Australian Journal of Basic and Applied Sciences, 5(12): 201-209, 2011
ISSN 1991-8178

Location Oriented Service Frame Work Using Mobile Technology for Tourism Services

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Abstract: This paper portrays the benefits of a location based service framework application deployed in Melaka urban area is a world known tourist destination for its long history and valuables remnants of historical importance, diverse cultures and multi exotic and traditional cuisines where it has charmed millions of visitors since its founding in the 15th century. The proposed Melaka tourism location base service is deployed to substantiate tourism activity to find any nearby venue around the current location of the visitor. This system is specifically designed for mobile phone which supports MIDP 2.0 profile and CLDC 1.1 configuration to run JSR 179 Java Micro Edition Location API due to its capability of handling networking activity in handheld device. The idea of location based service is to find one's own position. This is done along with identification of the land marks that is found nearby. Thus, by advancing location oriented service frame work utilizing mobile technology for tourism services can be the leading step of inauguration newfangled door for further utilization of localization technology in the tourism sector. To investigate and evaluate this phenomenon, two experiments were conducted using simulation mode as well as the real time environment. Simulation mode is conducted on the emulation device and offline mode. In this case the client device is running on the Java Wireless Toolkit and the server is running on local host web server. On the contrary, real mode is conducted on the real time environment, where the client is operated using mobile phone model Nokia E71 and server is operated on an online web server. The experimental results have shown that our proposed model performed well in simulation mode as well as in real world environment.

Key words: Location Oriented Service, Mobile Technology, Tourism Service.

INTRODUCTION

Today, the development of mobile technologies has made a significant impact on services and other related human activity more reliable. The comprehension of tourism market opportunity behind this technology development and the increasing market demand towards mobile activity create a new phenomenon of a mobile localization technique.

According to the European Information Technology Observatory, the number of mobile phone users in reaching 4.4 billion in 2009 and it will still continue to increase from year to year. The combination of wireless and mobile phone technology has become an ideal platform for realizing any kind of today activity. Nowadays, people are tending to carry a light weighted mobile phone today rather than a thick book to guide them while on mobile.

The development of mobile technology has made a significant impact on services and other temporal human related activity more reliable. The comprehension of tourism market opportunity and the increasing of demands toward mobile activity create new phenomenon of localization technique (Brimicombe, 2002). The prevalence of mobile devices with personally identifiable location-based information is in top concerns for 2011.

The basic idea of location based service is to answer where am I? What is around me? Where is it?. When individual find themselves in new environment they are not familiar with, their needs and behavior are easily predicted. People need to find somewhere to stay, where to eat, or to withdraw money from ATM. As the tourism sector is heterogeneous, the diversity of information services for mobile users is clearly a usability issue. How can information be delivered based on their needs? (Purnomo, 2011).

This paper is organized into five sections. Section I gives a brief introduction about the technology. In section II described about the background and related work, section III the listing of research frame methods used in developing the proposed system. Section IV discussed the expermetal outcomes and the final conclusions are drawn in Section V.

Background and Related Work:

According to Virrantaus *et al.,* (2001), location based service is information service accessible with mobile device through the mobile network and utilizing the ability to make use of the location of the mobile device. In research, location based service is considered to be a special subset called context aware services where it can

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automatically adapt the user location to be matched with the database and deliver useful information into the user. User could find location based service application easily in our surrounding such as car, navigation system, electric flier, tracking system and many more. There are many examples of location based service today ranging from information and directory services into commerce location based service.

LBS technology is served in between of some major technology. It is intersection between three technologies. It is created from New Information and Communication Technologies (NICT) such as mobile telecommunication system and hand-held devices from Internet and Geographic Information System (GIS) with spatial database (Shiode *et al.,* 2004).

