خدمات هاتف الجوال المبنية على سياق الحالة في الحج والعمرة

د. محمد بن عبدالرحمن داؤد

جامعة أم القرى

ABSTRACT

In this paper, we propose a context-aware Mashup of services for Hajj and Umrah pilgrims. The system comprises several important services for end-users who intend to or are already performing Hajj and Umrah. The system first gathers the context of the user so that we tailor the Mashup services accordingly. The sensory data we currently utilize are location-based information that is collected through user's GPS and IP coordinates. Our main targets are mobile devices which are ubiquitously available nowadays to most pilgrims. Those devices access our services through the web. We make use of several available web services APIs that are being utilized to build our system Mashup. The system collects location co-ordinates, locate spatial nearby services such as accommodation, restaurants, money exchange centers, maps, transportation itinerary, translation, news, video streams, …etc. We have tested our system through end-user subjects. We will provide our testing results and the general impression of end users about our system. We will also present our conclusions as well as future directions that we plan to target.

1. Introduction

The holy places accommodate huge number of pilgrims during the hajj and Umrah seasons. This number could reach more than four million pilgrims throughout the year. Some problems could happen as a result of several factors. First problem is due to the fact that this event occurs in limited areas. Secondly, background difference could lead to customs and languages barriers. Finally, problem could arise because of age and gender diversities. Saudi government faces a major challenge in order to provide daily services to them, which is considered as a religious and humanitarian duty. The government of Saudi Arabia provides many facilities for those pilgrims; this can be reflected in several aspects: security, health, accommodation and transportation. The integration and coordination between these services will have a positive aspect in terms of saving time and effort. Any pilgrim for example could use GPS service to know the nearest hospital or money exchange center. Also by using GPS maps, the person would be able to plan her/his daily trip. For instant, knowing the nearest train or bus station to the holy mosque, then move to Hira Mount or any market market, and return to the hotel or the holy mosque again without getting lost in the way.

The Government of KSA is continuously working to improve the services provided to the pilgrims through several ministries. Ministry of Hajj is working on providing electronic services [1] such as query statements for pilgrims, inquire about licensed companies and institutions and maps showing the camps in Mina. Ministry of Interior [2] provides the capability for citizens and residents to inquire about their

eligibility to perform Hajj this year, and that by making sure they did not perform the Hajj in the past five years and facilitate for exit and return visa. Ministry of Foreign Affairs [3] helps in areas such as add requests for Hajj visas, and processes requests issued by the Umrah and the Saudi Ministry of Hajj. Ministry of Health [4] deals with an “ejad” system for the health services where ”ejad" assists the pilgrims and institutions involved in the helicopter and the Hajj to report missing people while performing the rituals of Hajj and search for them in all hospitals located in areas to perform the rituals. Ministry of Culture and Information [5] provides many services such as news for pilgrimage, live broadcast of “Almasha'er Almokadasa”, opinions and the provisions of the Hajj and provide Maps and the most important sites. In addition, several social network services have been developed as a personal initiative to offer some Hajj and Umrah services offered through Facebook and Twitter. Many other interesting services have been developed in the past. Author in [6] have demonstrated an approach for spatial-temporal visualization of pedestrian movement from/to the Jamarat area. The work presented in [7] demonstrates how the web-based Geographic Information System (GIS) can be utilized to provide efficient distribution of the traffic plan in crowded place like Mina and Arafat. For example in [8], the authors use GPS (Global Positioning System) and GIS (Geographic Information System) concepts to analyze the movement of pilgrims in Mataf area in order to support space redesign. In [9], airborne images have been used to extract pilgrims’ tents and optimize the exploitation of limited land in Mena area.

