

## **Experience in Developing a Mobile Course Portal**

Meng Xu, Mark Fountain, Scott MacArthur, Matt Braunstein, Raja Sooriamurthi  
MSIS Kelly School of Business, Indiana University, Bloomington, IN 47405, United States  
mxu@indiana.edu, mtfounta@indiana.edu, skmacart@indiana.edu, mcbrauns@indiana.edu, raja@indiana.edu

**Abstract:** This paper describes our experience in developing a mobile course portal for higher education institutions. The objective of this project is to bring a portal framework for collaborative work and distance education to students through the use of wireless web-enabled PDA, and similar other mobile devices as well. Through this portal, Pocket PC users on campus can easily access the Course Management System of their university. Indiana University at Bloomington is the base campus for our studies. The project was to build upon methodologies in teaching and learning with mobile technologies. Our portal also provides collaboration services for project team management and video classroom. Usability tests were performed on this portal and received positive feedbacks.

### **1. Introduction**

E-Learning can be defined as “The delivery of a learning, training or education program by electronic means. E-learning involves the use of a computer or electronic device (e.g. a mobile phone) in some way to provide training, educational or learning material”. [1] It is typically used, as an enhancement to, rather than a replacement of traditional face-to-face teaching. Extending learning to the mobile platform can greatly change traditional teaching process, extend the scope of education audiences, and improve the quality of learning. In 1999, a home-grown CMS (Course Management System) named Oncourse (<http://oncourse.iu.edu>) at Indiana University was built. As an e-Learning platform, Oncourse permits faculty and students to create, integrate, use, and maintain Web-based teaching and learning resources. It has been used by more than 80,000 students and instructors on IU’s core and regional campuses.

Indiana University is the top “most-wired” higher education institution. According to the survey of Intel, its Bloomington campus also ranks in the top as the “most unwired college campus”. [2] Based on the well-constructed wireless network, Oncourse services may be accessible via unwired devices, such as Mobile phone handsets, PDAs, tablet PC’s, etc. As the number of students who own at least one mobile device is rising, the demand for mobile Oncourse, which allows users to access Oncourse from any one of wireless access points on the IUB campus, is growing and has been fully aware of by IU.

As one of the major partners of the Sakai Project ([www.sakai.org](http://www.sakai.org)), IU is on its way to launch improved versions of Oncourse based on Chef framework. Mobility-oriented CMS services are one of the most important parts of it. In order to promote the development of Oncourse unwired services, a Mobility Competition [3] was held this year. Students from Kelley School of Business (KSB) Master of Science in Information Systems (MSIS) program, School of Computer Science, and School of Informatics worked as a team to develop a business case and a working prototype that would deliver course management services onto PDA, keeping in mind other mobile devices such as cell phones and Blackberries. Meanwhile, our projects have given Oncourse developers at University Information Technology Services (UITS) a wealth of insight in how students want to see their course information presented on mobile devices.

In this paper, we present the development experience in one of projects in this competition. The paper is organized as follows: section 2 discusses the design principle and important issues. The prototype system is introduced in section 3. The evaluation and usability test is presented in section 4. Finally we give the conclusion and future work.

### **2. Design of mobile Oncourse portal**

#### **2.1 Portal technology for PDA**

Providing unbundled services for wireless devices is one of the major trends in the development of CMS in the university. It is impractical and inefficient for individual university services to manage connectivity to the moving target of the emerging wireless world. The prudent path would argue for unbundled services connecting to the Portal, and then the Portal managing connectivity and evolution to mobile devices [4]. However there are many technical constraints in integrating Portal services on PDA such as limited screen size, limited functionality, no multiple-window support, etc. Therefore the key issues in building a CMS portal for PDA users are how to tailor appropriate services to the IE browser in a PDA

Currently, many CMS portal are based on MVC (Model-View-Controller) architecture to separate logic and data representation. The Model provides an internal representation of the data. The View displays data without incorporating significant business logic. The Controller determines what processing to perform and what steps to take next. PDA portal should share the same model as the normal portal for PC, and keeps its own View and control layer. The Struts framework [5] based on MVC architecture provides a good solution to build a PDA portal. Struts tag libraries provide a high level of functionality while making the Views more readable and easier to maintain. Furthermore, Struts has several other advantages, such as ease of configuration, which provides maximum productivity with minimum coding. The Struts architecture is not only pre-defined but also well proven, avoiding the need for the Portal Team to define its own. And finally, because of its well-defined architecture, Struts is almost self-documenting.