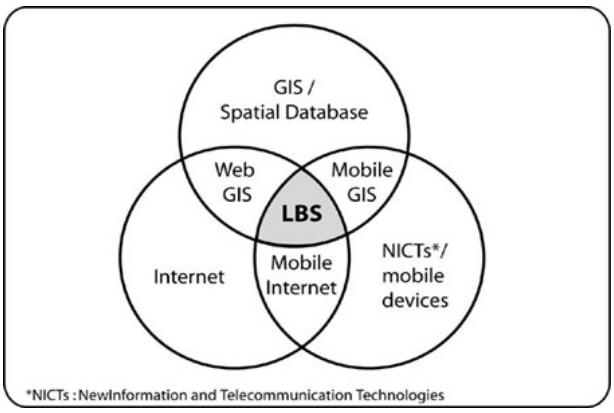
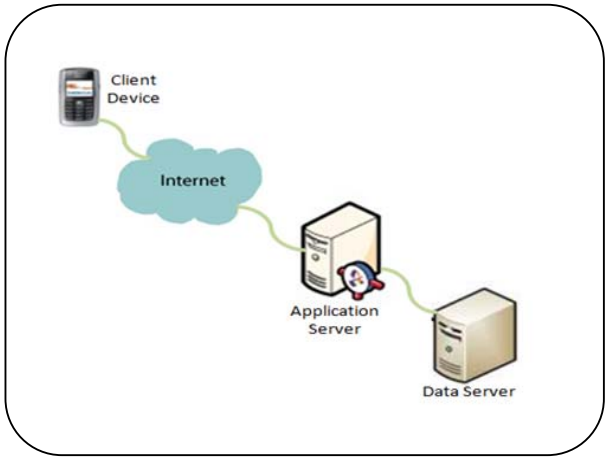


Fig. 1: LBS as an intersection of Technologies (Brimicombe, 2002).



Despite of its popularity of the technology, it is not being efficiency utilized especially for tourism industry. Theoretically tourism world can intrinsically benefit from the use of mobile technology which provides services to travelers on the move since tourism is always identical with location.

Melaka tourism location based service is deployed using a client server environment in projection of the whole system. The client act as system component who requests service and data provided by server, who has resources to be utilized. As the system architecture can be represented as below:

Several frameworks has been successfully developed such as The Location Based Mobile Tour Guide Services towards Digital Dunhuang, LBS application implemented for Dunhuang Mogao Grottoes a world cultural heritage by the Chinese Academy Sciences of Beijing China (China, 2007). The system was deployed for a specific urban area having the same characteristic with the system. The system was developed for the system similarities happened in the system architecture for using J2ME technology as multi threading mechanism, MIDP network programming and JSR 179 Location API.

Research Frame Work:

The location based service basically has four basic components arranged the whole system. They are mobile devices, communication network, positioning component and service provider.

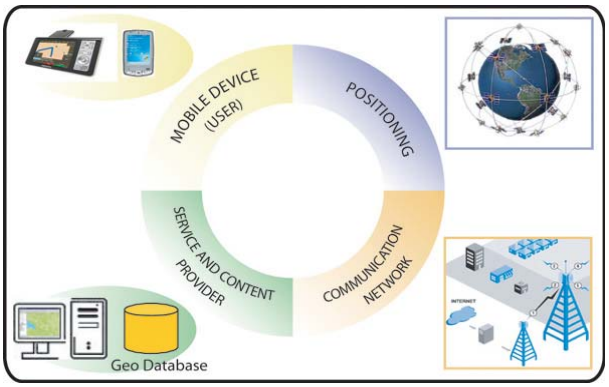


Fig. 3: The basic components of an LBS (Shiode *et al.*, 2002).

Mobile Devices:

A component that a user used to request or received the information or service. The content can be a text, picture, or video. Mobile device is a pocket sized computing device, which having a display screen with input or output control. There are hundreds of mobile devices appears today such as mobile phone, personal digital assistant, pager, personal navigation device, digital video camera and many more. They are brought by the developers with different applications and functionalities to increase human activity efficiency. Mobile phone is might be the most suitable device to be used as LBS implementation due to its comfortable and capability for supporting the requirements. Mobile phone comes in a wide variety of types and models with a different feature inside. The latest modern mobile phone or cell phone carries wide variety of customer tastes and lifestyles. Today phones are completed with fashion accessories and application with their stylish shape to interest customer more, moreover they provide some business and leisure services to the user. There are phones specialized in game such as Nokia N-gage, business activity like Nokia Communicator, Blackberry and fashionist phone such as Iphone. The latest phone generation implemented in mobile phone, the 3G Generation allows user of 3G services to view video content including music video and some real time streaming.

Communication Network:

This component is detailing the mobile network which facilitates the data transfer between the mobile devices to the service provider. In location based service application, the communication network generally represents wireless mobile network that serves two way communications. It collects the data sent by client, transfers it to the service provider and sent back to the client with the particular result based on user information. The existing mobile networks are classified into several categories on the basis of purpose, range and limitation of its waves.