Despite the availability of all these services, it is not available for the pilgrim in one place. Pilgrims need to search for these services to get the benefit of these services provided to them. We want to offer these services through one of the Web 2.0 techniques called Web Mashup that helps creating and developing web sites and applications to produce a new service. Web Mashup can combine any number of web services for example: maps, photos, search engine, RSS feeds, language translation, etc. During the past decade, the Saudi Hajj and Umrah authority has developed several online services to ensure the security and safety of the pilgrims as well as their well-being and comfort. Steps were also taken to establish online facilities and services aimed at improving housing, healthcare, sanitation and transportation. Saudi Government has also introduced 4G network in the holy places where smart phones can connect to the Internet and get access to these online services. However, a pilgrim needs a context-aware system in his smart phone that understands the location, time, physiological developments, ambient information and events and provides him necessary services from the pool of Mashup of services. For example, during the need of a fellow pilgrim’s emergency situation, the smart phone will automatically show the nearest hospital, available information leading to the transportation service, contact numbers of nearby medical staff, nearest caregiver family member, and contact number of Hajj agent, to name a few. Also, the smart phone can disseminate life-saving information such as current location of the event of the individual having severe health crisis to the respective authority. In this way, the Saudi Hajj and Umrah authority has better control to each individual’s need and can provide customized care.

In this paper, we propose the following contributions. First of all, we have developed Mashup architecture by combining a set of web services offered by different Hajj and Umrah service provides.

Using our proposed Mashup architecture any number of existing or new web services can be offered to the pilgrims. Second, we have added context-aware capability to identify a user context such as location, time, and significant events around the ambient environment of each pilgrim. Finally, the proposed system helps in mapping a subset of services from the available services to a particular context of a user. For this, we leverage our earlier developed context-aware system called SenseFace [10], [11], [12] in which a pilgrim having a smartphone with Internet capability can consume a subset of services at any given situation. This architecture will help pilgrims in enjoying Hajj and Umrah related services in a personalized way any place and any time.

2. Context-Aware Services Design

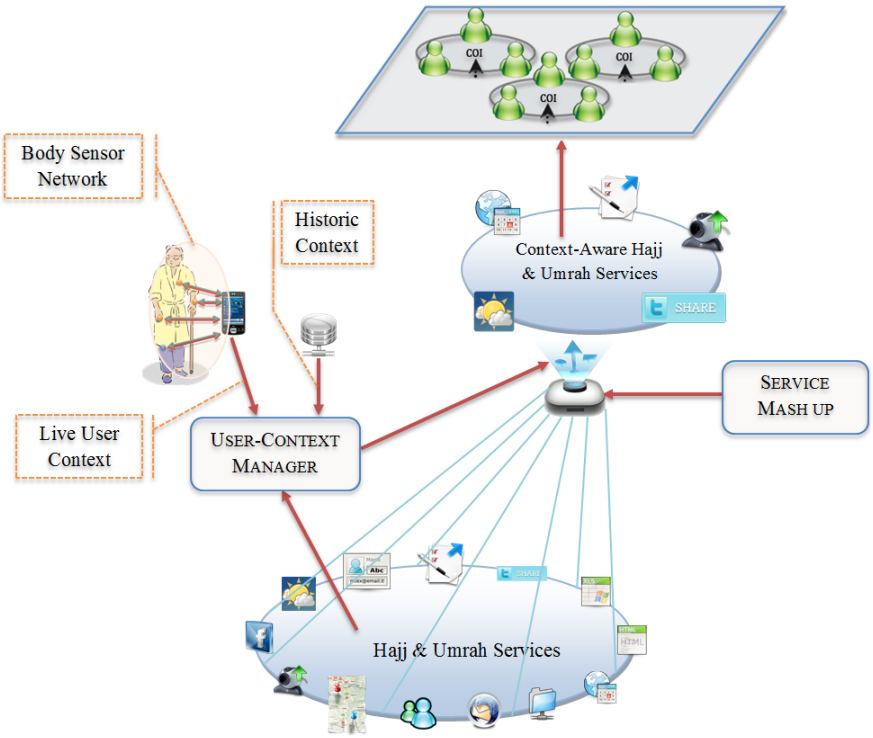


Fig. 1. High level system architecture

The proposed context-aware Mashup system can be depicted as shown in Figure 1. The framework supports user mobility by assuming that a user has a mobile device with Internet connection. The widespread acceptance of smartphones nowadays has made this assumption a reality. Not only the modern smartphones come with several built-in sensors but also supports external sensors that help us in collecting user context such as location of a user, time of the day, physiological condition of a user such as heart rate and body movement and ambient information such as temperature and noise level [13]. Hence, the smartphone forms a body sensor network around a pilgrim. The smartphone thus acts as a gateway between

a pilgrim and Hajj and Umrah services. Given that the smartphones can be reached using its mobile operator as well as can be configured to host a web server, it can also be accessed from a server side, either through mobile 3G/4G network or through Wi-Fi network.