Integration of what users want and expanding upon it is the key in the design of the system. From a web-based survey of thirty IU Students and Faculty, we found that several services of Oncourse system are quite popular. However, due to the viewing, processing, and hardware restrictions of PDA, it is not feasible to implement all those services, such as some multimedia courseware. Finally, services implemented in our system include: Course Listings, Course Announcements, Course Syllabus, Course Schedule, Course Member Profiles, Grade Books, Personal Profile, Profile Search, Calendar and Personal Schedule, E-Mail, Weather Report and Bus Schedule Inquiry. In addition, our feedback shows that students are calling for more attractive tools to enhance the collaboration and distance education among university community members. So we decided to create a Team Space, which is a shared area for team members, and a Video Classroom, which provides not only live video for students who failed to attend a lecture, but also archive video to benefit viewers who are unable to watch the live webcast due to scheduling conflicts.

Just as mobile experience is quite different from PC experience, so is the mobile device website. We create three policies to guide the design of user interfaces for PDA. Firstly, we try to use simpler layout and easy-to-use menus that can comfortably fit onto the small screen of a PDA. This will make information less cramped and easier to read. Secondly, our design intends to make browsing user-friendly by reducing the number of clicks a user has to make in order to simplify browsing. To do this, similar menus have been implemented on every page. These menus allow users to access information for any course regardless of what page they are currently on. The easier it is to use and navigate Mobile Oncourse, the more likely it is that a user will take advantage of our program. Thirdly, Mobile Oncourse will reduce the amount of processing that is necessary to run efficiently. To do this, the use of images will be avoided whenever possible. Instead, more emphasis will be placed on clear and concise menus with text. Furthermore, Mobile Oncourse is primarily designed for students who are "on-the-go". Thus, reducing the amount of processing power required allows users to make quick references, which encourages usage of the program.

## **2.2 Webcasting technology for PDA**

With the growth of broadband networks, Internet broadcasting, also called webcasting [7], is becoming more and more popular. Webcasting technology enables a highly engaging and effective virtual classrooms and events. It fills the need for live instructor-student interaction while offering the immediacy and geographic coverage of Internet delivery. It also allows students to watch the archives of the old lectures on demand. Webcasting for wireless devices can include Mobile phone handsets and PDAs greatly enriches the streaming service of CMS system. If students and faculty can receive real-time and archived video/audio streaming by their mobile devices, our classes will be enlarged across the geographic boundary and available for people in anytime and anywhere. Since fast wireless connectivity has become more available, such an 'anytime, anywhere' virtual class will come into reality soon.

Technical constraints in delivering streaming to these mobile devices include:

(1) *Limited Network Bandwidth for Wireless Communication.* Video streaming usually demands high bandwidth for communication. For mobile device there are local network connection like 802.11b wireless Ethernet and global wireless network like GSM, GPRS and 3G. 802.11b wireless local network has the bandwidth 11Mbps, which is enough for medium quality of video and audio streaming. However global wireless network like GSM, GPRS and 3G can't meet our demand. In our competition, we only focus on 802.11b wireless local network for PDA.

(2) *Limited Capability of Mobile Devices.* Due to the limited processing capability, memory constraints and the power budget of PDA, we need a streaming player especially design for PDA, which implements video/audio codec with reasonable computing overhead and adapt the size and color scheme of the desktop video frame into PDA screen. Currently, major webcasting technologies include: Windows Media, Real [8] and Apple Streaming. Both Windows Media Player and RealOnePlayer have their version for Pocket PC. But we choose RealStreaming technology because it takes free distribution of key software in its strategy to compete with Microsoft and reasonable prices for extended services. The lowered prices and free software availability are very important to non-profit institutions, especially universities.

Fig. 1 below shows the architecture for RealStream webcasting. Helix Producer can capture live video and audio by camera and microphone, encode them into Real format and send them to Helix Server. A RealOnePlayer in a PDA connects to Helix Server and plays audio and video streaming in Real format. Our Web Server of mobile Course portal maintains the directory of all the RM files and live RM links. A course instructor can upload his RM files into RM archive database and create descriptions through the course portal. When he/she wants to make a live broadcast of some lecture, he needs to set up audio and video devices, start his Helix producer to encode the stream into Helix server and create broadcast description in web server.

