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A Service-Based Mobile Tourist Advisor

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Abstract

This paper presents a service based mobile application that assists tourists traveling to a country. The application provides tourists with context-aware information adapted to their personalized requirements. Detecting the real needs of the tourist is based on context management which is a key element in our system – Murshid. Advice to tourists is proposed after sensing the context and a fine analysis of its ingredients. Murshid is designed as client-server architecture and it uses GPS based location to provide a visual aid using UAE map. Murshid is flexible, user-friendly, portable, and support dynamic information. The application offers a set of services to tourists through their mobile handsets, namely: special event notification, sightseeing, weather forecasting, currency exchange, language translation, and location bookmarking and sharing. Each of the services recommends tourism guidance according to the user's context that is constantly changing since we are dealing with nomadic users. The application utilizes different context information to adapt its functionality according to the surrounding environment. This information can be spatial, temporal, or related to the environment. The context model includes the user location, the user profile, the current date, events related information, and user interaction. The paper presents the context model, the system architecture, the services implemented and offered, and an evaluation of the main functionalities of the system. It describes also how the context is managed in order to adapt the system functionality to the changes that may occur in order to react accordingly at the right time, at the right place and for the right person.

1. Introduction

The availability of many interesting Web Services and the rapid development of hi-tech technologies in the Information and Communication Technology field are promoting the emergence of new practical and fashionable means of information management. In particular, the widespread of mobile phones and their acceptance by a large population made it possible for users to get access to specific web services through their mobile handsets in their everyday life. Now mobile handsets are not only used as a mean of communication, they can access the web, retrieve and display images, stream videos, they can take photos and videos of memorial life events, they can be used for tracking people, they are good tools for learning, they are also used to share social information with friends and relatives, and so on. For the tourism industry, the use of mobiles is very attractive in many ways: i) it can really help tourists to get up-to-date information about sightseeing all around the world, ii) it can be used by specific communities to share valuable information and findings, and iii) it can be used as a mean to track tourists by their peers or as a prevention against specific risks. The development of mobile application to assist tourists in their journeys poses many challenges to researchers and developers. The main challenge is for sure the lack of a comprehensive tourist model that can encompass any tourist involved in any kind of tourism activity. Another challenge is that information relevant for tourists is not centralized in specific servers; it is dispersed all over the web. The use of mobiles also poses a challenge; mobile devices offer an attractive environment for information management, however they have inherent technological constraints that need to be taken into account such as the device capabilities (screen resolution and size, memory storage limitation, software constraints, energy consumption), the network bandwidth and the communication cost. Moreover the development of mobile application can be very useful responding to the user's needs only if it is context-aware allowing the user to get fine-tuned information adapted to his context and personal requirements [1]. This requires a system that is capable of sensing the context and reacting to any change that may occur.

The paper presents Murshid a mobile tourist companion that provides guidance to tourists traveling to a country. Murshid has been designed to be used in any country; it uses worldwide web services dispensing information about any country. However, it has been used

only in UAE where many scenarios have been devised to test and validate the system. Among the activities a tourist is interested in when visiting a country is to know the tradition and the culture of the country and also to attend any special cultural or business events. Tourists come from different countries, speak different languages and know different things about their destination; they need to be guided and informed about all the sightseeing places, cultural and business related events, and tourism sites that they may not be aware of. This guidance should be provided according to their interest and preferences and can be accessed anywhere and at anytime. This can be done by managing the user context efficiently and adapting information accordingly. This requires complex context modeling and management in order to provide tourism guidance according to temporal, spatial, and environmental context information [2]. Furthermore, it provides guidance anywhere, anytime and for the right person, since it is designed to be a portable mobile application, which makes it easy to use. The architecture of our system has been designed to embed a wide range of worldwide tourism related web services. These services are proposed to the user based on the current context which is continuously sensed and managed.

Next section gives an overview of related work and systems similar to Murshid. Section 3 presents the system design focusing on the context model used in this research. Section 4 details the system architecture and then in Section 5 we present our application through a set of testing scenarios. Section 6 is dedicated to evaluate the system according to a set of criteria. Last section concludes this work with future research direction.

