Web Services-Based Hajj Information System

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Abstract

The past decade witnessed an increased interest in Web-Based Information Systems. Numerous techniques have been used to produce information systems in many areas. This paper describes a Web Services-Based information system dedicated to Muslims pilgrimage, known as Hajj in Arabic. More than two million Muslims gather in the holy city of Makkah every year. People come from different cultures with various levels of background knowledge. However, the main problem facing the organizers of this event is two-fold. First, is the lack of enough background knowledge most of pilgrims have about Hajj and its environment. Second, is guiding people during the Hajj period and keeping them up-to-date with the latest Hajj information. Our proposed system aims to tackle these two problems.

1. Introduction

The Muslims annual pilgrimage (Hajj in Arabic) is the biggest mass assembly ever on Earth. Two to three million Muslims arrive in the city of Makkah, Saudi Arabia, every year to perform Hajj. Hajj is the fifth pillar of Islam as the Prophet (peace and blessings be upon him) said, “Islam is built upon five pillars: testifying that there is no true God except Allah and that Muhammad is the Messenger of Allah, performing Prayer, paying the Zakah, making the pilgrimage to the Sacred House (Hajj), and fasting the month of Ramadan.” (Reported by Al-Bukhari)

Hajj can be seen as a dynamic system with many states. To give an overall picture on this system let us give a brief description on the typical Hajj activities. People arrive to the holy city of Makkah wearing the Ihram clothes. Once in Makkah they start by performing Tawaf or the circumambulation around the sacred house (the Ka'bah) seven times. After Tawaf

they perform the Sa'i; the act of jogging seven times between the hills of Safa and Marwah. The distance between Safa and Marwa is about 500 meters which means the total distance of this activity is 3.5 kilometers. Then they cut their hair and wait until the day of Arafat. In this day all pilgrims (Hujjaj) must assemble around the Mount of Arafat from morning until sunset. After sunset, all pilgrims start moving from Arafat towards Muzdalifah, an open place where they spend a night under the open sky. In the morning they head towards Mina, where they spend three days in camps. Two rites are performed during these three days: stoning the devil and sacrificing the animals. Each day pilgrim throws 21 pebbles at three stone monuments which symbolize the devil. Each adult male is expected to sacrifice a healthy animal, preferably a sheep. More than one million animals are slaughtered during these three days. The meat of these animals goes for the poor all over the world, especially in Africa. The final rite of the Hajj is the farewell circumambulation around the Ka'bah.

From this brief description of the Hajj we can see that hajj is a physical and knowledge intensive activity. Because of the short time frame and the huge number of people, there are many problems associated with the Hajj activities. There are communication problems, health problems, transportation problems, etc. We highly believe that using Web technology will play a big role in eliminating most of the problem. Web technology delivers information and services through visual interfaces on computers. However, the revolution of the Web has also covered services that can be accessed via telephones where the interaction between the system and its users can be through voice input and audio output, or through Web enabled browsers on mobile phones.

The Hajj System proposed in this paper is designed to be accessed via three interfaces:
1) A web interface that will provide information service for the pilgrims. 2) A phone interface (VoiceXML) connected though public telephony and a gateway with the help of a voice server connected to the internet. 3) A WAP interface for people with WAP browsers on mobile phone.

The rest of this paper describes our proposed Hajj Web Services-based Information system. Section 2 represents the architecture of the Hajj Information System. Section 3 describes scenarios of system usage and Section 4 gives some concluding remarks.

2. System Architecture

As shown in Figure 1, the system architecture consists of three layers: Presentation Layer, Business Logic Layer, and Database Layer. Three-tier architecture is adopted because we are seeking system reliability to allow services to be available to pilgrimages 24x7, flexibility to allow the implementation of new functions and features, scalability to allow the system to easily scale up in terms of number of devices and pilgrimages, and maintainability. Separating the presentation layer will make it possible to accommodate a variety of devices with possibly different UIs. The system architecture layers are described below.

