A Multi-Channeled Learning Materials Indexing & Enquiry System

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Abstract. Lecture slides are commonly used in university to support teaching and learning. An effective way to organize and access slides will enhance the education quality. This paper presents a software system that allows instructors to index slides for student search and enquiry. The web-based system can be accessed with multiple channels of wireless handheld devices and wired desktop and laptop computers for added flexibility and convenience.

1. Introduction

In this information era, the World Wide Web has become an important resource to get information. Web-based online learning is commonly used in education, with the early computer-based delivery and the prevailing learning/content management systems delivering technology-driven learning contents. However, there are a number of drawbacks.

In university, slides are commonly used in lecture. These slides are created by instructors, and students are the users. In the use of these slides, there are little inputs from students, except that students make their own notes on the slides as needs arise. The delivery is mostly a one-way flow, with instructors having the rights to contribute learning materials. There are little opportunities for students to contribute. Students will also find it difficult to search slides when there are hundreds or thousands of slides. Availability of effective search facilities will enhance student study and understanding. Also no search engine is available to conveniently enquire materials. The accessibility to web sites is limited to wired desktop computer, constraining the mobility of users. Access with handy handheld devices, which has yet not been part of current features, will facilitate interactive learning with instant information browsing. Lustigova [1] suggests that a two-way leaning object repository should be developed. He indicates that a high quality and user friendly system should have an effective search engine, rights of contribution and public accessibility. Technology should be involved to address and alleviate these problems.

This paper presents a web-based system for retrieving learning materials through multiple channels of desktop and laptop computers, and wireless handheld devices. The system allows students to index, search and access learning materials, particularly lecture slides.

2. Technology and Learning

2.1 Multiple Channels Technology

Based on current computer technology, there are different alternatives for the online access of learning materials. The desktop and laptop computers are based on the prevailing hardware technology and have been on a continuous trend towards smaller in size, higher processing power and cheaper cost for over fifty years. The newer mobile technology [2] is penetrating in our daily livings. Handheld mobile phones and personal digital assistants (PDA) can be seen everywhere. Using the wireless devices in learning will let students learn anytime, anywhere and any pace without the fixed and wired restriction. These devices are also moving towards smaller size and higher processing power and storage capacity, together with higher connectivity. However, majority of the existing systems are designed for PDA and Pocket PC (PPC). Only a few projects are based on mobile phones. There are three reasons to explain the phenomenon. Many people are still using 2G phones, which are weak at handling multimedia. And PDA and PPC are founded before smart phones, which directly affect the popularity.

2.2 Mobile Learning

Mobile learning refers to an innovative way of learning that uses wireless handheld devices in the teaching and learning process. Many publications [3-6] from the research community show a clear trend towards mobile learning. Though the technology is presently not mature enough, Currin [3] pointed out that the growth of mobile learning will be seen in the near future. A number of counties have engaged in mobile learning projects, for examples [4, 5]. Similar learning organizer systems have been reported [5, 6].

2.3 Learning Scenario

The following outlines three scenarios that we have pictured. They are carried out by instructors and students in the teaching and learning process and use multiple channels:

- Contribute lecture materials from desktop and laptop computers – With the lecture slides prepared, an instructor opens a web browser on a desktop/laptop computer and connects to the system. He uploads the lecture slides (in PPT format) to the server, which will convert the PPT to XML for later access. Both PPT and XML are stored in the server.
- Inquire lecture materials from handheld devices – A student suffers from broken leg and is staying in hospital. He uses his mobile phone to access lecture materials with the XHTML-supported browser. Through search by keywords, results in the

form of returned hyperlinks and files in XML format are downloaded and stored. He can study the leaning materials through the handheld device while still staying in the hospital.

- Inquire lecture materials from desktop and laptop computers – During study, a student needs to find information related to the lecture materials. She logons to the system with the web browser on desktop/laptop computer and enters the search criteria by keywords. The search results in hyperlinks and the file in PPT format are returned. She saves the results in local storage and then engage in detailed studying.

3. PowerPoint Indexing and Conversion (Conceptualization)

3.1 Parsing, Indexing & Searching

We make use of the parsing, indexing and searching techniques provided by Apache Lucene [7]. This includes Document Object Model (DOM), Simple API for XML (SAX) and Streaming API for XML for parsing (StAX). DOM parsing will be used when the application needs to recursively navigate, alter or have random access to an entire document at one time. SAX parsing will be used when simple read-only streaming is needed. StAX is used for streaming application with full namespace or multiple document requirements. Three steps are involved in indexing a document, namely converting to textual information, analysis and index writing. The search process includes parse query term, search from index and return results.