2. Related Work

The user context is a key element for any mobile system dealing with nomadic users. Context needs to be gathered first and then a fine analysis of its ingredients needs to be done on a continuous basis in order to react to any change. The term context awareness was introduced by Schilit [3]. It refers to the ability of a system to sense the environment where it evolves and to react by tacking suitable decisions or actions. Schilit defines context as "*(…) any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and application themselves.*" A context aware system can utilize contextual information to adapt the system functionality according to the environment surrounding the system. This information can be spatial, temporal, and environmental. Context awareness is becoming more popular for mobile devices, because it allows the information to be obtained anywhere and whenever the user needs it [4].

Applications that can be designed based on the context awareness idea include medical, places of interest, and advertising systems. Each application depends on different context information and provides different functionalities. One example of a context awareness system is presented in [2]. This system provides a learning facility to a learner with different information that reflects the current learning context. This system achieves contextualization using web standards and other context information such as learner profile, device profile, and connectivity profile. Another example of context awareness system is proposed in [5]. This system is designed to provide Muslim users with Islamic information and services according to user context, namely: user location, current time and date, and user profile.

Additionally, there are several systems implemented for the purpose of tourism guidance that use context models. In [6], the authors describe a system that provides information to the user about a specific preference. This system employs user location, time, speed of travel, direction of travel, personal preference, and device type as the context information. Moreover, this system is a web service-based system, which can also be accessed by a phone browser. On the other hand, the system proposed by Hinze and Buchanan [1] provides information about recommended sightseeing. The context information in this system includes the user location, current time, interest, and sights which comprise the information of the sight location, sight type, and the sight similarity to other sights. Additionally, the user interest in this system is captured from the user personal profile, the travel history, and the user feedback on history. This system is implemented for use on PDAs. Another system described in [7] provides information about attractions and key buildings in a given area, and it uses the interest, current location, attractions that are already visited, time, and opening times of attractions. This system is implemented for use on pen-based tablet PCs. Another pervasive prototype application that exploits context awareness in the tourism industry is the Cyberguide system [8]. This system uses a PDA to imitate the services of a human tour guide when visiting a new location. The system tries to replicate a human tour guide through the use of mobile device with the help of ubiquitous positioning and communication services such as the Global Positioning System (GPS). Also the system uses a history of past locations to provide services that resemble those expected from a real tour guide. SPETA [9] is another social pervasive real-time e-Tourism advisor. SPETA uses context aware information in the form of the user's current location, social network profile and preferences, as well as history of past locations in order to provide the

services that the tourists expect from a real tour guide. The system uses a server manager that interacts with a service locator, a reasoner and a social network. It also uses e-tourism ontology to integrate tourism specific domain concepts and recommendation characteristics. A framework for Personal Tourist Guide (PTG) system based on Service Oriented Architecture (SOA) is proposed in [10]. In this system service brokers collaborate to find the right services in response to a tourist request based on his context. The system uses 4 components namely: Rule-base for decision making, GIS engine for context analysis, Context manager for collection and deriving context data, and SOA connector to transfer the information between the GIS and the PTG. A simple case study is provided with some parts of the PTG not used. A social context information dimension to tourism is introduced in a context aware mobile tourism guide in [11]. This system provides group sightseeing and involves some social network's members in some tourist activities such as sharing photos or buying a souvenir.

An evaluation framework of context awareness mobile applications is presented in [12]. This framework is characterized by two orthogonal dimensions, comprising context and adaptation, and the mapping in between represented by the notion of customization. The evaluation is applied to some of the system described previously and some other similar systems. For more details about the evaluation and its conclusion the reader is referred to the original paper.

The system described in this paper is also based on context modeling; it provides a visual guide using a map (Google Map), and it is a location-based context aware system as it contextualizes the current user location as a part of the user context. Additionally, the system uses the current date, the user interest, user occupation, and spatial and temporal information of events that take place in UAE. It senses the context information during the user's interaction with the application through the navigation in the provided map. It also provides many tourist information services on request from the tourist such as weather condition status and prediction, currency exchange rates, language translation, as well as some UAE culturally focused services such as sightseeing locations sharing, automatic and on demand UAE events notification, prayer times, Qiblah (Mecca) direction.

