



## Accessing Academic-Related Materials through WAP Protocols



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**ABSTRACT:** Nowadays, wireless technology has been widely used in various applications. Mobile Internet users have been increasing rapidly around the world. Several benefits of using mobile internet includes transmitting data through querying and updating databases, e-commerce transactions and daily business application as well as in education such querying examination results. This paper presents the development of a mobile database application to enable students to access the teaching materials such as lecture notes or tutorials using supported mobile phones or Personal Digital Assistant (PDA). Students could also use the system to access class information and check the course work for the enrolled class. The idea of this project is to employ Wireless Application Protocol (WAP) application in the learning process to overcome time constraint problem and it is the effective method for accessing information as mobile phones is used by most people. Wireless Markup Language (WML) is used to provide user interface at the client device while Active Server Pages (ASP) for server transaction process.

**Keywords:** WAP Application, Prototype Model, Relational Database, E-learning.

**Received:** 12 March 2009, Revised 18 August 2009, Accepted 23 August 2009

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### 1. Introduction

The rapid growth of the World Wide Web, has made information dissemination becomes more crucial as the information has expiry dates. Since the Internet were introduced, the trend is clear that the web technology has moved and distributed pervasively in most mobile devices due the increasing number of mobile users. It has been predicted that the number of mobile user keep on increasing more than the number of personal computer users (Hwang, Tseng, and Huang, 2002). Wireless Application Protocol (WAP) was developed with the intention to support application programming for resource constrained devices such as mobile phones and Personal Digital Assistant (PDA) (Mujib, 2002) which are access wirelessly. In relation, the increase uses of WAP-enabled devices led to many web sites creating wireless content. This made the access to networked content exponential, and highly ubiquitous. Moreover, WAP was the initial technology leading ideas to designing various wireless applications (Aalto, Gothlin, Korhonen, & Ojala, 2004).

The WAP takes a client server approach (Schbach, 2004). The WAP client is usually a handheld wireless device containing a micro browser. To create wireless Internet content for WAP-specific technology, a Web site should create special text-only or low-graphics versions of the site. The data is sent in Hypertext Transfer Protocol (HTTP) form by a Web server to a WAP gateway. The system includes the WAP encoder, script compiler, and protocol adapters to convert the HTTP information to Wireless Markup Language (WML). The gateway then sends the converted data to the WAP client on user's wireless device such as the PDA (TutorialsPoint.COM, 2009).

A PDA refers to a mobile device which contains a micro browser for accessing standard internet site. Current available PDA technologies are equipped with various capabilities such as accounting utilities, entertainment utilities, communication utilities, and planner utilities. A micro browser is a small piece of software that makes minimal demands on hardware, memory, and processor. It can display information written in a restricted WML. Although tiny in memory footprint (compared to desktop computer or laptop), it supports many features and is even scriptable (Tikekar, 2001). Although several limitations of PDA were found in terms of reading, text highlighting, and note making (Waycott & kukuska-Hulme, 2003), PDA has been used widely in education because of its other benefits such as

WAP application has been utilized in various domains such as in education (ACM SIGGROUP Bulletin, 2001; Kiili, 2002), business (Shih & Shim, 2002; Juul & Jorgensen, 2003), entertainment (Hagleitner & Mueck, 2002), informative portal (Quah & Seet, 2009), and advertisement (Aalto, Gothlin, Korhonen, & Ojala, 2004).

This project discusses the process of constructing a wireless mobile application, using Wireless Markup Language (WML), Active Server Pages (ASP) and Visual Basic Script (VBScript) technologies for use within academic-related information retrieval. WAP technologies provide a lot of benefits for application that work with limited resources. With the technology, students can access the intended information quickly, in ubiquitous environment.

The wireless telecommunication and the Internet are rapidly growing and are gaining more and more customer everyday. In order to deploy a WAP application, an important issue that the developer needs to consider is to identify the benefits for bringing the application to the WAP platform. Supporting the benefits must be the primary goal of the prototype development. The most common problem in WAP development is that there are a number of limitations that reduce the performance of the communication.

WAP Forum (Forum, 2004) is an international organization established with the motives to define new protocols based on the constraints inherent within the mobile terminal devices and the communications network available for these devices. The constraints of computing environment in handheld terminals are:

- Less powerful CPU's
- Less memory (ROM and RAM)
- Restricted power consumption
- Smaller displays and different input devices (e.g. keypads).