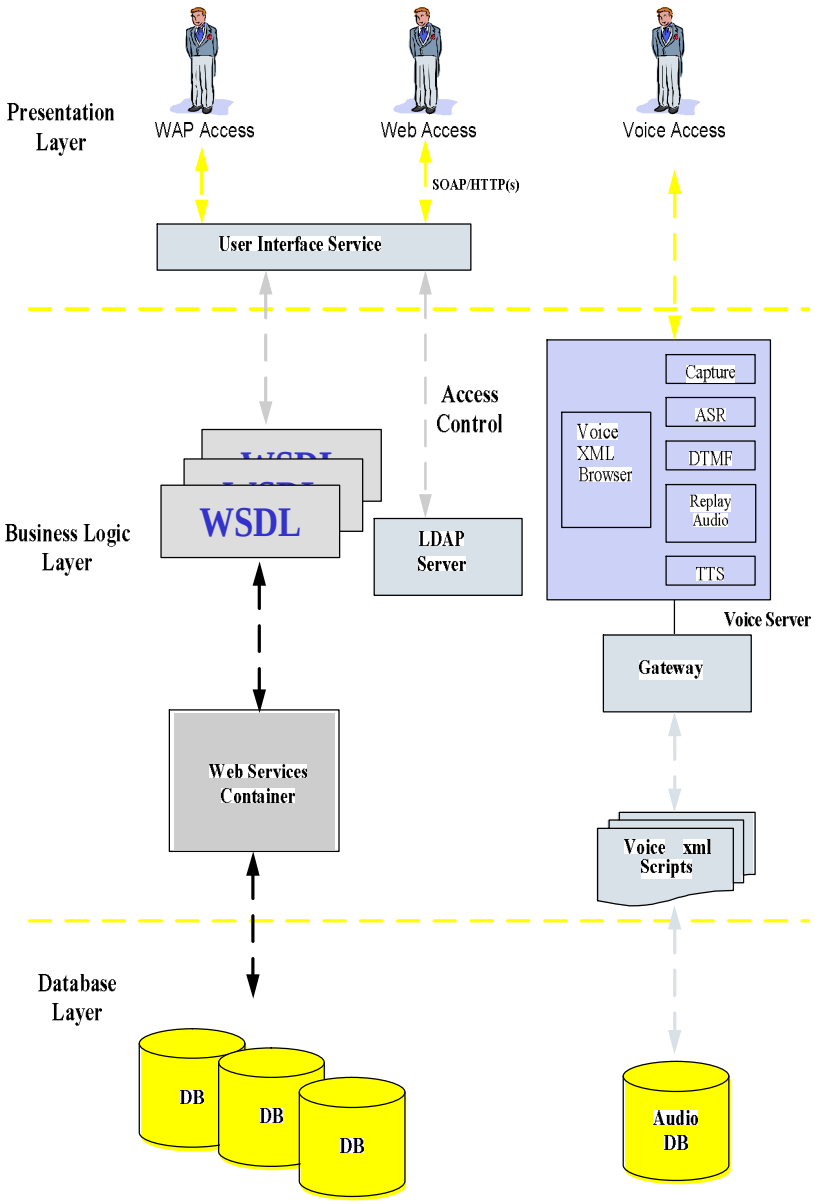

Figure 1: Hajj System Architecture

2.1 Presentation Layer

The Presentation Layer provides the communication channel between the system and its users. It accepts users' requests through the Web interface, Voice interface (telephone or mobile phones), touchtone (DTMF keypad), or WAP interface. Users receive system responses in form of text, images, videos, pre-recorded audios, or synthesized speech using a Text-To-Speech Synthesizer.

2.2 Business Logic Layer

The Business Logic layer consists of two technologies based on the client access mechanism. These technologies are VoiceXML and Web services. VoiceXML is designed for creating audio dialogs that combine speech, audio digital, speech recognition, DTMF

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key input, recorded or synthetic speech, and telephony. Speech recognition application development with VoiceXML is simplified by using Web servers. Instead of using a PC with a Web browser, any telephone can access VoiceXML applications via a VoiceXML interpreter or browser running on a telephony server [1]. The typical VoiceXML voice browser of today runs on a specialized voice gateway node that is connected both to the public telephone network and to the Internet. A voice portal is a system that lets pilgrims to access information on the Internet through a telephone interface. It uses technologies such as speech recognition and text to speech (TTS) conversion to create a user interface that allows users to navigate through the 'voice web pages' using a phone and voice commands.