3. System Design

The system is designed to be flexible, user-friendly, portable, and to support dynamic information. The application is developed using Java Platform, Micro Edition (J2ME) [13] so that it can be used on different mobile phone devices. In addition to that, the application has the visual aid of a UAE map (Google Map using J2MEmap API), which makes it easier for the user to interact with the application. Additionally, since the system is designed as client-server architecture, both the client side and the server side gather the context data elements. The server side uses a database that stores all the context data for the purpose of context analysis.

3.1 Context Elements

The application senses the user context, analyzes it, and provides guidance accordingly. It utilizes different context information to adapt its functionality according to the surrounding environment. This information can be spatial, temporal, and/or environmental information. The context model in our proposed system includes the following elements: user location, user profile, current date, weather status, events information, and user interaction [14].

1- *User location*: The user location can be the user's current GPS location or the location of the user navigation in the map provided, according to the user necessity. The mobile phone device being used is assumed to have a built-in GPS receiver or connected to an external GPS receiver. Otherwise, the context reasoning will rely only on the location of the user navigation within the provided map.

2- *User profile*: The user profile is a set of personal data about the user. The profile includes the following information: user occupation, interest, duration of visit, preferred currency, hometown, and native language. This information is entered by the user once after installing the application; it can be updated at any time. A database residing on the server side stores all details of the user profile. This is done for the purpose of minimizing the storage requirement in the mobile phone device, and to make the user data accessible using any mobile phone device hosting the application.

3- *Current date*: The date of the mobile phone device which is used to identify the current date so that the application is able to analyze the context and provide guidance for ongoing events.

4- *UAE event*: The event information consists of event location, event type, and event start date and duration. Event information is retrieved from official sites of UAE events (e.g. www.dsf.ae) and stored in a local database in the server to be analyzed and compared to the other context data.

5- *User interaction*: The application monitors the user interaction with the provided map through the navigation and with the services list provided.

3.2 System Services

This system continually senses the mentioned context data, and then analyzes it to provide a set of services to UAE tourists, which are; special events notification, location search, hotel location, weather forecasting, sightseeing locations, currencies exchange rate, language translation service, location sharing service.

1- *Special events notifications*: The application provides the user with a notification of special events. These events need to match with the tourist profile in which case a notification is displayed to the user. Examples of UAE special events are the yearly worldwide GITEX (Gulf IT Exhibition), and the yearly Dubai Shopping Festival (DSF) that attract people from all over the world. The notification is given according to the current date, weather status, events information, and the user profile details such as the user occupation, interest, and the tourism period.

2- *Weather forecasting*: A Two-day weather forecast is displayed to the user. The forecast is for the city where the user is located. The weather forecast depends on the current date and the user current location, i.e. the current city the user is visiting. The weather information is retrieved from Yahoo weather services [15], it is filtered and then displayed in a convenient way to the user.

3- *Currency exchange rates*: According to the user preferred currency specified in the profile, the current exchange rates to and from UAE currency (AED) and the tourist preferred currency is retrieved to the tourist from a web service provider [16].

4- *Language translation service*: A translation service is added to Murshid, so the user can translate between the user language to and from English. This service is based on Google translator that is available online.

5- *Location bookmarking & sharing service*: The tourist can share his findings of sightseeing or any interesting places by sharing the location that he/she is visiting with other tourists. Accordingly, any user within a specified group can have access to this bookmark on the map in order to visit that location. Murshid provides the tourist with shared locations according to their interest.

4. System Architecture

The architecture of the system is presented in Figure 1; it includes the server-side and the client-side components which communicate through the GPRS/WiFi network. In addition, the system has access to a set of Web Services achieving a variety of specialized tourism services.

On the client-side the Interaction Manager (IM) listens to user's initiated requests and invokes accordingly the right service. Additionally, the IM manages the graphical user interface on the user's mobile handset by displaying all the information in a consistent and fashionable way. The server-side includes three modules: the Context Manager, the Reasoning Engine, and the Display Composer which are described in the following sections.

4.1. The Context Manager

The Context Manager (CM) is the module in charge of delivering a consistent user context to the reasoning engine for further processing and action taking. CM senses the current context by gathering four context elements: the user's profile, the mobile handset specifications, the current user's location from the Global Positioning System (GPS), and the current date and time.

