation phenomenon of the day.

Revenues from these services will grow about 25.5 billion dollars in 2008 [4]. The basic idea of these services is to locate the agent on a map and provide the information to choose according to his profile. When the agent is in a location that does not know, his need is to find a place to sleep, eat, also find an ATM to withdraw money. As the tourism sector is heterogeneous, the diversity of information services for mobile users is clearly a question of ease of use and meet all needs.

LBS technology is the intersection between three technologies : information technology and telecommunication (ICT), the mobile telecommunications system and geographic information system (GIS).

LBS adds structure to the real world for the fixed Internet and wireless networks with dynamic content related to the location [5].

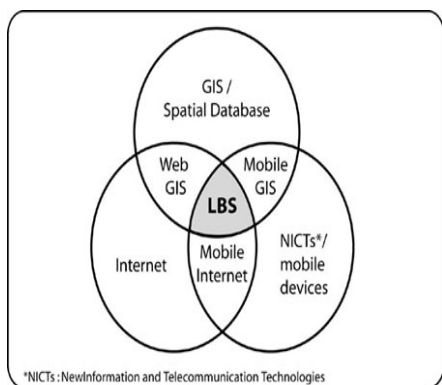


Fig. 1: LBS is crossroads of technology [6]

On the platform there are two different ways to access services LBS :

1) *The initiative of the platform:*

The user sends a request (a text) for information on services in areas near him, or craft and historic areas.

2) *The initiative of the user*

The user registers in advance to receive certain information each time it is close to a place of interest. He can receive the requested information on new items or promotions craft when it is near the place.



Fig. 2: Extract from the Medina map showing the artisanal circuit

2.1 SERVICES

2.1.1 *The service itinerary*

The application helps customers plan their travel, manage their time and reach their destination by describing the exact area.

Subscribers can request the road (text) of their trips.

2.1.2 *The proximity service*

The proximity services allow subscribers to search and/or to identify points in their neighbourhood public interest such as archaeological sites, museums, monuments, handicrafts, car parks, and other public services, etc ...

2.1.3 *Rescue service*

This service enables a subscriber in trouble to call in an emergency to a service that can locate and to provide the necessary assistance. This assistance may cover the following needs: auto repair, medical emergency and police assistance.

2.1.4 *Information on archaeological sites and artisan*

Information on archaeological sites and artisan are also stored in the database server. The requested information is a request from the terminal to the server via the HTTP protocol.

2.1.5 *Hotel Information*

The user can enter the name of the hotel, via a form that will be sent to the server, the server stores it and returns a description sheet with relevant information, including text and images.

2.1.6 *Browsing*

After downloading the map, the user can move the map in the lower left and right, the map data is stored and will be displayed as sub-layers, the user can automatically show or hide certain layers.

2.1.7 *Related work*

Today there are hundreds of sites and mobile applications that offer services based on the current position of the users. These include "Google Latitude" which allows you to specify which one is in real time

geolocate his friends by sending them an invitation in advance. "Twitter" and soon "Facebook" also allow users to share their location. Finally, "Foursquare" or French "Plyce" allow people to identify, from their mobile phone, his friends who are nearby. Users can also recommend and advise on their favorite places such as restaurants or coffee.

The work of this research emphasizes the approach that provides services dominant in a definite place.

3. GEOLOCATION

3.1 POSITIONING TECHNOLOGIES

There are several methods to locate a mobile, which are based on the transmission of certain signals and their reception at the other end. Positioning technology used is selected according to need (e.g. response time) applications. Among the various existing positioning technologies, we have : GPS Global Positioning System: uses a range of satellites to locate the user. This raw information is processed through the terminal or sent over the network to be processed to recover the position. The accuracy of the position varies between 5 and 40m clear sky.

The current position must be to the extent possible, meaningful information is based on the principle of reverse geocoding of translating the GPS data (longitude, latitude) to address human-readable. This procedure for reverse geocoding is limited initially to translate the position based on the available database.

With Java ME a class can receive the GPS coordinates. In fact from the start of a Midlet application contains three text fields to receive the GPS coordinates (Longitude, Latitude and altitude) automatically.