As shown in Figure 1, a smartphone captures live user context from the internal and external raw sensory data, analyze the raw sensory data to find low level user context by employing domain-specific context extraction algorithm and if needed, sends the user context to the *User-Context Manager*. *User-Context* Manager is responsible to receive user context information from all the pilgrims and stores them to a cloud service or a database. Details about the user-context manager and its internal components can be found in [12]. *User-context manager* also leverages historic context as a knowledge base, which stores past user contexts of every pilgrim. By combining live as well as historical contexts, *user-context manager* can suggest high quality pilgrim context information.

User-context manager combines multiple primitive context values in the presence of multiple sensors data. Let us consider a physiological context of a user such as a "user is stressed". *User-context manager* can deduce this high level context by analyzing smaller chunks of primitive contexts as shown below. Note that the following breakdown of primitives might vary from pilgrim to pilgrim, the sensors available to the pilgrim, and how the pilgrim wants to express his/her health condition in that particular context. Assume that a pilgrim has sensors to measure heart rate, body temperature and sweat level, time of the day, current location and surrounding temperature. Using each sensory data reading, user-context manager can obtain several possible context primitives. For example, using HeartRate data several unit context can be inferred such as USER HeartRate HIGH, USER HeartRate Low, USER HeartRate NORMAL, USER HeartRate ALARMING…Assuming the existence of such sets of context primitives, we can infer a high level user context such as "user is stressed" as follows:

c1=USER HeartRate HIGH [Events Context]
c2=USER Body Temperature HIGH [Events Context]
c3=USER Sweat Level HIGH [Events Context]
c4=TIME is MIDNIGHT [Temporal Context]
c5=LOCATION is HOME [Spatial Context]
c6=AMBIENT Temperature NORMAL [Events Context]
c7=USER not MOVING [Events Context]
If (c1) and (c2) and (c3) and (c4) and (c5) and (c6) and (c7) Then
Context = *User is stressed*

The system leverages a web service Mashup architecture proposed in [11], which can combine web services from heterogeneous sources using open stack. This is done by the *Service Mashup* component. In order to map a subset of services from the pool of available services with a pilgrim's given context, we use

fuzzy ontology using the Mamdani inference engine through the following four steps, details of which can be found in [11]:

1) Fuzzification, where we map each crisp sensory input data type into a fuzzy set;

2) Determining the individual context rule to semantically map the input and the output in the fuzzy domain;

3) Determining the aggregate context output of all the fuzzy rules;

4) De-fuzzification, which means finally mapping each fuzzy output to a crisp set of outputs, i.e., a vector containing the context-aware Hajj and Umrah service.

Hence, the rule of how to formulate a high level user context is completely flexible and a pilgrim can personalize all such context-to-service mapping. Once the context-aware services are selected, the proposed system allows a pilgrim to communicate with his/her community of interest (COI) through these services. For example, a pilgrim can send a Tweet to his/her followers via the Twitter service.

3. Implementation

We have implemented the Mashup services using open source software. Web server has been implemented using open source XAMPP 1.8.1 containing Apache 2.4.3 and PHP 5.4.7. On the backend, we've utilized MySQL 5.5.27 database management system. As discussed in the introduction and design sections, we made use of the following 3rd party API's in building the Mashup:

a. Weather services: Google Weather API
b. Haramain Live Broadcasting service: Justin TV API
c. News service: Ministry of Hajj, KSA, Google and Arab news RSS feed API
d. Interactive client-server communication service: Google AJAX, reverse-AJAX and JQuery API
e. Currency converter: Google currency converter API
f. Location and live direction services: Google maps API
g. Automatic Text-to-Speech service: Google TTS API
h. Any-language to any-language translation service: Microsoft BING API
i. Dynamic latitude, longitude finder service: Google reverse Geocoding API

Figure 2 depicts the home page interface of our system that shows all services currently included within the system. The demo has been ported to the following website[16] for quick review. The following is description of some of these services that we've implemented.