At every new session, the user needs to login in the system. Once the user is identified, his profile is accessed and a set of related information is retrieved from the profile repository, namely: the *tourist occupation* that is his current profession or work, *interests* in terms of society related activities (art, business, sport, and leisure), *stay period* that is the period of time during which the user will be in the country, *preferred currency* to allow the system to give an up-to-date currency exchange rate with the local currency, *hometown* that is the city where the user live, and *native language* that is the user's language he usually use so that the system translates any text to this language.

The mobile handset specifications are collected at the beginning of a new session to allow the system to compose and display the results accordingly on the GUI. The main information collected is the screen size and resolution to better fit any map on the user's screen, and GPS availability. GPS information is sensed at regular periods of time defined by the user. In case the mobile handset is not equipped with a GPS receiver, this information should be obtained by other means such as using WiFi to collect the location from other devices nearby. In some specific situations where the user is indoor and the GPS is unable to get the current location, the last known location is used by default. Beside, the current date and time is retrieved from the mobile handset every time the reasoning engine needs to reason about time. When CM gathers all the above context elements, a current context image is created and stored into a database for further access.

4.2. The Reasoning Engine

The reasoning engine (RE) is the module responsible to decide the suitable information to be displayed to the user given the current context. RE has three functions:

request specific web services, adapt information to suit the current context, and send the information to the GUI in order to be displayed on the mobile handset. RE accesses the database and retrieves the current context. Besides, the interaction manager communicates directly to RE the user's query. For any web service invocation the reasoning engine formulates the appropriate http request through the specific web service's API which sends the request to the appropriate web service. The information obtained is processed, filtered and adapted in order to fit the current context. Finally, it is sent to the Display Composer module which decides how to display it on the user's mobile handset.

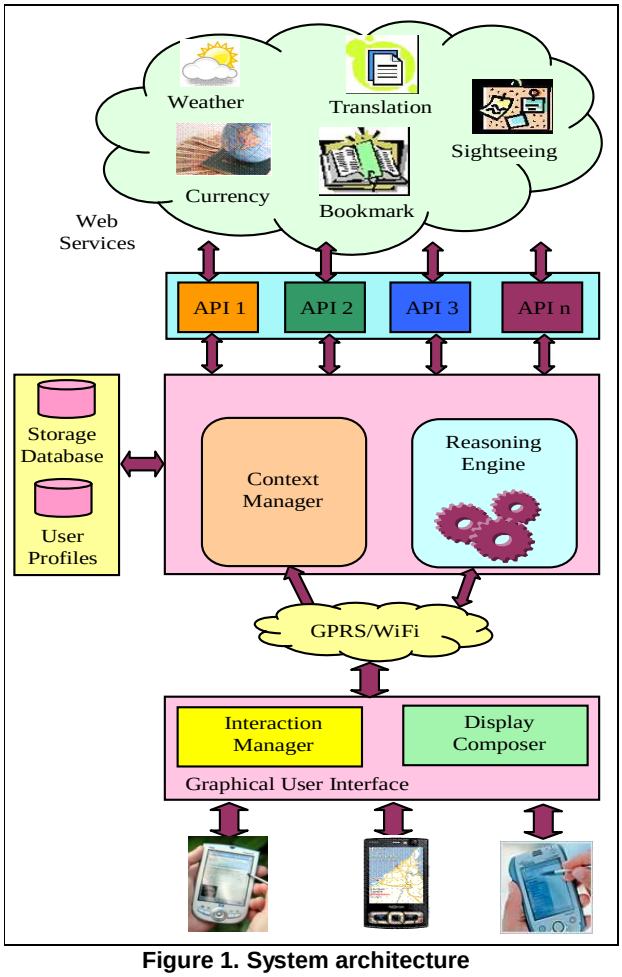


Figure 1. System architecture

For instance, let's suppose that the user is interested to know the events he might be interested to attend during his stay. The user uses the GUI menu to request "UAE Events"; his request is processed by the interaction manager which sends it to the reasoning engine. The latter retrieves the current context from the context manager and then formulates a request to Eventful Web Service (www.eventful.com) which returns all the events that are located nearby the location of the user along with a set of event's related attributes, namely: event location, event type, event start date, and event duration. This information is first processed in order to be stored in adequate data structure. Then RE filters non relevant events to the current context; it selects only the events that match the current context. Hence, the user's current location needs to match the event location, the user interest and occupation are compared with the event type, and the user stay period should overlap the event lifetime which is calculated from the event start date and its duration. Afterwards, RE sends the results to the Display Composer Module (DC).