Positioning Technology:

To be able to receive particular service or information, the user position should be determined first. To distinguishing the location based service with traditional wire line applications, it is necessary to understand basic principle of wireless network. The basic function of any positioning method is the measurement of observables object such as angles, velocity, ranges. There are three major positioning methods to discover mobile phone location. The satellite positioning or global positioning system and the network based positioning.

Global Positioning System (GPS) is a positioning method using 24 satellites and 5 monitoring stations all around the globe. It uses a satellite based methodology that is maintained by the US Department of Defense whose primary purpose is to provide global positioning and navigation for land based, swa-based and air based, but it also been made available for commercial use (Jagoe02). The major benefits using satellite or GPS based positioning is the accuracy compared to mobile network positioning. Despite of its high accuracy, GPS has a weak satellite signals because satellites are in high orbit and broadcasting over a large area coverage, this system will not suitable for indoors usage or within area which does not have good signals or in the area where there are bouncing signals off reflecting objects such as tall buildings in the metropolitan area.

Mobile Network Based Positioning is used for devices for devices that do not have integrated GPS chips instead of using Location API to acquire location in terms of longitude and latitude. The advantage of network based positioning over satellite method is the stronger signals and the availability for indoor location. Where it will not be affected by the less coverage effect. There are four main mobile network system that are used worldwide, GSM, WCDMA, CDMA and TDMA. Mobile phone system itself is a network organized in cell around the Base Station (BTS). Base Stations connected to each other using high-speed channel.

Service Provider:

This element is one who offers number of services to user. Such services for searching any nearby point of interest, electronic advertisement and reservation respected to the user location.

Content Provider:

Service provider usually stores and maintains all data and information which can be accessed by user. It might be points of interest spot, banks database and etc. This more likes a party who provides database to the user.

The proposed framework model considered several system components, which are illustrated as follows:

Point of Interest:

Point of Interest or which well known as POI is a specific point location where people may find it useful or interesting. It can be a building, tourism spot, or any related land appearance which people might be going to. There are hundreds of points of interest in each city in the whole globe. Point of interest is represented with unique name to distinguish them with other similar type. Such as restaurant a, or hotel b. Each point of interest can be seen in map by its representing icon, therefore it can be easily recognized whenever to find a categorized item in the map. Point of interest has some components describing their details. It can be a description, an image, or a latitude and longitude. To ease and attract visitor, usually POI put interesting information about their details. Melaka is one of the cities in Malaysia Peninsular who has numbers of POI to be visited.

Location API:

The Location API is compact and generic Java Micro Edition API producing information about the device present location to Java applications. It was developed under Java Community Process as JSR 179. The Location API for J2ME (Java Micro Edition) specifications defines an optional package, javax.microedition. location which enables developers to write wireless location based application for limited devices like mobile phone (Mahmoud, 2004). JSR 179 requires the Connected Device Configuration (CDC) or version 1.1 of the Connected Limited Device Configuration (CLDC) since the CLDC version 1.0 is not capable enough to support floating point numbers, which API uses to represents coordinates. Meanwhile MIDP (Mobile Information Device Profile) version 2 is required to let writing a downloadable applications and service for network connectible mobile devices. The MIDP 2.0 delivers an enhanced user interface, greater connectivity, over the air provisioning and end to end security to mobile information devices [4]. According to the Motorola Developer Network, there are three main features provide by JSR 179 Location API described as follow:

- Obtaining information of device location.
- Possibility to create, edit, store and retrieve landmarks.
- Capability to obtain the device orientation.

The Location API supports the conversion of string representation of coordinates into double representation and vice versa and the calculation of distances. Furthermore, an application can make use of so-called landmark stores for storing, deleting and retrieving landmarks from a persistent database inside the mobile devices. A landmark can be used to represent points of interest and it contains fields for specifying coordinates, address information, a name and a description (Virrantaus *et al.,* 2001).

Haversine Formula:

Calculating the distance between points of locations is often an important component in all variants of spatial analysis in business and research. The haversine formula is a preferred methodology in many GIS applications for common case to minimize rounding errors. It assumes a spherical earth and ignores all ellipsoidal effects.