[16] http://advancedmedialab.com/mediaLabDemos/student/GP/hujjNUmrah/

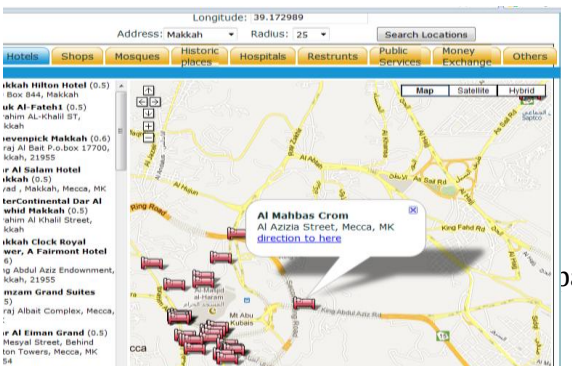
Fig. 2. Service Mashup Interface

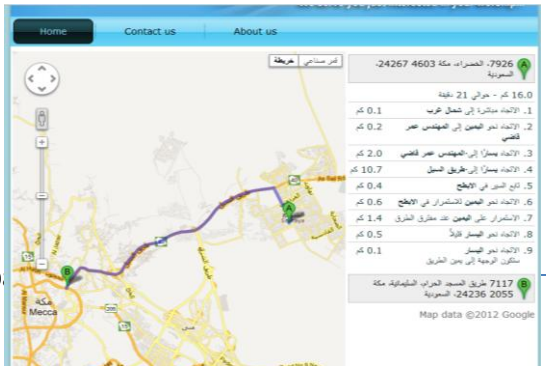
3.1. Location Service

In this service, the user can locate his current place on the map if he/she has a *Global Positioning System* (*GPS*) through the utilization of his/her smart phone. However, if the user doesn't have a GPS client, the site will use his client's IP to determine the position of him/her on the map as shown in figure 3. Meanwhile, the user can also choose one of the three addresses (Makkah, Madina and Jeddah). The location services have been tested with both mobile devices at outdoor location and PC workstations within an indoor environment. As part of this research, we have developed a database customized from the freely available NOKIA web services. Currently, our database consists of more than 2,500 records containing information about hotels, shops, mosques, historic places, hospitals, restaurants, public services, money exchange centers and other services available in the above three locations.

Fig. 3. Dynamic location finding service using GPS

Then, if user search for hotel "Al Mahbas Crom" for example, a Google map, as shown in figure 4 (a), will be generated that locates the specified query along with other nearby hotels. The user can get direction from her/his current place to the hotel by click on "directions to here" link as shown in figure 4 (b).