4.3. Display Composer

The display composer module decides how to display information based on the mobile handset specifications and also the GUI status. For instance, in the example described in Section 4.2., if the user requested information about events while browsing the map, then all the events will be displayed as icons on the top of the map with their respective locations. The GUI offers the possibility to the user to click on the icons in order to have access to the event related information. On the other hand, if the request is formulated from the main menu then the results will be displayed as a list of events in text mode. In this case the user can scroll down to browse the events he is interested to attend during his stay.

5. System Implementation and Testing

Systematic testing has been conducted for the purpose of validation and verification of the implemented system. The testing has been conducted for all the functionalities and services provided by the system. Each module of the system was tested independently. Although testing has been conducted with all scenarios that can be encountered, this paper includes only major test scenarios. The registration and the login system were tested. First of all, new users of the application have to register in order to use the application. The registration requires a username, password, and a password confirmation. The username needs not to be used before by another member. When the system attempts to connect to the server, it requests the user permission to use the internet and to identify the access point to be used for the connection. After that, the registered users have the ability to login to the application by providing the username and the password. The login in our system provides authentication of the application user and maintains his/her privacy. Also using the login system allows the application to store all the user related data in the local database, which in turn allows the user to use the

application on any mobile phone device on which the application is installed. For the first login of a user, a profile initialization form appears with choices that the user can select from as shown in Figure 2. Moreover, the user profile can be updated by the user at any time. Once the user has logged in successfully to the application, or the new user has registered his/her profile, the main menu of the application appears to the user as shown in Figure 3.

(a) (b)

Figure 2. User profile registration form

Figure 3. Application main menu

The GPS localization was tested in a mobile device with an internal GPS receiver. The accuracy of the result obtained using the GPS was equal to about 20m. Figure 4(a) shows a sample of location coordinates obtained in the city of Dubai. Figure 4(b) shows the GPS control functions provided by the application. The Start GPS and the Stop GPS functions give the user the ability to enable or disable the application form tracking his/her location. Furthermore, the user has the ability to specify the time period used by the application to update his current location.

In case the user is using a mobile phone device having no internal GPS receiver, the application will initiate a Bluetooth search to look for an external GPS receiver to connect with. However, if none exists, the application will consider the user interaction with the map as the user location reference. On the other hand, in case the GPS receiver is located indoors, or the user has disabled the GPS receiver, the application will consider the user's last known location as the current location. The application queries the user preferences each time he/she is triggering the "UAE map" command as shown in Figure 5(a). Then the application shows the map centered on the user's current location if it is known by the application. Figure 5(b) shows the UAE map.

(a) (b)

Figure 4. GPS control functions

Within the display of UAE map, as shown in Figures 6(a) and 6(b), the user can select a set of services provided by the application. The "UAE Events" command shows UAE events. From the user preference as shown in Figure 5(a), the user can filter the results according to his/her preferences, i.e. choosing "according to your interest" preference; the application will display only today's events that match the user interest. In case the user has multiple interests, each group of events will be displayed using a different icon than the other groups. For instance, in Figure 7, the circle marker represents a sport event location, the diamond marker represents an art event location and the pin marker represents an entertainment event location. In addition, choosing the "according to your location" preference, the application will display only today's events that are close to the user location. On the other hand, choosing "your stay period" preference, will let the application display all the events that will take place during the tourist's stay period.

Triggering the "New Event" command allows the user to update the application with a new event as illustrated in Figure 8(a). The event details can then be displayed on the map (see Figure 8(b)).

The user can bookmark any location by triggering the command "Bookmark this location" and then specifying its details and if he/she would like to share this location

with other users as shown in Figure 9. The user also has the ability to view the list of bookmarks and bookmark locations that are bookmarked by other users. The list of bookmarks is ordered with the nearest location at the top of the list.

(a) (b)

Figure 5. Preferences query, and UAE map

(a) (b)

Figure 6. Menu within the map

By triggering the "Where am I" command, the application displays the user's current location and the UAE city name the user is visiting. In addition, the user can view the weather condition of the current city, as shown in Figure 10(a). The application also displays an icon on top of the map for illustrating the weather condition as shown in Figure 10 (b).