In order to calculate distance between two earth coordinates as demonstrated in figure 4, the following algorithm is used:

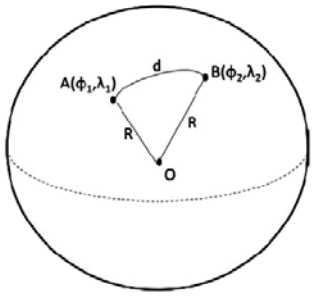


Fig. 4: Distance between two coordinates on sphere.

Given: two coordinates A (φ1, λ1) and B (φ2, λ2), sphere radius R and distance (between A and B) d,

$$haversin\left(\frac{d}{R}\right) = haversin(\Delta\varphi) + \cos\varphi_1 \cos\varphi_2 haversin(\Delta\lambda) \quad (1)$$

φ1 is the latitude of A, λ1 is the longitude of A, φ2 is the latitude of B, λ2 is the longitude of B,

Δφ = φ2 − φ1, Δλ = λ2 − λ1 and haversin(θ) = sin2(θ/2).

So, d can be obtained by:

$$d = 2R \times \arcsin\left(\sqrt{haversin(\Delta\varphi) + \cos\varphi_1 \cos\varphi_2 haversin(\Delta\lambda)}\right) \quad (2)$$

Finally

$$d = 2R \times \arcsin\left(\sqrt{sin^2\left(\frac{\varphi_2 - \varphi_1}{2}\right) + \cos\varphi_1 \cos\varphi_2 sin^2\left(\frac{\lambda_2 - \lambda_1}{2}\right)}\right) \quad (3)$$

d is a distance between two points in the earth in this case is a distance between current location and destined point of information available in kilometers scale.

Connection String:

Melaka Tourism Location Based Service use Http Connection string to provide communication link between client and server since *j2me* programming language have not support JDBC connection to access the database server, the behavior Http Connection is one that combines an Output Stream and exactly one Input Stream. The orders in which the streams are used are important as well. The Output Stream, if used, must be used before the Input Stream. Once the streams have been used the connection should be closed and new Http Connection should be opened to continue communication if necessary. This follows the HTTP request-response paradigm. Mainly there are three states to does an Http Connection they are, Setup Connection, Connected and Closed Connection (White *et al.,* 2002).

Map Retrieval and Reverse Geocoding:

Google Static Maps API is an easy way to provide a map when user doesn't have Javascript available. It is not as powerful as the full Google Maps API but still, it can provide a basic map containing both markers and paths. The basic concept is to generate image by adding URL parameters to the querystring of the URL. The Google API Maps parameters are certain value separated using ampersand (&) character. The basic Google Static Map URL must be in the following form to complete the API request:
"http/maps.google.com/maps/api/staticmap?parameters"

There are several parameters available to be used on the API to customize the map item:
Location Parameters (centre, zoom)
Map Parameters (size, format, map type, `language)
Feature Parameters (markers, path, visible, type)
Reporting Parameters (sensor)

Other Google service implemented in the system is Google Reverse Geocoding API via HTTP request. Reverse Geocoding is a method to convert geographic coordinates into an address. The Geocoding API supports reverse geocoding directly using the latlang parameter.
http://maps.googleapis.com/maps/api/geocode/json?latlng=x,y&sensor=true_or_false.

Where x is latitude coordinate and y is longitude coordinate. The query will result a JSON (Javascript Object Notation which later will be parsed into php file to return a specific address of current location.

Fig. 5: Google Reverse Geocoding.

Show Location Map:

This functionality is an enhancement of the current location functions, it pass the latitude and longitude value into the Google Maps API static image and it returns an image url to convert into a static image. The exact current location is marked with X blue symbols and centered on the image.

Fig. 6: View Location Map.

The Category List:

The category list functionality is listing the existing point of interest category to be selected to filter those points. The category is made based on point of interest type such as hotel, restaurant, office and many more. Any minor category may be found on the others category. This features is addressed to ease the user selecting particular venue sorting by its type.

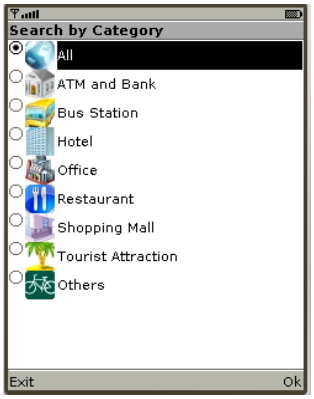


Fig. 7: Category List.