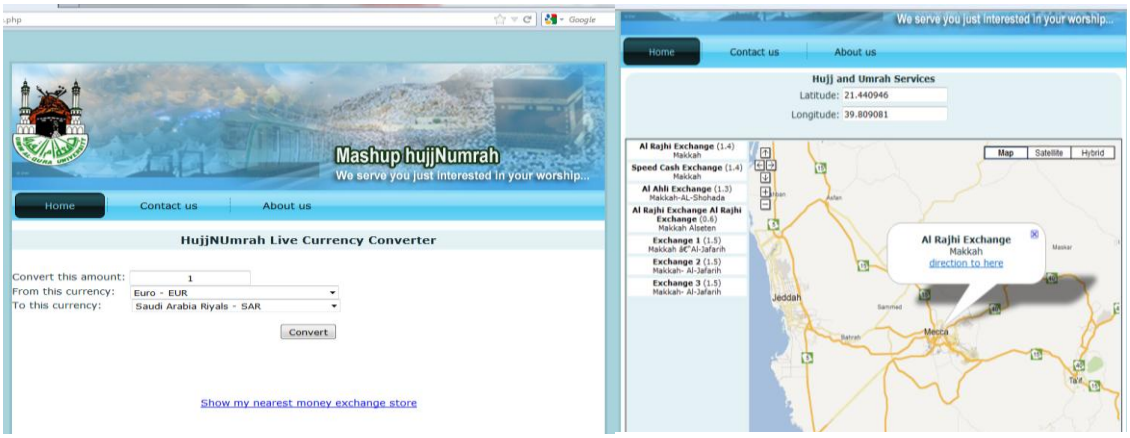


(a) (b)

Fig. 4. Location service (a) an example searching a hotel within 25 KM radius, and (b) then showing path leading to the selected hotel and the pilgrim's dynamically calculated current location

3.2. Money Exchange Service

In this service, a pilgrim can utilize the currency conversion tool as shown in Figure 5 and can also get direction to the nearest money exchange to his current location by clicking the "Show my nearest money exchange store" link then choosing "Direction to here" link.



(a) (b)

(c)

Fig. 5. Interfaces showing a scenario of a pilgrim's consumption of money exchange service (a) live currency conversion service (b) showing nearby currency exchange services depending on current locations and (c) instantaneous direction finder

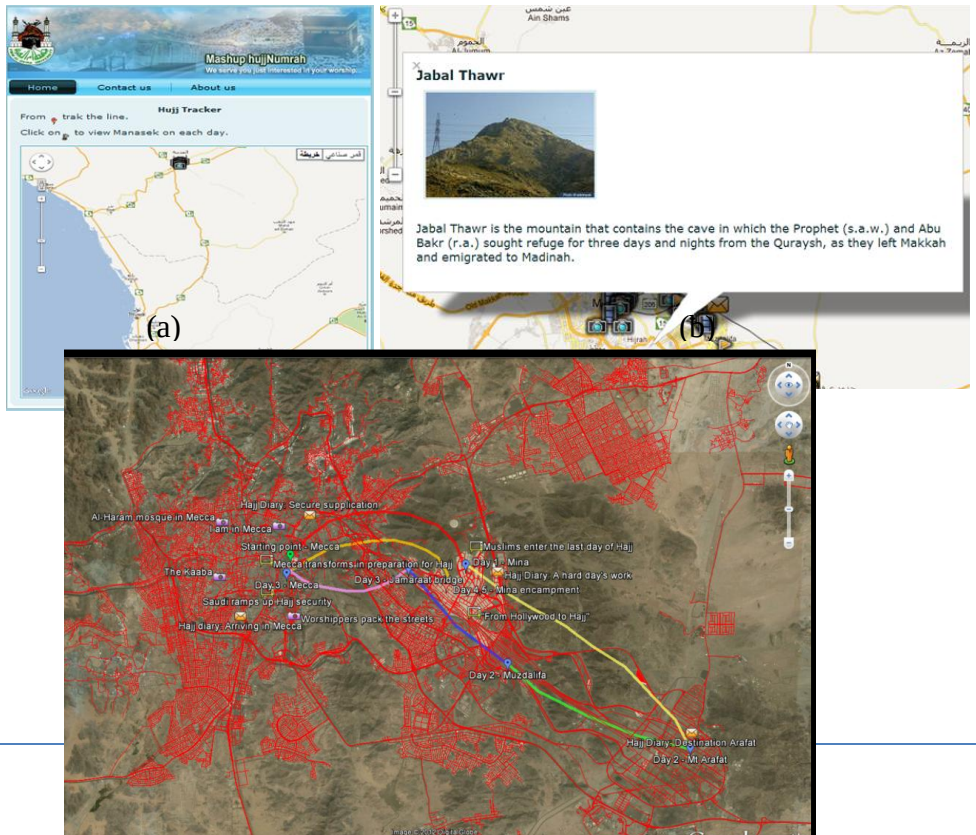
3.3. Language Translation and Text-to-Speech Service

Using this service, a pilgrim can translate words or sentences from any language to Arabic and vice versa and can listen to the word in the source or translated language as shown in Figure 6. A pilgrim can set preference about his/her source language and the output language to make the service seamless.