Similarly, wireless data networks present a more constrained communication environment compared to wired networks (Klasen, 2002). Because of fundamental limitations of power, available spectrum, and mobility, wireless data networks tend to have:

- Less bandwidth
- More latency
- Less connection stability
- Less predictable availability.

The aims of this project are to develop a repository in the back-end computer and also to propose an application on remote accessing data repository. This work was mainly targeted for utilized by final year electrical engineering students in university campus. Through the developed prototype, the students can access lecture notes, tutorial, and other documents such as assignment or additional notes for registered subject from a database. The prototype assists students to access learning materials for each subject enrolled. These functions are popular with WAP technology as discussed by Steendered (2002).

This section discusses the WAP technology, and its use in previous works. Also, it introduces this paper in brief. Next, a section discussing on the WAP technology and prototype follows. Then the prototype development process is explained and results are obtained showing examples of shots of the prototype. Lastly the discussion and conclusion sections are outlined.

## **2. Background Study and Related Work**

There are three main technologies used in developing the prototype which are WML, ASP, and VBScript. WML is a markup language used for rendering content on client devices, in which the documents are valid XML document. Also, WML technology is optimized to work well on network with poor latency and on resource constraint devices.

The development of WML application is based on steps as follows:

- Write the WML decks and WMLScript files. This is a text editing step.
- Create bitmap images. Existing image is converted to '.png' format using conversion utilities.
- Run and test the application using emulator. An emulator provides an Integrated Development Environment (IDE) for testing the project and has a simulation of mobile device execution.
- Deploy to a production environment. This step means making WML document available via a Web server.
- Run the application on real mobile device.

ASP is a server side technology. There are a number of advantages of ASP in developing client server application over technologies such as Java Server Pages (JSP) and Common Gateway Interface (CGI). ASP is a powerful tool and no extra modules required because it is equipped with a built-in database interfacing element; a few choice of scripting language, and it incurs no cost because it is free. This technology has been used for creating dynamic content for the WAP applications.

VBScripts is a default language for ASP where it controls all available ActiveX elements. When requested, the script executes in the ASP environment and produces outputs to the requesting browser. In order to view the VBScripts in action, we need an appropriate web server installed and running on the computer. For Windows operating system, Microsoft's Personal Web Server (PWS) or Internet Information Server (IIS) are options of the web server. IIS is a set of Internet based services for Windows machines. The web server itself cannot directly perform server side processing but can delegate the task to Internet Server Application Program Interface (ISAPI) on the server.

Some previous related works on the development of WAP application have been reviewed. The work by Mujib (2002) has explored the motivation for the application development methodologies and the tools associated with it, for small mobile devices that employ cellular technologies. Two leading application development tools and technologies for small mobile devices which are WAP and Java 2 Platform, Micro Edition (J2ME) are among popular technologies (Lei & Hui, 2006; Mihailescu, Lee, Shepherdson, 2005). Azra et. al (2002), have developed a WAP prototype as a computer hardware information query agent with the main feature is the capability to handle the customer request on certain information about computer hardware. The application provides a better solution to the company to offer their services. Topland (2002) in his project developed a multi-channel e-learning services on the Internet in which the content is located at the same mode. The e-learning channels consist of web, WAP phones, PDA, and fax. Throughout this application, client with different devices (mobiles phones, PCs, fax, PDA) can access the application from the same mode. On the other hand, the work by Hwang, Tseng, and Huang (2003) developed an Intelligent WAP Site to help the mobile user. In short, J2ME has been used in many wireless applications (Umphress, Cross, Jain, Meda, Barowski, 2004).

These systems were developed based on a common architecture, which is adopted into this study also. Next section discusses about the architecture.

### 3. Architecture

Referring to the diagram illustrated in Figure 1 that depicts the common architecture for WAP applications, the cell phone is connected to the WAP server through a WAP gateway. The gateway manages relatively unreliable network connection to the phone. WAP utilizes proxies to connect between the wireless domain and the WWW. Ming-Zhi, Wei-Jie, Shui-Li, and Lun (2006) list A WAP gateway's typically functionalities as below:

- Protocol gateway – The protocol gateway translates requests from the WAP protocol stack to the WWW protocol stack. The WWW protocol stack includes HTTP and TCP/IP.
- Content encoders and decoders – The content encoders translate WAP content into compact binary-encoded formats to reduce the size of data transferred over the wireless network, while decoders translate content back to standard form.