The J2ME API[7] for the JSR179 specification defines a group of options, javax.microedition.location, which allows developers to write location-based applications and services for devices of limited resources such as mobile phones.

3.2 CONVERTING GPS COORDINATES IN SVG

* Convert sexagesimal degrees in decimal degrees.

The geographical coordinates are often given in sexagesimal degrees, ie in degrees, minutes and seconds. However, computers prefer the decimal system and it is necessary to convert sexagesimal degrees in decimal degrees.

Example. Is a latitude of 45 ° 53 '36 " (45 degrees, 53 minutes and 36 seconds). Expressed in decimal degrees, the latitude is equal to :
 latitude = 45 + (53 / 60) + (36 / 3600) = 45.89

General formulation: latitude (decimal degrees) = degrees + (minutes / 60) + (seconds/ 3600)

* Create a scale of data: That is to define the range of min and max GPS that was, and put them in the SVG using a function $y=a *x + b$. In the database, there is a minimum longitude L_{min} and maximum longitude L_{max} . When the minimum and maximum longitudes are known, ranging from -5.004101 to -4.952431 for about Medina and if the map is 500px wide, so just find the values of a and b from the two following equations.

$0 = a * (-5.004101) + b$; $500 = a * (-4.952431) + b$
 This gives $a= 9676.79$ and $b=48423.66$. To place items in the database, it is necessary to apply the function :

$$x= 9676.79*longitude +48423.66.$$

For example, if you have a point with longitude -4.970026, will be placed in 330px on the SVG map.

This small system of equations is sufficient to cover all longitudes in the right place on the map SVG.

The same for the latitude, you can have two functions to link latitude and longitude with height and width of the SVG map.

3.3 DISTANCE BETWEEN TWO POINTS: ROUTE SIMULATION

1) formula of Haversine

The calculation of the estimated distance between the locations of the points is important to manage time and organise itinerary. Haversine formula is preferable to be used in GIS applications, it assumes a spherical earth and does not include the effects ellipsoidal. To calculate the distance between two terrestrial coordinates as shown in Figure 4, the following algorithm is used:

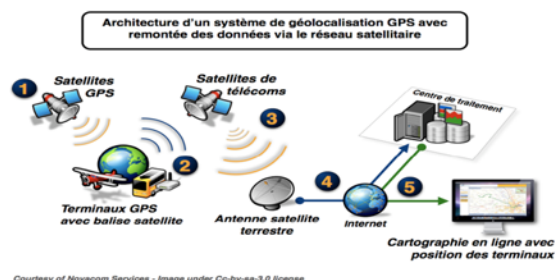


Fig. 3: Architecture of a GPS location system with feedback of data via the satellite network.

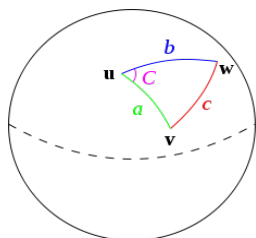


Fig. 4: Spherical Triangle to illustrate the law of Haversine[10]

The expression of Haversine formula is:

$$\text{haversion} \left(\frac{d}{R} \right) = \text{haversion}(\varphi_2 - \varphi_1) + \cos(\varphi_1) \cos(\varphi_2) \text{haversion}(\Delta\lambda).$$

Haversin is Haversine function $\text{Haversin}(\theta) = \sin^2(\theta/2) = (1 - \cos(\theta))/2$

d is the distance between two points (along a great circle of the sphere, see spherical distance).

R is the radius of the sphere (R = 637 100: the radius of the earth in meters).

φ_1 is the latitude of point 1,

φ_2 is the latitude of point 2

$\Delta\lambda$ is the separation of longitude,

On the left side of the equals sign, the argument of the function Haversine is in radians.

In degrees, Haversin (d / R) in the formula would become $\text{Haversin}(180^\circ d / \pi R)$.