Web services are software programs that use XML to encapsulate a service and when a client passes data or instructions to it, the service processes that information and returns something to the application [2]. Each Web service is accompanied by information and description explaining what they do and how other applications can access and use them. These descriptions are written in Web Service Description Language (WSDL). WSDL is an XML-based language through which a Web service can convey to other applications the methods that the service provides and how those methods can be accessed [2]. Our Hajj system can access Web services from the Traffic Department, Ministry of Interior, etc and return the information back to the Pilgrims. Web services are based on XML which enables Web services to communicate with other applications, even if those applications are written in different programming languages and run on different platform. According to industry analyst firm Gartner Group, by 2008 more than 60 percent of enterprises will use Web services as the guiding principle when creating mission-critical applications and processes. "Businesses that ignore the potential of SOA will find themselves outpaced by rivals who improve their agility and transform themselves into new kinds of enterprises," says Gartner analyst Yafim Natis. Web services standards technologies are based on open standards service-oriented architecture recommended by the World Wide Web Consortium (W3C) [3]. The key Web Services standards are Web Services Description Language (WSDL), Simple Object Access Protocol (SOAP), and Universal Description, Discovery and Integration (UDDI) [4]. Both WAP interface and Web interface can use WSDL to access the system functions.

The Hajj Information System will support different access level (configurable LDAP based) structure, where user name and password are dedicated to the user to register and have access to the system with different rights. The system will also provide customizable report generator, capable of printing reports or saving report data to a file.

2.3 Database Layer

This layer consists of the underlying databases used in the system (Fatwa database, pilgrims' profiles, etc.) The main focus at this stage is on relational databases.

3. System Usage Scenarios

As discussed in the introduction section above, our proposed system aims as training people before they arrive in Makkah for Hajj and provides them with guidance and up-to-date information during the Hajj period. This section discusses some scenarios of using the system.

3.1 Using the Voice Interface

This section describes the Hajj Information System voice access. This interface is implemented as a finite state machine. Figure 2 shows a typical scenario of using this interface. In this figure white rectangles represent states in the dialog. Inside each state the text at the top is what the system speaks to the user and a colored box encloses the text of a possible user's response. Arrows represent transitions from one state to another. Typically, the transition target depends on the user's response. An oval box represents an action that the application makes.

We have implemented a prototype voice access interface for the Hajj Information System using Nuance V-builder and Voice eXtensible Markup Language (VoiceXML). VoiceXML is a powerful markup language for representing human-computer dialogs. This language assumes a voice browser with audio output (computer-synthesized and/or recorded) and audio input (voice and/or keypad tones). However, to fully implement the voice access interface the following requirements must be taken into account: (1) the dialogs must be system driven where the system lead the conversation; (2) the dialog will proceed if and only if each question is being answered; (3) the user must be able to speak naturally; (4) the user must be able to request help at any time.

3.2 Using the Web Interface

The Web interface can be used for training people before they go for Hajj or give them the required information during the Hajj. Figure 3 shows the stages of the training process. To start their training, users need to register themselves to the system. All they need to register is a working email address. After registration they will be issued a user ID and password. This information is needed to update the trainees' profiles and test their skills. The reading material is divided into multiple lessons in a programmed learning approach [5]. This approach organizes the reading material into small pieces of knowledge that can be quickly grasped and easily remembered [6]. Lessons are provided in two languages, Arabic and English, other language are going to be added subject to the available funding. Lessons also include Multimedia sessions where users can listen and view the real actions. After each lesson the user's knowledge is tested. Users cannot go to the next lesson until they pass the previous one. This process goes over and over until they read all lessons and pass the self assessment tests. At this stage they are ready to take the final test. This is a comprehensive test based on multiple choice and true/false testing schemes. After submitting the test the system will display the final score with the correct answers increase the benefits of the system. People can delete their profile and start fresh at any point.