3.2 PowerPoint Conversion Alternatives

Many mobile devices do not support PPT files directly and therefore file conversions need to be done. In order to solve the problem of delivering online presentations, there are three alternatives to transmitting slides to mobile phone, as follows:

- Convert PPT to HTML document
- Convert PPT to image file
- Convert PPT to XML

There are pros and cons to each of these alternatives. For mobile phones with WAP2.0 service and XHTML, its browser supports the HTML format documents. The presentation contents can be showed completely as HTML documents are able to contain images, graphs and tables. This means that no extra works are needed for online presentations. However, HTML documents cannot be downloaded to the local drive in mobile phone. User needs to access to the internet every time in reading slides. The consequence is that user needs to pay for the GPRS charge for every Internet access. In addition, different web browsers result in screen displays with various formats, increasing the difficulty in controlling the interface display. For

instance, scrolling is unnecessary for one mobile phone but may not be true for another one.

With slides converted to images, such as in the Gif or Jpeg format, no extra application will be needed for opening image files on mobile phone, Similar to HTML documents. Graphs, tables and other non-text objects can be showed correctly. Though image files can be saved to local drive, the internet charge for accessing image files is high since the size of media elements is large. Furthermore, user needs to wait for a long time because the bandwidth is generally low for second generation mobile phone.

In the PPT slides to XML conversion, XML documents can be saved in local rive, which means that the user does not need to access the online presentations every time. The size of XML documents is small and fits the limited bandwidth, leading to lower GPRS charge and shorter waiting time. The display on screen is consistent and can be easily controlled. XML is the choice in the design.

4. System Description

4.1 Function

There are two ways for users to access the system, either with the fixed desktop/laptop computer or mobile phone. Desktop and mobile users are assigned different read, write and modify privileges. The system allows users to upload/delete PowerPoint slides to and from archive. The uploaded PPT slides are converted to XML documents. Students and instructors can search the lecture materials by keying n keywords. A full-text search is invoked and the query-matching documents, PPT for desktop computer and XML for mobile phone, are returned. Users can select and download the desired documents to local storage. For mobile users, the downloaded XML documents can be opened and viewed with the XML Viewer tool.

The following summarizes the main front-end functions made available to users in the respective channels:

- A login system function for both desktop and mobile users
- A file management function for both desktop and mobile users to view documents (PPT for desktop and XML for mobile phone)
- A file upload function for desktop users to upload lecture materials
- An enquiry function for both desktop and mobile users to search lecture materials by entering keywords

Other functions include PPT conversion, storage of learning materials, activity logging, XML parser and indexer. These functions are processed by the back-end architecture.

4.2 Architecture

The system is divided into two parts, the front-end and back-end architectures. The front-end architecture includes the followings:

- A web interface for access by both desktop and mobile users, and consists of login, file manager, file uploader, search query handler and display module.
- A XML Viewer that includes file explorer, XML parser and displayer.
- A mobile application for reading lecture materials on mobile phone

The back-end architecture includes a number of back-end services for supporting the front-end applications described above. These include file converter, batch job handler, index database, event log and web services. The index component comprises index database, indexing module, event log and window service.

4.3 Implementation

The entire system implementation employs multiple programming languages. The front-end system is implemented with JSP. The XML Viewer application that runs on mobile phone is programmed by J2ME. The back-end applications are implemented with J2EE, which mainly includes Java servlet, Java Bean and Java classes. The web and window service are developed with Visual Basic .NET and the WebService.Java class. All databases use MS-SQL Server.

5. Evaluation and Conclusion

There are limitations with both the hardware and software. File system must be used in order to open XML documents in the local drive of the mobile phone. Consequently the system requires a JSR75-supported mobile phone to handle the resided file system. It is assumed that XHTML-supported browser is included in the mobile phone. XML documents are encoded with the ISO-8859-1 standard. English is the only supported language, disabling multi-lingual support. As a result, the uploaded PowerPoint slides should not contain non-English characters. Further, only textual information are extracted from slides and converted to XML format. The generated XML document will not contain any non-text objects such as graph, image, etc. The format displayed on the mobile phone will probably be different from the original slides.

We have presented a web-based system that supports lecture slide materials through multiple access channels of wireless handheld devices and wired desktop/laptop computers. The system provides indexing, search and enquiry of learning materials, particularly lecture slides and facilitates two-way interaction. Different functions are allocated to front-end and back-end architectures.

References

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