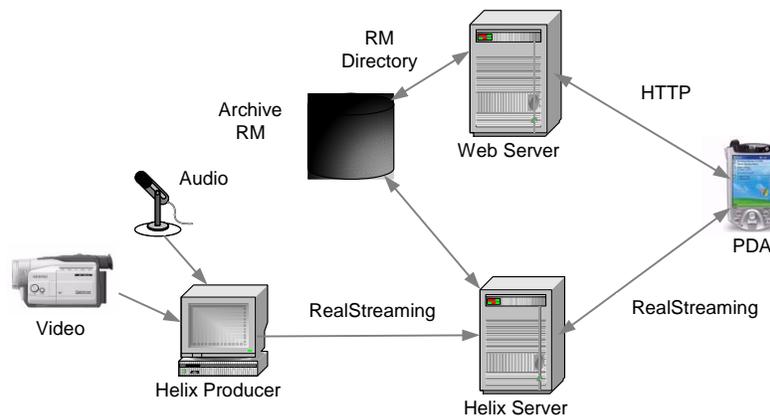


Figure 1. WebCasting for PDA

With the RealOne Player, Pocket PC users will be able to access and play RealAudio and RealVideo. RealAudio and RealVideo content can be streamed in real time directly over a wireless data connection, including 802.11b (Wi-Fi), GPRS and so on. The RealPlayer is available for any Pocket PC device that meets the minimum system requirements. Our competition uses HP Jornada 560 supported by RealOne Player.

During the implementation of webcasting to PDA, we found the bit rate of Real Stream file is the key issue to ensure the smooth video and audio. RealOne Player for Pocket PC can only handle Real stream with the bitrate less than 100kbps. If it is higher than 100kbps, you will get breaking video and audio. Therefore when a RM file has the high bitrate, it has to be transcoded into the format less than 100kbps before it is uploaded into Helix server. In addition, when a live Real stream is created by the producer, the proper bitrate must be set in Helix Producer.

### 3. System Implementation

A PDA Course Management Systems (CMS) are designed with a main purpose of keeping students connected together in all aspects of the "class life." They are designed as a collaboration framework for sharing information,

disseminating news and events and in general, allow the students and teachers to be in contact with each other when they are away from the classroom. Figure 2 shows the structure of the system we built.

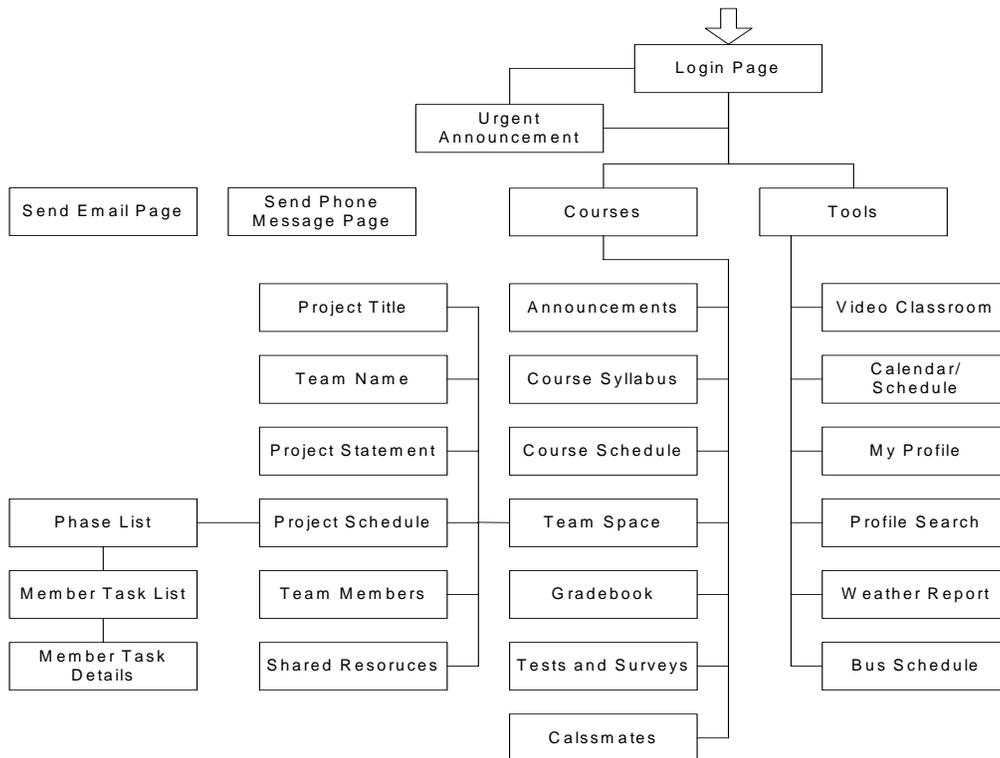


Figure 2. System Sitemap

### 3.1 Standard Features

All announcements, both urgent ones and normal ones, will be listed in the announcements area of each course. *Course syllabus* is uploaded by the professor. Students who are enrolled in the class will have the access to that syllabus via PDA. The *schedule* for a class lends itself for going hand-in-hand with the course syllabus. Professors have the ability to give semester-wide/weekly/daily updates for what will be covered in each class meeting. With *on-line grade books*, professors have the ability to post student grades as soon as they are graded. Not only will students be able to check their grades but they can also look at class averages and the like. Course members list the *contact information* of the instructor and all students in the same class. This is the area where users can click on a person's name and send them either an e-mail, or a phone short message.