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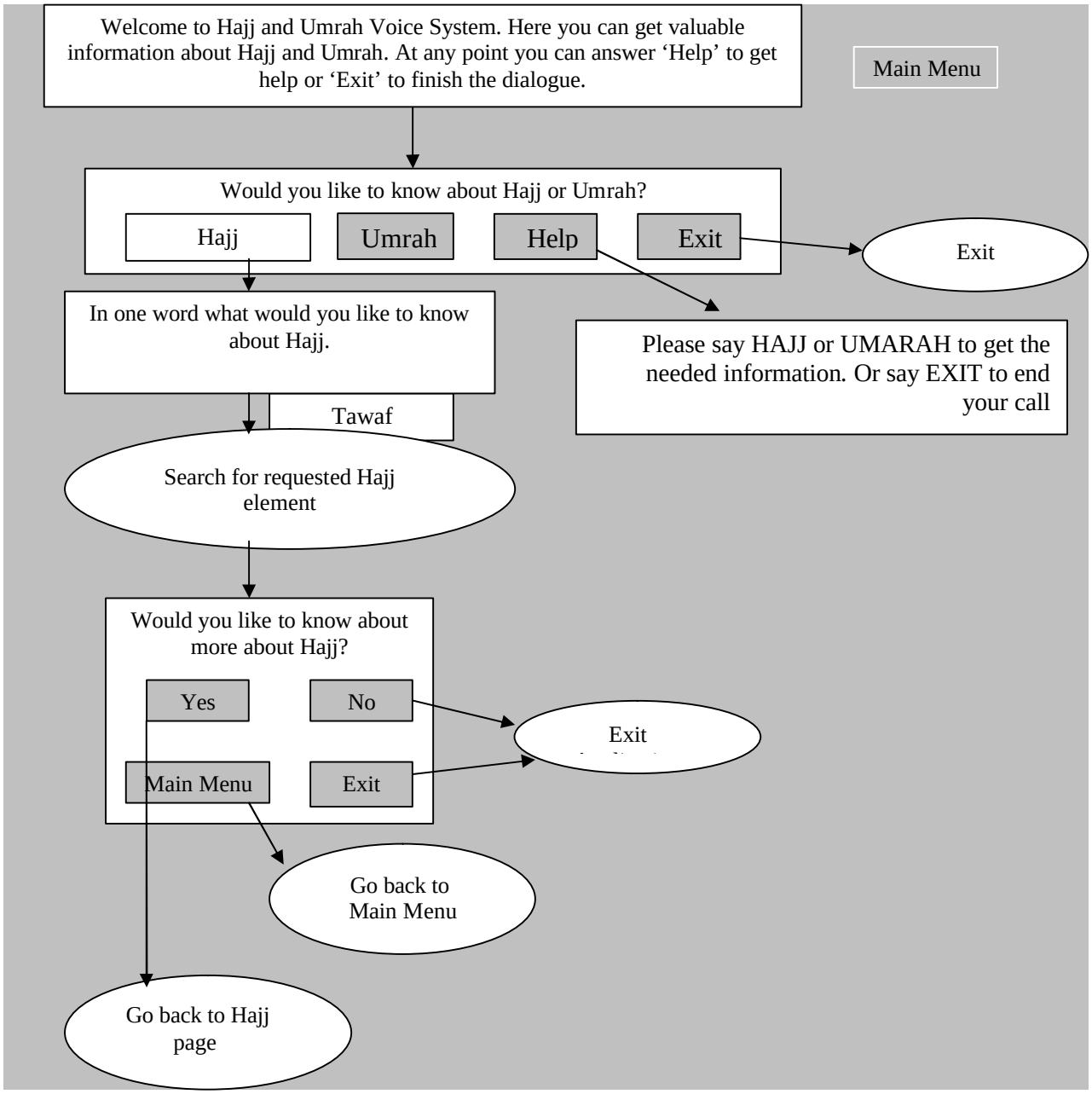

Figure 2: A Typical Dialogue flow for HIS Voice Access.