The operational procedures are explained in this paragraph and the remaining. When a user makes a query, for example in the login process, the system translates the user's query, entered through a cell phone and connects to the web server. The server then executes appropriate processes on the result set from the database, converting the result back into a WML format, and retransmits the resulting WML data to the user.

In this operation, the WAP server functions similarly to the Web server. The WAP server processes the request from the WAP clients. ASP provides server-side scripting for IIS Web servers. ASP combines WML and embedded VBScript. IIS includes an Object Linking and Embedding (OLE) automation server that executes the VBScript and sends the output in WML form to the client. ASP scripts execute on the server, and they work with any Web browser because the browser receives only a stream of WML.

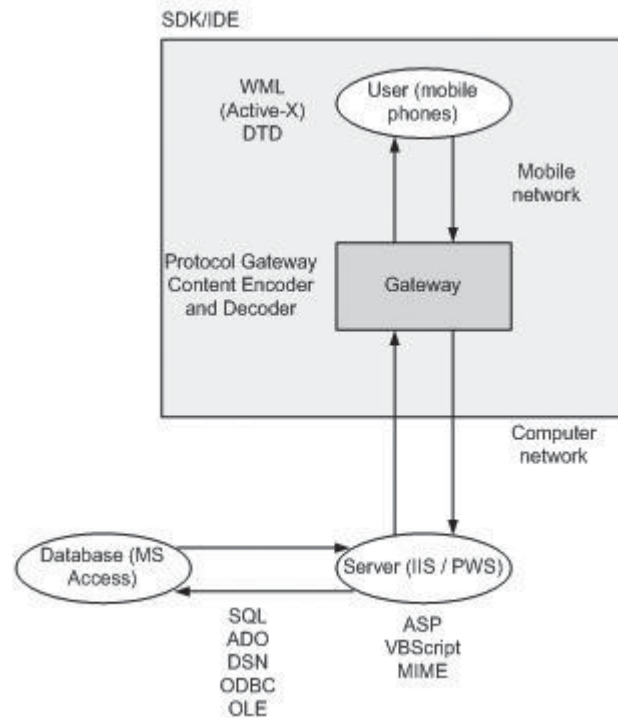


Figure 1. WAP architecture and interface elements

The Web server sends the WML page containing the ActiveX script to the client's browser, which is responsible for executing the script. Client-based scripting increased burden on the client. An ASP page, conversely, executes on the IIS Web server. While executing the page, the server passes any WML or client scripts that the ASP page contains to the client. When the server encounters an ASP server script, it executes the script and sends to the client any output that the script generates, in WML form. Because IIS interprets ASP on the fly, ASP is an ideal mechanism for incorporating the results of interactive database queries in WAP pages.

The aims of this paper were achieved by performing activities as discussed in the Methodology section which comes next.

#### 4. Development Methodology

The project focuses on designing user interface for the WAP application and designing database system for back-end repository to be integrated by the WAP application.

Figure 2 illustrates the methodology applied in this study. There are five phases: (1) identify and study the basic requirement, (2) develop initial prototype, (3) testing the prototype, (4) revise and enhance the model and prototype, and (5) deploy the real prototype. The prototype involved in this study is a working version, allowing users to interact and experience the functions provided.

Basic requirement covers the technology and functions to support users' tasks. The technology paper is focused in this paper and gathered from literatures. Functions provided to the users include ability to access class schedule, access notes, check test marks, and check final examination grades. In setting the requirement, the target solution is considered first before iterating the step in order to meet the user requirements as suggested by Brady (2000).

The requirements were used as the basis in developing the prototype. The technical specifications of prototype development are explained in the next section, together with the testing. The prototype was evaluated by allowing the real users experiencing the prototype. This is to make sure that the system is designed correctly.

Openwave Phone Simulator version 7.0<sup>1</sup> (Inc., 2004) was used in developing the prototype as the WAP emulator as suggested by Wesson and van der Walt (2005). There are a number of emulators available in the market either for free or commercial

<sup>1</sup>It is free, and available in the Internet.