The user will also be able to get the currency exchange rate of his currency by triggering the command "Currency exchange rate". Note that the exchange rate date and time are also provided. In order to ease the communication between the tourist and UAE residents, the user can also get basic translation between his language and English or Arabic languages which are the main languages used in UAE. A sample of translation from Italian to English is shown in Figure 11.

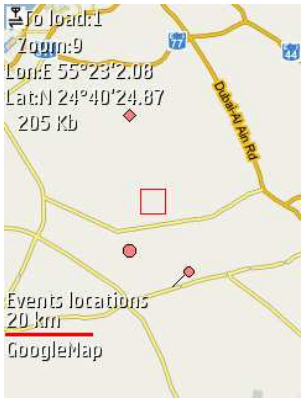
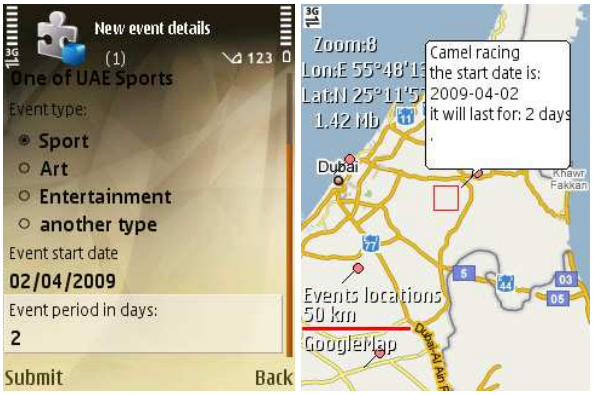
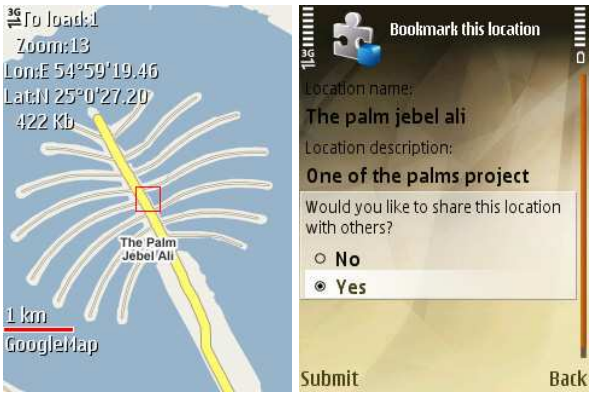


Figure 7. Events with multiple interests



(a) (b)

Figure 8. New Event and event details forms

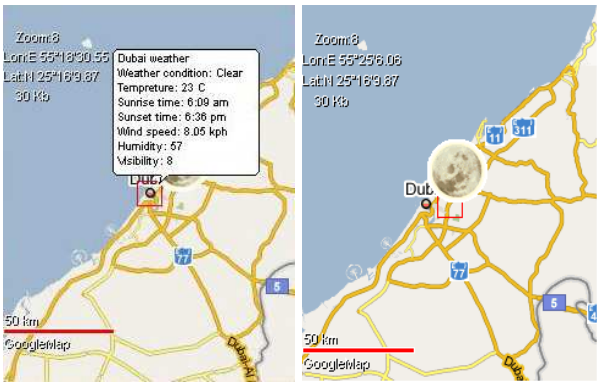


(a) (b)

Figure 9. The Jebel Ali Palm, Dubai, location bookmarking

Also Murshid provides the user with the five prayer times for the day. The prayer times provided by Murshid have been tested to ensure the accuracy of the prayer times of a given location. The prayer times provided by Murshid have been compared to the current prayer times, and it was noticed that the prayer times provided by Murshid had a slight deviation from the actual prayer

time, and this might be because Murshid is referencing the exact coordinates of user location, and the current prayer times we have is referenced for the whole city. Figure 12 shows the prayer times obtained by Murshid for a day.



(a) (b)

Figure 10. Weather condition for Dubai city

Figure 11. Translation from Italian to English

As the application is a guide for UAE tourist, it also suggests some sightseeing for the user such as cultural sites, museums, zoos or shopping malls. This is done by providing the name of the sightseeing and its location. The sightseeing information details are retrieved from a web service provider [17]. The suggested sightseeing locations are given according to the user location. Figure 14 shows suggestions of Sightseeings in UAE provided by Murshid.