Under the *personal profile*, users will have the ability to store information they wish to share with other users. They will be able to store their e-mail address, phone number, webpage and a catchall for other information. *E-mail* via the web is an important aspect for any CMS and the Mobile Course is no exception. Instead of forcing the user to find their e-mail application or go to another computer, we give them the power to e-mail directly from mobile course system.

### 3.2 Additional Features

Our group developed additional features that add to the strength of using the PDA. These features include the ability to create and maintain a group team space, view a live or archive webcast of the classroom, view bus schedules for all buses on campus, and check weather in the for the campus area. The following is an in-depth look at those features.

(1) *Team Space* is designed to facilitate the collaborations among team members. Team space can be used to share schedules, send e-mail and phone messages to team members, post pertinent team information and share resources

in an environment that is secure and available while on the move. One of the major parts of Team Space is the Team Schedule. Team Schedule is maintained by the team leader and shared by all team members. Here, team leader is able to create several phases he think are needed to implement the project. He can also assign tasks to each member during a specific phase, and set a deadline to each task. Moreover, team leader has the final say of the status of each task assigned to the team members. If the task has been finished on time, team leader will change the status of this task to “Done”; otherwise, the status will be set to “Delay”. Team Schedule gives each team member a better understanding of the role he plays in this team. Maintaining such a detailed schedule may help team leader keep the progress of this project under control. Figure 3 is the snapshot of several pages in Team Space.



Figure 3. Team Space tool in Mobile Oncourse Portal

(2) *Video Classroom*. With live webcast you can open your PDA and watch the lecture live, from wherever you are on campus! This is a fully functional web cast with both audio and video output. In addition to live streaming video, the video streams can be captured and stored for later viewing. The streaming video uses RealOne player for pocket PC, a free, highly available program for viewing movies. Figure 4 shows two pages of Video Classroom. The left one lists all the available videos, live and archive, for the user. A live lecture webcast allows students to watch the presentation at the same time as their peers. A webcast can be recorded for future replay on demand, thereby benefiting viewers who are unable to watch the live webcast due to scheduling conflicts. In addition, we also created an area for students to submit their questions or comments. This area allows remote viewers the opportunity to interact with the speaker, thereby providing a more valuable learning experience. The figure to the right shows you what students are able to see on PDA, after he/she clicks the viewing icon on this page.

(3) *Bus Schedule*. The Indiana University bus system is a busy system with 79 bus stops across the campus and a total of 5487 registered bus riders this year. On top of that, the schedule for busses changes throughout the week! With all of this information and all of these users, there are a great number of people who would benefit from having a copy of the bus schedule from wherever they are.

(4) *Weather Report* provides detailed weather forecasting information for the next three days. Indiana University has eight campus locations. Due to the limited screen size, our mobile course system only provides the weather report related to the campus the user belongs to.

## 4. Usability Test

Our main usability test was conducted on Indiana University students. We also had the pleasure to invite a project manager from Eppley Institute, which is currently developing courses on-line for the National Park Service, to take our test.



Figure 4. Video classroom in Mobile Oncourse Portal

The usability focus group had positive feedback on the user interface and system in general, with all respondents giving the system between a 4 and 5 rating on a 5 point scale. 15 out of 20 people think Video Classroom is their most favorite feature. Many of them love Video Classroom and Team Space both. Respondents also gave us many constructive suggestions on the screen navigation. For example, in selecting classmates to send email, many respondents suggest us adding a “Select All” box on the top of the name list; many buttons should be changed to say “Add” instead of “New”, etc. All these changes made the screen layout more apparent and easier to operate by users, even the first-time PDA user.

## 5. Conclusion

This paper describes the project in the Mobility Competition for graduate students from Indiana University. In this project, we design a mobile course portal for Pocket PC users in the campus. Through this portal, Mobile users can easily access the Oncourse system of Indiana University, and use the classic services including: course syllabus, course schedule, grade books and so on. Moreover, the portal provides collaboration services for project team management and video classroom. Usability test was extensively performed on IU students and gave positive feedback. Video Classroom is the most impressive feature. And many of them love Video Classroom and Team Space both.

In the future, we would like to improve our portal in collaboration and wireless communication. More collaboration services like video conferencing can be added into mobile portal. And more mobile communication tools for global wireless network should be supported, include SMS service (short message service) and Streaming over GPRS.

## 6. References

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