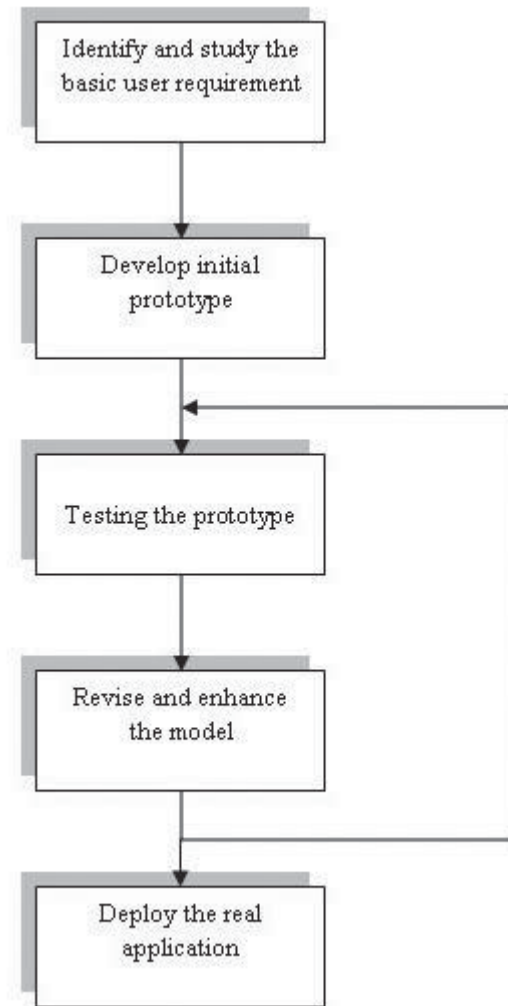


Figure 2. Basis of methodology

such as Nokia Mobile Browser and Smartphone Emulator Developer Edition. Besides it is free, Openwave Phone Simulator version 7.0 is used because it includes the Phone Simulator Windows that helps developer in debugging.

Limitations of WAP technology were considered when designing the prototype. The first step in the development process is to set the Multipurpose Internet Mail Extension (MIME). The MIME type must be set to enable the IIS recognizes and correctly processes the WML pages. If the MIME type is not set correctly, the simulator will not be able to support the content type. The MIME type is set as follows:

- wml - text/vnd.wap.wml
- wmlc - application/vnd.wap
- wmls - text/vnd.wap.wmls
- wmlsc - application/vnd.wap
- wbmp - image/vnd.wap.wmlscript

### 5. Implementation And Testing

The Microsoft Access 2003 database is utilized as the back-end data repository; which is used to develop the data model. The data model is a logical description of data storage. All the lecture notes, class information and grades are stored in a database called wapdb.mdb. This database contains five tables which are USERS, CA\_GRADE, DB\_GRADE, JAVA\_GRADE and CLASS\_INFO, LECTURENOTES\_JAVA and LECTURENOTES\_CA.

The default method to communicate with a database from within ASP is to use Open Database Connectivity (ODBC). It is using ActiveX Data Objects (ADO). ADO is an application program interface in Microsoft that allows Windows applications to get access to a relational or non-relational database from Microsoft and other database providers (Smith, 2004). In this application, ADO is used to connect ASP with the database. When accessing the database using ADO, the first required thing to be done is to make the connection. There are two ways to create the connection either using Data Source Name (DSN) or without DSN (DSN-less) (Smith, 2004). In this application, the DSN was utilized using the following code:

```
set conn = Server.CreateObject("ADODB.Connection")
set rs=Server.CreateObject("ADODB.Recordset")

Query = "Select * from student"

conn.open "dsn=wapdb"
rs.open Query
```

The WML is the main technology used to create user interface for the WAP devices. It is a highly structured language that needs great care. The basic of WML is it consists of card and deck. Deck is a combination of multiple cards. Each time new deck is created, they must be declared. The declaration is shown in Figure 3.

```
<?xml version = "1.0"?>
<!DOCTYPE wml PUBLIC "-
//WAPFORUM//DTDWML 1.1//EN"
"http://www.wapforum.org/DTD/wml_1.1.xml">
```

Figure 3. Declaration of deck in WML

The declaration is essential to establish the version of the WML used and confirmed by the WAP browsers. WML also requires a Documentation Type Declaration (DTD). If the DTD is not used, then the browser will not recognize it because all the WAP browsers look for the DTD declaration. For the purpose of creating dynamic WAP application, WML is used with the ASP technology.