Nearby Point of Interest:

This user functionality is listing names of nearby point of interests inside the radius arranged by distance to current location and based on list group selected on list functionality. This process requires a user interaction to select one of the venue names to view the complete details of it. Since choice element is made exclusively, therefore it only enables selecting one name at the time.

Fig. 8: Nearby POI.

Point of Interest Detail:

After selecting one of POI names available in our radius coverage, it goes into new from describing more details of that point of interest. Each venue has distinguishable details depending on the record added by the administrator. The details might be useful for user to research and gain information about the venue. This feature is one of the additional enhancement have not existed yet in the most commercial location based service application nowadays.

Fig. 9: Detail POI.

Routing Direction:

One of features implemented in Melaka Tourism Location Based Service is routing capability to a specific point of interest from current detected location. The routing functionality is applied using Bing Map REST Services Application Programming Interface (API) provides representational State Transfer (REST) interface to perform task such as creating map with pushpins, geocoding an address, retrieving imagery data, or creating route.

Fig. 10: Routing Direction.

In order to display a static map route the following URL format must be sent.
"http://dev.virtualearth.net/REST/v1/Imagery/Map/Road/Routes&wp.0=a,b&wp.1=c,d&key=bingmapkey"

wp.0 is the current coordinates, wp.1 is the destined coordinates and bingmapkey is the api map registered on the bing service.

Experimental Results:

This section is briefly discussed about the implementation of the system, the test conducted and the obtained results. The application test is conducted in both simulation mode and real mode then comparing both of options in details.

Experiments with Simulation Mode:

Simulation mode is conducted on the emulation device and offline mode. In this case the client device is running on the Java Wireless Toolkit and the server is running on localhost web server.
Client Device: Java Wireless Toolkit CLDC 2.5.2
Web Server : Localhost

Based on the simulation test above, all of the functions are working properly, there is no significant error or late data delivery between client and server side since both sides are located in the same machine.

Table 1: Simulation Mode Testing.

Scenario	Input	Output	Result
Adding POI	POI Information	POI Record	Successful
Edit POI	POI Detail	POI Record	Successful
Delete POI	POI Record	Deleted Item	Successful
Retrieve Location	Present Location	Coordinates	Successful
Show Location Map	Coordinates	Map Image	Successful
List Category	Present Location	Category List	Successful
Nearby Venue	Selected Category	Venue List	Successful
Routing Direction	Coordinates	Map Direction	Successful

Experiments with Real Mode:

Real Mode is conducted on the real time environment, where client is operated on mobile phone and server is working on online web server.
Client Device : Nokia E71
Server : purnomo.abdullahabbas.com

In real mode testing, both client and server are located in different machines; it may results latency in data delivery or minor error due to traffic congestion in internet network. One difficulty arises in real mode when dealing with client device selection since it requires MIDP 2.0 profile and CLDC 1.1 device configuration. Only latest phone series are built with those specifications such as Nokia E Series.

Table 2: Real Mode Testing.

Scenario	Input	Output	Result
Adding POI	POI Information	POI Record	Successful
Edit POI	POI Detail	POI Record	Successful
Delete POI	POI Record	Deleted Item	Successful
Retrieve Location	Present Location	Coordinates	Successful
Show Location Map	Coordinates	Map Image	Successful
List Category	Present Location	Category List	Successful
Nearby Venue	Selected Category	Venue List	Successful
Routing Direction	Coordinates	Map Direction	Successful

Conclusion:

The proposed location oriented service frame work using mobile technology is designed to come up with a framework which leads to practical implementation of location based service in tourism. It assistances a tourist to locate a point of interest, trace out where they are and query the system for directions from a location to another. The proposed system is the first location oriented service designed specifically for Melaka city. Due to its numbers of tourism spot available in the area, it proliferates a demand for virtual mobile technology providing trustworthy information for tourists needed. The system is providing an integrated tourism information with location based technology. It is facile to implement and require low manoeuvre overhead. The identification of location is using the JSR 179 Location API technology. It is capable of showing user location in coordinates, geographical address, as well as a map view. Any nearby point of interest is listed based on its category within the radius coverage. Thus the proposed system developed a reliable design model of Melaka tourism location based service by converting user information into information services. At the end, this research has the potential value for the tourism industry in Malaysia as well as in other countries. Furthermore, it has opened a newfangled opportunity towards the technologically advanced research in the domain of tourism industry entailing mobile technology.

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