Fig. 6. Interface of auto translation and text-to-speech service

3.4. Hajj Tracker service

Using this service, a pilgrim can see how to perform their Hajj requirements and track the percentage of completion of the ritual, including information about the roads from where to where he must go, and some videos (from Aljazeera Channel or other Channel that follow the movements of pilgrims), pictures of Islamic Landmarks, and diaries written by reporters and other fellow pilgrims. This Mashup service also allows pilgrims to upload different multimedia objects such as text message, photos, videos and other similar experiences so that other pilgrims can see those information later on. Some samples of this service interfaces are depicted in figure 7.



(c)

Fig. 7. Hajj tracker service (a) spatial and temporal multimedia information uploaded by fellow pilgrims (b) an instance how each uploaded media can be viewed and (c) an elevated coordinate of holy places in Makkah with color annotation rendered on top of Google earth view showing important date, location and route of events during Hajj period.

3.5. Haramin Channels Service

Using this service, a pilgrim can watch the Holy Mosque live video stream 24/7 and listen to Qur'an on "Al- Qur'aan al kareeam" Channel, as shown in Figure 8. Meanwhile, when a pilgrim selects the Madinah Channel option, "Al sunnah Al Nabwih" video stream will be streamed to his/her browser. One feature that we have added is that if a pilgrim is in Makkah or Madina, the system will by default show the corresponding channel by inferring the current location of the user, which can be changed by the pilgrim later on. This service will help a pilgrim to see the crowd and other cues available before actually visiting the holy mosques.

Fig. 8. Live 24/7 online Haramain video channel service

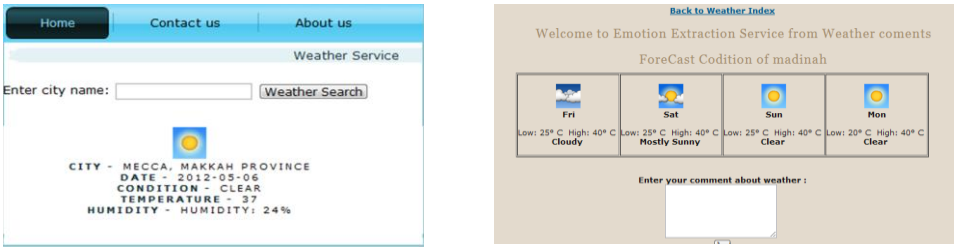
3.6. Dynamic Prayer Time Calculator and Reminder

This service leverages the location service to dynamically find the current position of a pilgrim and can show the prayer time in varieties of formats and calculation methods. It also shows the next prayer time with proper annotation, including the remaining time. A pilgrim can also subscribe to an SMS service if he/she intends to get notified for any particular prayer time.

Fig. 9. Location-aware prayer time visualization and alert service

3.7. Haramain Weather Service

Weather service provides live weather information, with an alert option. For example, a pilgrim can configure the weather service to send an alert message if the weather goes above an alarming state (see Figure 10 (a)). Also, pilgrims can input their comments about the weather information live, which is available to other pilgrims (see Figure 10(b)).



(a) (b)

Fig. 10. Weather service: (a) Weather visualization and (b) alert service

3.8. Haramain Prayer Archive

Using this service, a pilgrim can browse historical archive of Haramain audio and video archive in diversified formats such as wmv, mp3, ogg, ogv, and mp4, to name but a few. We have also added YouTube and Daily Motion video channels for each video type. It is an exciting event to share the moments in the Holy Mosques with one's community of interest. For example, using this service, a pilgrim can share particular prayers of interest to one's family members; can browse those moments when he/she leaves KSA.