We can then solve for d either by simply applying the inverse Haversine (if available) or by using the arcsinus (inverse sinus):

$$d = R \text{haversion}^{-1}(h) = 2R \arcsin(\sqrt{h}).$$

h is Haversin (d / R)

The implementation of this formula in a MIDlet class is as follows:

$$\Delta\text{latitude} = \varphi_1 - \varphi_2$$

$$\Delta\lambda = \text{long}_1 - \text{long}_2$$

$$a = \sin^2(\Delta\text{latitude} / 2) +$$

$$\cos(\varphi_1) * \cos(\varphi_2) * \sin^2(\Delta\lambda / 2)$$

$$c = 2 * \text{atan2}(\sqrt{a}, \sqrt{1 - a})$$

$$d = R * c$$

2) shortest path

The Dijkstra algorithm finds use in calculating the exact itinerary, However the Haversine formula calculates the estimated distance no longer interested nodes, it is a distance as the crow flies. As against this algorithm requires the need of information stored in the database with the weight of the arcs, the distance (the shortest route), the estimated time (for the fastest route), the most cost etc ...

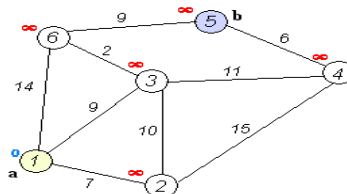


Fig. 5: An example of the progress of Dijkstra's algorithm



Fig. 6: Extract of a route traveled

Assume that L (x) denotes the length between the node 1 to node 5, a Java class dedicated to implement the algorithm returns the shortest path and distance.

The platform provides the shortest route between two places after the entry of the place name, the server can calculate the shortest path and return to the client the exact path. The coordinate information will be added to file SVG to redraw the map and display the path on the terminal screen.

3. 4 IMPLEMENTATION

The architecture can be divided into two main parts: the local client and remote server.

The client manages data visualisation locally on a Web page for the PC or using a MIDlet for mobile phones. The user requests and communication with the remote data server can perform the loading of the SVG file that is the map with the required choice.

The platform includes mobile equipment like PDA or PC and the remote Web server. The Web server forwards the client execution environment for data visualisation. The server responds to user queries by running them itself or by redirecting them to the databases.

To extract data from the map SVG global XSLT processing is done on the server by the Apache Xalan processor, which uses Xerces for parsing XML documents. Servlets are simply receiving the request, invoke the Xalan processor to process and return the answer. In this architecture, the data received by the client are in HTML and SVG.

They are usable with any browser plug-in Adobe SVG Viewer.

Also a Midlet dedicated to mobile devices is responsible to download an excerpt from the SVG global map from the server after authentication.

Another solution is Google Static Maps API is an easy way to provide a map when the user does not have Javascript available. It is not as powerful as the full Google Maps API, but it can provide a base map containing both markers and paths. The basic concept is to generate the image by adding parameters to the query string of the URL. The link of the Google Static Map must be in the form below to respond to the request of the API:

“<http://maps.google.com/maps/api/staticmap?parameters>”

The platform helps to customize these settings.



Fig. 7: Extract image Google Static Map

The Fig.7 shows the creation of a picture of a Google Map centered on the Medina of Fez. The url of the image is :

<http://maps.google.com/maps/api/staticmap?center=Fez,Ma&zoom=13&size=900x900&sensor=false>.

Other Google services implementation of the system is the geocoding to convert geographic coordinates to address.

Geocoding API supports reverse geocoding directly using the following URL :

http://maps.googleapis.com/maps/api/geocode/json?latlng=x,y&sensor=true_or_false
 x is the latitude and y is longitude. The result will be a JSON(JavaScript Object Notation) which later will be analyzed by the server to return a specific address of the current location.

Reverse geocoding is to determine the address of a point on a map. This technique works well in urban areas and in countries well documented (geographically).



Fig. 8: reverse geocoding with Google

4. TECHNICAL

4.1 CLIENT-SERVER MODEL

The choice of J2EE technology enables the development of applications that can distribute and run on a set of platforms.

In this work, the term customer refers to all hardware resources(laptop, PDA, PC ...) and software(MIDlet, Navigator) used by the mobile user to access system services.

The term server is used to name the computer on which the resources are centralised (SVG Map of Medina, Mysql Database,MVC Model-based JSF), That means that data and applications, which accessed by the client.