The application grants the users of the application the ability to have a list of friends where it is possible to locate any friend after having his/her permission. Figure 13 shows the result of locating a friend who is allowing his/her location to be visible in his/her profile.

Figure 12. Prayer Times obtained by Murshid

Figure 13. Locating friend using Murshid

Murshid gives the user an indication of Al Qibla direction by drawing the direction on top of the map according to the user location. Figure 15 shows Al Qibla direction obtained.

6. Evaluation

System evaluation tests have been conducted for the purpose of validating and refining the system requirements against users experience after using Murshid. Moreover, the evaluation has been conducted to assess the user acceptance of using a context aware mobile application tourist guide, and to evaluate the quality of Murshid guide and its relevance to the user context. Also the application has been evaluated by comparing it against another similar system.

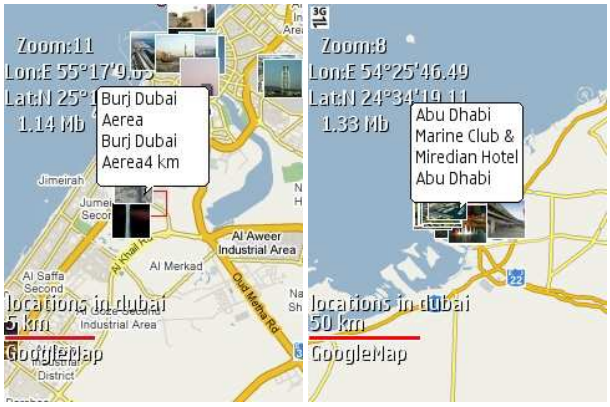


Figure 14. Suggestions of Sightseeing in UAE

Figure 15. Al Qibla direction

The field trial evaluation was carried out by a number of students and colleagues. Unfortunately, we had no chance for having actual UAE tourists to evaluate the system. However, the users performed the tests were asked to behave and evaluate Murshid as if they are actual UAE tourists who know very little about UAE, by thinking of actual tourist needs and necessity. As a result of the evaluation conducted, a number of findings were concluded for each criteria of Murshid. The findings of the field trial are summarized in the following subsections.

6.1 System Features and Evaluation

Most of the evaluators appreciated the features and the services provided by Murshid since they are real-time services and relevant to the tourist needs and necessities in general. In addition to that, the evaluators expressed their appreciation of having a location based and context-aware based system, in view of the fact that both are completing each other for providing tourism guidance. The system evaluators suggested that Murshid would be more useful if it is equipped with additional services such as online hotel booking, restaurant location, and map routes and paths finding service.

6.2 Cost Evaluation

All the evaluators liked the ability of using both the GRPS and the Wi-Fi for the internet connection, since using the Wi-Fi reduces the cost significantly and sometimes it might be free of charge. The cost of using Murshid during the field trial using the GPRS connection has been measured, showing an average of US$ 1.63 for light usage and about US$ 3.81 for heavy usage of the application. Some of the evaluators found this cost acceptable compared to the cost of getting all Murshid services using another service provider. Table 1 shows the usage cost of using Murshid connecting to the server via the two internet connections. Also the evaluators appreciated the caching mechanism used in displaying the map, which reduces the cost of the navigation through the map. In addition, the evaluators pointed out the idea of caching all the other services, for the purpose of further reduction of the cost.

Internet Connection	Light Usage cost (average)	Heavy Usage cost (average)
Wi-Fi	Free of charge	Free of charge
GPRS	US$ 1.63	US$ 3.81

Table 1. Testing usage cost of using Murshid via the two Internet connections

Moreover, the evaluators valued the small size of the application as it is only 384 Kbytes which is more than acceptable taking into account the current large memory capacity of mobile phone handsets. Also they conceded the idea of storing the user related data in the server, as it eliminates the storage cost on the mobile phone device memory.

6.3 Performance Evaluation

Generally speaking, the evaluators were happy about the performance and the response time of the application, which is a consequence of the minimal computation required in the mobile phone device, since most of it is done on the server side.