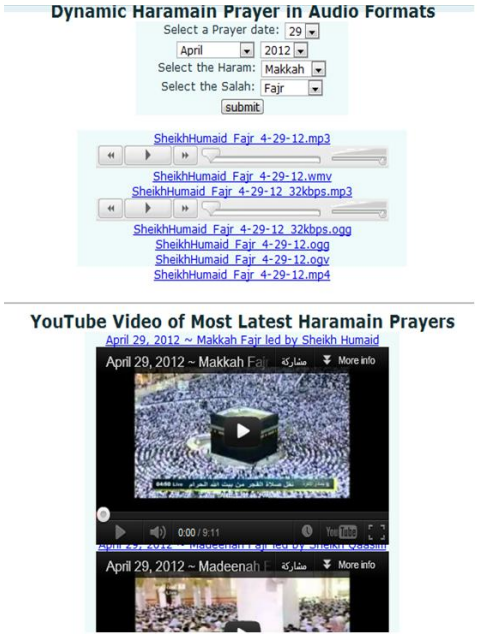


Fig. 11. Interface for browsing historical Haramain prayers in both audio and video format dynamically

4. Testing results

In order to validate the usability of the proposed context-aware Mashup of Hajj and Umrah services, we have conducted a usability test in which 51 persons took part. The subjects were from different age group with some experience in Internet-based services. Some of them have performed Hajj and Umrah and some were intending to perform them in their earliest opportunity. We provided our Mashup portal including all the web services for them to use. They have accessed the system using both desktop web browsers as well as mobile browsers. Later on, we have asked each person to take part in a questionnaire session that consists of 12 questions. Most of those questions are subjective by nature to understand the viability, usability and intuitiveness of our system services and user interface. Table 1 shows a summary of the list of the questions along with the user responses to each question. As seen from the survey results, 45% of the test users have tested our site through smartphone and the rest tested through a desktop PC. Except the user interface, which scored the least (73%), the rest of the questions scored more than 98% positive response.

This motivates us in extending the current framework with new dimensions of services and knowledge.

TABLE 1. SYSTEM TESTING QUESTIONNAIRE AND RESULTS.

Number	Question	Yes	No
1	*I used the website "System" through a mobile phone?*	23 (45%)	28 (55%)
2	*Is the "check weather service" useful?*	51 (100%)	0 (0%)
3	*The design and colors that were used to build the website's*	37 (73%)	14 (27%)

	pages was good?		
4	*Did the "Location Service" determine your location correctly?*	50 (98%)	1 (2%)
5	*Is the way you view the services was interesting?*	51 (100%)	0 (0%)
6	*Were you able to access and deal with the services easily?*	51 (100%)	0 (0%)
7	*Did you see that the way to access the information and services is appropriate?*	50 (98%)	1 (2%)
8	*Do you support the idea of integrating the pilgrim's services in one place?*	50 (98%)	1 (2%)
9	*Suppose you are visiting Makkah for the first time to perform the Hajj. While you are in 'Arafat you wanted to go to the nearest hospital. Do you think that our system will be useful for this kind of scenario?*	50 (98%)	1 (2%)
10	*I like the service "Show my nearest money exchange store"?*	50 (98%)	1 (2%)
11	*I like the way of representing the "Islamic Landmarks" and "Hajj Tracker" in "Hajj Tracker service"?*	51 (100%)	0 (0%)
12	*Do you think that the "Language translation service" and "text to speech in Arabic" will be useful for the Pilgrims?*	50 (98%)	1 (2%)

5. Conclusion and Future Directions

In this paper, we have presented a dynamic Mashup that integrates several services related to Hajj and Umrah. We make use of user's context for the delivery of the appropriate and customized services. The context information we currently utilize are GPS longitude and latitude co-ordinates as well as client IP address. We customize contents for the delivery of services to mobile devices such as Android smartphones. Some of the services we have implemented are location detection, retrieval of nearby hotels, restaurants and hospitals, money exchange centers, routing inquiries, news, real-time as well as archived videos. We have conducted some qualitative tests to gather the audience impressions of our services. We have presented the questionnaire results' summary that we have received. The reviews show encouraging results that the system is overall satisfactory for the users who tested the system and the services were useful for their requirements.