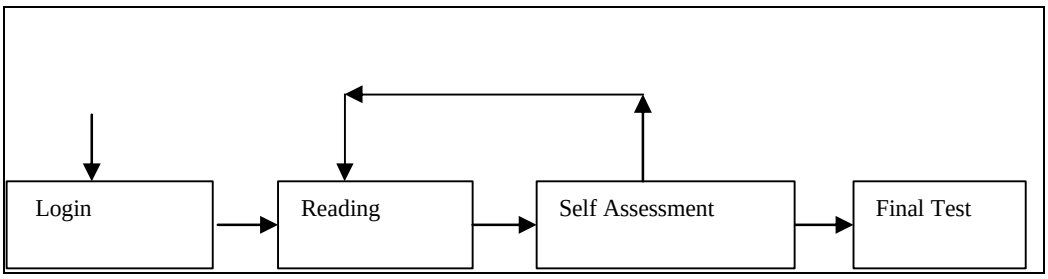

Figure 3: the Training Process Stages

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We have implemented a prototype for the Hajj Training module. Apache is used as a Web server [7], PHP as a scripting language, and MySQL as database server [8,9]. The information we collected for this purpose comes from well trusted Hajj books according to the Sunna of the prophet Mohammed (Peace be upon him) and the holy Quran. Snapshots of the prototype system are provided below. For training purposes we followed a programmed learning approach. In this approach information is divided into chapters of small lessons (see Figures 4) and is delivered in sequence. The user is asked a simple question after reading each page of information. At the end of every lesson the user is tested using a multiple choice test (see Figure 5). The result of this test is stored in the database and the user can take the test many times.