The user (client) and uses a local application or MIDlet or browser,connected to the network via a wireless (WiFi, 3G, GPRS ...)

4.2 SVG

Scalable Vector Graphics (SVG) is a format that is known to have great potential to play an important role in the visualisation of geospatial data. SVG is a standard language developed by the W3C (World Wide Web Consortium) for describing two-dimensional graphics in XML[9].

SVG is a language for describing two-dimensional vector may havevector/raster graphics in XML.

The W3C publishes two recommendations: SVG1.1 and SVGMobile.

This open vector graphics format extends the multimedia capabilities of mobile phones and handheld computers.

4.3 J2ME

In J2ME, the Java runtime environment is suitable for machines whose capabilities are limited.

In this platform this language creates a class Midlet dedicated to mobile devices at the end to connect to the server and have required result.

HttpConnection class provides the communication link between the client and the server from the programming language and supports J2ME JDBC connection to access the server database, the behavior is one that combines HttpConnection InputStream and OutputStream.

4.4 XSLT LANGUAGE

XSLT (eXtensible Stylesheet Language Transformations) makes the transformation to create a new XML or HTML document from an XML document. It is mainly used to create different views of a document for presentation to a specific user, but it can be used to make treatment more complex. XSLT and XSL-FO is set XSL (eXtensible Stylesheet Language), the language of style sheets for XML.

The transformation made by XSLT file from a global file SVG to file SVG reduced, because of its implementation in a mobile device.

4.5 GPS

GPS (Global Positioning System) is now the preferred tool to position with great accuracy and also serves as a time reference.

The system Navstar GPS (Navigation System by Timing And Ranging-Global Positioning System), commonly called GPS, is a positioning system using satellites. This system is global because it can be positioned at any time and anywhere in the world and its space environment.

Note that the precision HF is only accessible from May 2, 2000.

5. ARCHITECTURE OF THE PLATFORM

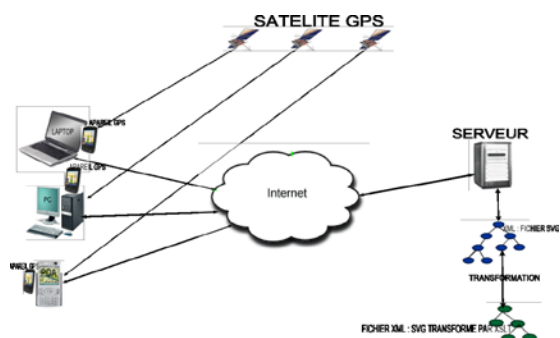


Fig. 9: Platform architecture

The basic concept for the implementation of this work along two axes. The first is to use the new XML technologies in a graphic in a Web environment combining traditional formats and raster images and the other is to prove that this architecture is easily implemented and gives the end-user effective results.

Server: It is in charge of analysing the request and resolve data transferred from the wireless network, and

to seek information from the database, and generate a good response.

Database: It is used to store archaeological and craft of the card and paths, user information and profile, and other geographic information useful for viewing maps with SVG. The data stored in the system consist of two parts:

One is the location information, related to the user coordinates that will be instantly stored in a table at the end of his route and find areas that interested him.

The other is submitted to the user from the database. The data are generated after the user made its request. LBS accepts user data and transfers them to the server, the server executes the query and the answer to the customer from the database.

The server can generate the type of map chosen from the start of Midlet, the extraction is done from a global XML file, this file contains data areas, routes to the destination of the zones and information, hotels etc. All data exchanges between the system and the terminal are based on XML on interaction with a MySQL database.

6. CONCLUSIONS

This platform provides customers with LBS services to mobile customised to its current location. Localisation services will be more important factors in the future. A platform for LBS concept is a development based on the convergence of several technologies including SVG Mobile, J2ME, J2EE, etc.

Localisation performance can be enhanced by the assistance of the provider network and updating of data should also be taken into account in practical application. In this article we have introduced location-based services used in the field of mobile telephony, these services are used to route the archaeological information and craft at all times and make available to the user based on its location.

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