In future, we are looking into integrating other multi-modal sensory devices. This will include RFID, video monitoring, gesture-based interaction and multi-modal wireless sensor networks. This would add more accurate contexts about end-users. Thus, the system will furnish more intelligent results and forecasts. Another issue that we need to address is preserving privacy of end-users and analyzing historical data so that both the authorities and end-users receive better quality of experience interaction with the system.

Acknowledgement

We want to thank Noura, E. Baqazi, A. O. Al-Husaini, and H. A. Al-Shanqeeti for their contribution in the conducting the usability test. Our sincere thanks go to King Abdul Aziz City for Science and Technology (KACST) of Kingdom of Saudi Arabia for funding this research.

References

[1] Ministry of hajj 2012, *electronic services for internal pilgrims*, Administrative General for pilgrims home, KSA, viewed 13 October 2012, < http://www.localhajj.gov.sa/>

[2] Ministry of interior 2012, *directorate general of passports*, Ministry of interior, KSA, viewed 13 October 2012, <http://www.moi.gov.sa/wps/portal/>

[3] Ministry of foreign affairs 2012, *electronic services for internal and external pilgrims*, Ministry of foreign affairs, KSA, viewed 13 October 2012, .< http://www.mofa.gov.sa/Pages/Default.aspx>

[4] Electronic Portal of the Ministry of Health 2012, *Healthy hajj services, Ministry of Health*, KSA, viewed 13 October 2012, < http://www.moh.gov.sa/eServices/Hajj/Pages/default.aspx>

[5] Ministry of Culture and Information 2012, *Dissemination of culture and knowledge*, Ministry of Culture and Information, KSA, viewed 13 October 2012, < http://www.info.gov.sa/hajj/intro.aspx>

[6] Nabeel A. Koshak. (2005). "A GIS-Based Spatial-Temporal Visualization of Pedestrian Groups Movement to and from Jamart Area". In Proceedings of CUPUM '05 (International Conference on Computers in Urban Planning and Urban Management, June 29 - July 1, 2005, London, United Kingdom.

[7] Nabeel A. Koshak. "Developing a Web-Based Geographic Information System for Hajj Traffic Plan." Journal of Urban Planning Research, Volume 6, Issue 6, May 2006.

[8] Koshak, Nabeel A., and Fouda, Abdullah (2008) "Analyzing Pedestrian Movement in Mataf Using GPS and GIS to Support Space Redesign". Proceedings of the 9th International Conference on Design and Decision Support Systems in Architecture and Urban Planning (DDSS), 2008.

[9] Abdulatif Alharthy and Nabeel A. Koshak. "Automatic Extraction of Tents during Hajj from Airborne Images to Support Land Use Optimization". Automation in Construction International Journal, Volume 16, Issue. 1, 2007.

[10] Mohamed Abdur Rahman, Abdulmotaleb El Saddik, and Wail Gueaieb, "Augmenting Context Awareness by Combining Body Sensor Networks and Social Networks". IEEE Transactions on Instrumentation and Measurement, vol. 60, no. 2, pp. 345 - 353, 2011.

[11] Mohamed Abdur Rahman, Sadek Hamdan, Abdulmotaleb El Saddik and Wail Gueaieb, "Context-Aware Social Networks Mashup: A Personalized Web Perspective," in Proc. of the IEEE Instrumentation and Measurement Technology Conference (I2MTC'2010), pp. 1228 – 1233, Austin, Tx, USA, May 3-6, 2010.

[12] Mohamed Abdur Rahman, Heung-Nam Kim, Abdulmotaleb El Saddik, and Wail Gueaieb, "A Context-aware Multimedia Framework toward Personal Social Network Services". Journal of Multimedia Tools and Applications, Springer, US, vol. 61, no. 3, pp. 1-31, 2012.

[13] Mohamed Abdur Rahman, Abdulmotaleb El Saddik, and Wail Gueaieb, "Building Dynamic Social Network From Sensory Data Feed". IEEE Transactions on Instrumentation and Measurement, vol. 59, no.5, pp. 1327-1341, 2010.