Nevertheless, there were some findings of the system response-time using different internet connections as follows: using the application and connecting to the server using the Wi-Fi connection gave a fast response-time, but using the GPRS connection of the UMTS network gave an acceptable and a satisfactory response-time. On the other hand, using the application and connecting to the server using the GPRS connection of the GSM network gave a slower response-time which also depends on the

network coverage. Table 2 shows the response time in second of different internet connections.

Internet Connection	Response Time (average)	Comments
Wi-Fi	2.5 seconds	The fastest response time Depends on the signal strength.
GPRS (UMTS)	5.3 seconds	Faster than GPRS (GSM) Slower than Wi-Fi connection Depends on UMTS network coverage and signal strength.
GPRS (GSM)	8.7 seconds	The slowest response time Depends on the GSM Network coverage and signal strength.

Table 2. Response time for different connections

6.4 Usability Evaluation

For the system usability evaluation, it has been found that the evaluators appreciated the use of the elegant Graphical User Interface with maps which makes the application more user-friendly, specially having the ability to change the map view to the satellite view and the ability to choose between different map providers, which makes the application more adapted to user preferences. Also it has been pointed out that the separation of the feature menu that depends on the map and the features menu that does not, adds a value on the application usability. Additionally, they pointed out that using and interacting with the application does not require learning and it requires minimal effort from the user side.

The evaluators also added that the application interface of the menus can be improved, to have another ways of displaying the icons and the text. Also they mentioned that the application user have no indication about the controls buttons on the map such as the zooming controls buttons. Therefore, they suggested that it would be better to provide the user with a list of control buttons along with their functions wherever the user needs to use them in order to have access to all the system functionalities.

6.5 Information Relevancy

A reasonable majority of the evaluators stated that the information they were getting is relevant to their profile and location, the application provided them with relevant suggestions for the events and the other features of the application. On the other hand, some evaluators partially accepted the information relevancy, and this is due to the unavailability of their interest in the provided interests list. Hence the suggestion of adding more interest categories to the interest list of Murshid is relevant. However, for the other services that do not depend on the user interest, the information provided was relevant and acceptable.

6.6 Evaluation against Other Systems

Comparing our system against other existing systems is done in this section in terms of comparing the context elements used and the provided services in each system. Since Murshid is both context-aware and meant to be a tourist guide, we can evaluate it by making the comparison against both context-aware systems and context-aware tourists guide systems.

One context awareness system is presented in [4]. This system is designed to provide Muslim users with Islamic information and services according to user context, namely: user location, current time and date, and user profile. Comparing Murshid against this system, we can find out that Murshid has the same context element with additional elements which are the events information, and the user interaction. This makes Murshid more contextually aware, which lead to be more accurate in providing the information.

Additionally, comparing Murshid against the system described in [5], gives Murshid less accessibility since the compared system can be accessed by a phone browser which requires no installation process on the mobile phone device. However, Murshid can be accessed only if the mobile phone device has the application installed. Whereas evaluating Murshid by comparing it against the system proposed in [6] that uses context elements similar to Murshid context elements, gives Murshid the advantage of having a wider range of services. This is because the system in [6] only provides information about recommended sightseeings. However, this system has the advantage over Murshid by having the ability to capture the user interest from the travel history, and the user feedback on history.

Another system that can be compared to Murshid is described in [7]. This system provides information about attractions and key buildings in a given area, and that makes Murshid more practical since it has wider range of services and it can be used in any country since it uses worldwide services. The System described in [7] is implemented for use on pen-based tablet PCs, which gives Murshid the advantage of the portability, since it can operate on different mobile phone handsets from different manufacturers.

7. Conclusion

In this research we presented the development and deployment of Murshid, a mobile application that provides guidance to users visiting a country for tourism or business. Murshid is context sensitive; it continuously

senses the user's context, evaluates it, and then provides information to the user through an elegant GUI. The context model includes the user location, user profile, current date, event information, and user interaction. The system architecture includes three main modules, namely: the context manager which gathers context data, the reasoning engine which analyzes the context and takes appropriate decisions regarding what to display, and the display composer that displays the information according to the user needs. Beside, the system makes use of available web services providing worldwide useful information and displays them on the map allowing the user to navigate and browse at his convenience.

Future work will focus on developing a more systematic tourist model to encompass a variety of user's interests and accordingly enlarge the services provided to fit the users' needs. This extension requires a meticulous selection of services to suit the current context allowing the user to get personalized information.

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