This application is made up of two distinct processes; the login process and the services application process. The login process ensures that only enrolled student for certain subject have access to the application. The application process contains information of lecture notes, class schedule, test marks, and final examination grades. Figure 4 pictures the process flow of login and application services.

When tested with the real users, it was found that the functions including checking class schedule, accessing lecture notes, checking test grades, as well as checking final examination grades work appropriately. The "Welcome" home page acts as an entry page for the users to the application. It contains a link called "Info" that displays the developer email which can be used by the student if they face any problem with the application. Then the first process begins. The user needs to enter correct username and password to go through the application. Once the users have passed the login process successfully, they could use all the modules provided. The user needs to choose their course and the subject to find the lecture notes, class information, and grades. Some examples of the application are shown in Figure 4.

## 6. Conclusion

The most important thing to note in the WAP application development is to find the devices that supports or compatible with the developed system. For instance, three important things that need to clarify in the early stages of the development are supported mobile devices or PDA, markup language to be used and the language for server processing.

For the next phase, this application will be used in real-time implementation in a university campus to assist student in their learning. Feedback from users as well as academic staff will be obtained so that improvement can be made. In addition, in order to make sure that the application is suitable and practical to be used, it is essential to consider feedbacks from the application's administrators in terms of reliability, and security.

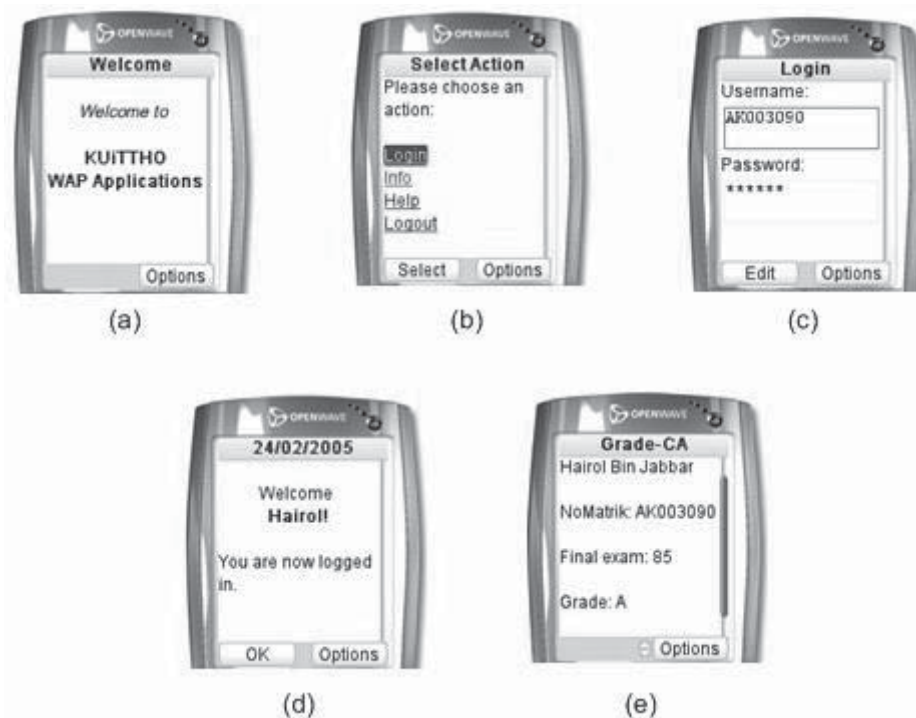


Figure 4. User interface of the application: (a) welcome page, (b) links provided, (c) login page, (d) authentic user, and (e) final exam result contains mark and grade

The development of the prototype has been done with intention for widening the existing method for accessing information particularly in the learning process. We proposed the Wireless Application Protocol (WAP) application technology that provides a number of benefits to the student in accessing information. With the integration of database component, dynamic WAP application is created in order to deliver useful information to the students.

The prototype developed in this study will be further experimented in future to test in terms of user acceptance and usability specifically on time taken to accomplish a task, number of errors made for each tasks, and number of clicks for each task completion (Preece, Rogers, & Sharp, 2007; Dix, Finlay, Abowd, & Beale, 2004). In relation, the study by Condos, James, Every, Simpson (2002) could be adapted.

#### Acknowledgments

We would like to thank Norman Mohamad Noah (Assistance Officer of Information System, UTHM) for discussions and comments about this work. We would also like to thanks for anonymous reviewers who give useful advices on this paper.

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