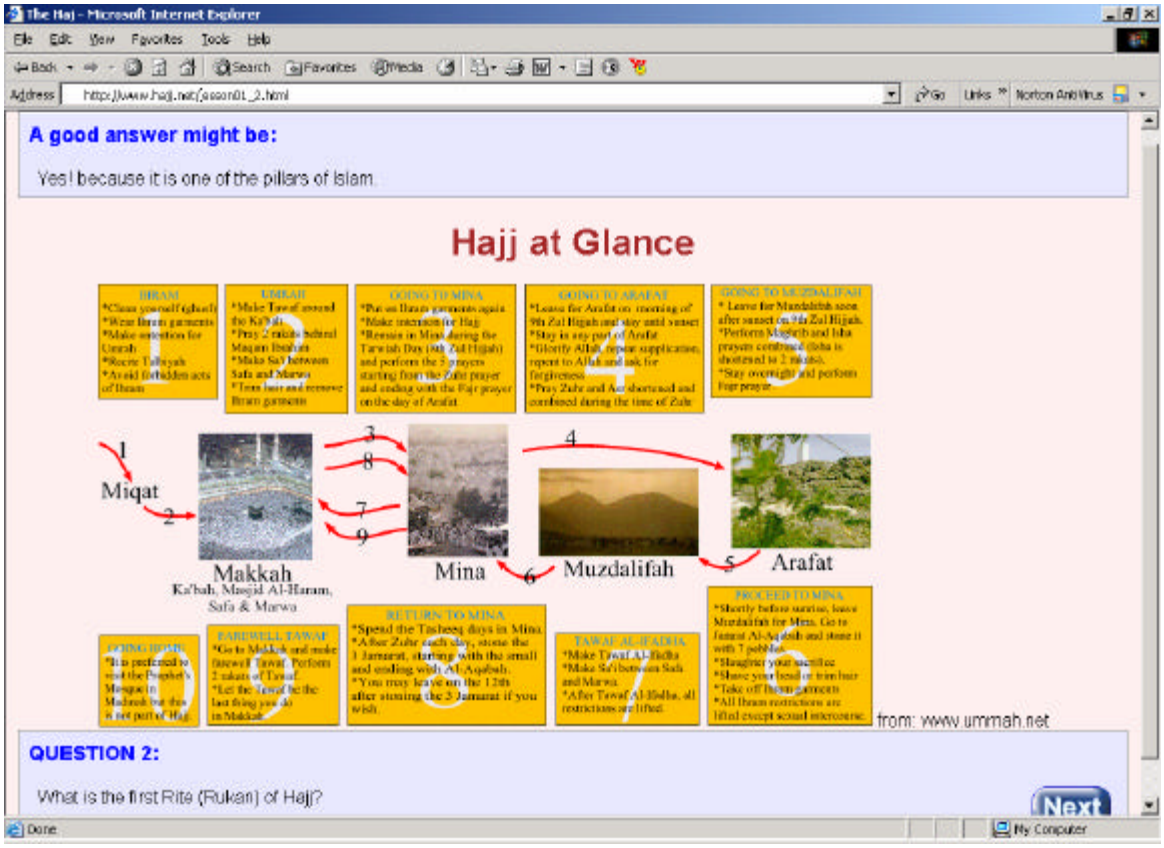

Figure 4: Hajj At Glance

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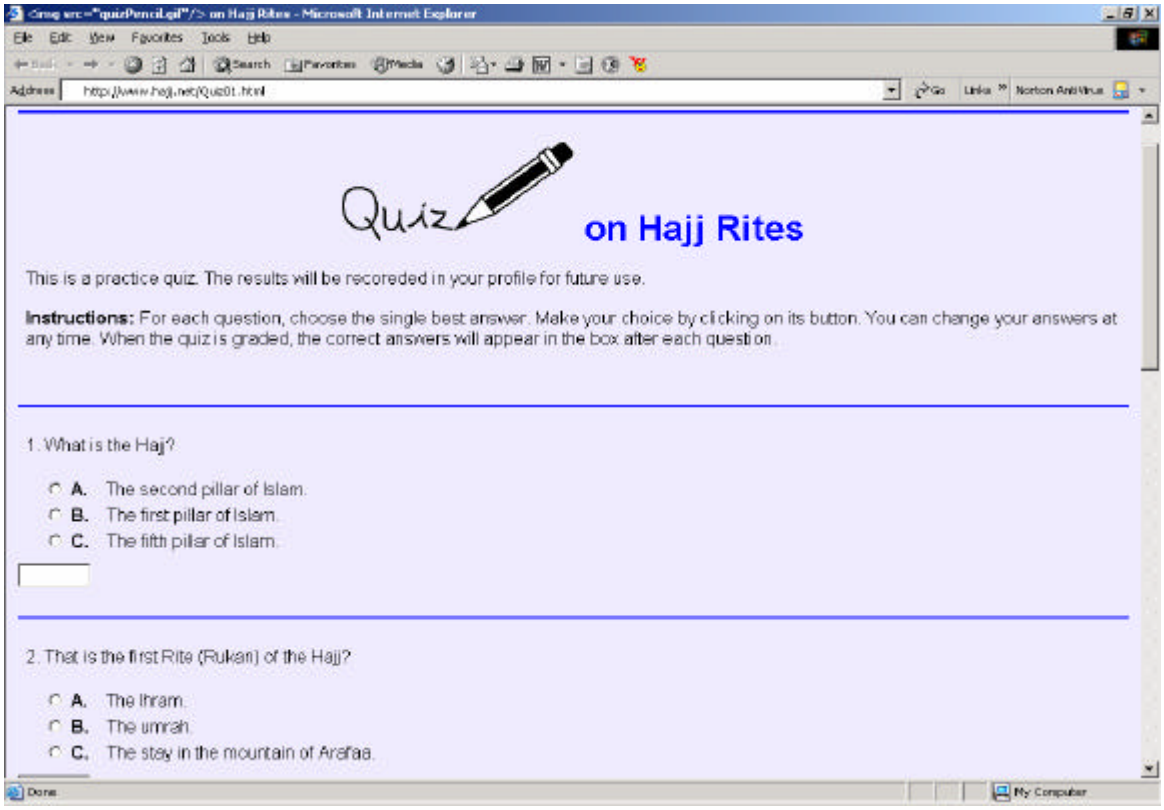

Figure 5: Sample Quiz on Hajj

3.3 Using the WAP Interface

The WAP interface is used to enable mobile phones to browse Web pages. Communication between a common web server and a WAP-enabled wireless device, in principle, is much the same as that between the web server and the traditional PC-based browsers. However, there is an extra step in the WAP technology. This extra step involves the transfer of information by a WAP gateway. WAP gateways serve as intermediaries between the client-based wireless browser and an information server. This service is provided to allow people to access essential information quickly during the Hajj period.

4. Conclusion

We have defined the architecture for a Web Services-based Hajj Information system. This system architecture is based on recent techniques of the Web to provide a powerful system. We highly believe that the implementation of this system is going to the Hajj much easier both for pilgrims and for organizers.

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