Work in Progress - A Mobile Computing Collaborative Framework for Problem-Based Learning Environment

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Abstract - Problem-Based Learning (PBL) is an important and effective learning technique. The increasing speed and capacity of computing and wireless communication and the decreasing costs of hardware components has made mobile personal computing a viable platform solution to the barriers incurred in the typical PBL process. Wireless infrastructures are becoming a standardized commodity. This paper deals with the development of various design principles, and methods that emphasize the effective integration and utilization of mobile solutions to construct efficient, robust, and reusable software modules in the context of a university's learning environment in computer engineering. A mobile personal software system framework has been developed and prototyped. The system framework supports several important factors involved in a PBL environment, such as resource sharing, cross-functional teamwork, and efficient information distribution. A mixture of modern personal pocket and tablet PCs, Wi-Fi and Bluetooth technology is used for the platform.

Index Terms - Mobile computing collaboration framework, Problem-Based Learning (PBL), pocket PC, resource sharing.

INTRODUCTION

Mobile computing and communication technology has been making significant advances in the recent years. Today, many new software and hardware products are being developed and produced for commercial use. The design and implementation of mobile solutions to facilitate various customer applications and to generate significant benefits are becoming a challenging and critical issue.

Problem-Based Learning (PBL) is a pedagogical strategy for posing significant and contextualized real world situations, and providing resources, guidance, and instruction to learners as they develop content related knowledge and necessary problem-solving skills.

In this paper, we will focus on how to use current mobile computing technology to design solutions to facilitate the problem-based learning process. The solutions can be applied in any typical learning or working environment. We will present a mobile solution framework to address major barriers encountered in a typical problem-based learning environment.

ADVANTAGES AND BARRIERS IN USING PBL

There are several major advantages in using PBL:

- To engage team members in structuring solutions to deal with real life, relevant, contextualized problems. Because the learning approach uses discussion forums, faculty mentoring process, and collaborative research, team members become more actively involved in learning the meaning of the target problem, and not just facts.
- To help team members become more responsible for their own learning. They would need to learn how to utilize resources themselves, such as on-line web searches, articles, library books, or journals.
- To build team members’ knowledge on desired subjects and skills. The use of real-world context and consequences in PBL can produce more profound and durable learning experiences for team members.

There are also some major barriers identified in using PBL.

- In a PBL environment, sharing research and knowledge in a team can be a great challenge. The potential team dynamics could lead to some conflicts and disagreements, potentially making the team counter-productive.
- It is a challenge to synchronize all team members’ activities to generate desirable progress or productivity.
- The information cannot be shared or discussed among the team members in a timely fashion. Team members would need immediate feedback or input to make decisions.

A MOBILE COMPUTING COLLABORATIVE FRAMEWORK

In this paper, we use a generalized PBL team format. The team includes a group of people (about 5-6 people) that work together to learn or work on a subject or project. They have different backgrounds, such as academic disciplines, skills and expertise, and working experiences. The PBL team is equipped with mobile computing devices with networking capabilities, such as Pocket PCs, Tablet PCs, Laptop PCs and Smart Phones, to support their activities.

The presence of wireless computing could be any time and any place. Their infrastructures are gradually being deployed in public areas, such as offices, schools, coffee shops, libraries, airports, shopping malls, or other popular...
places to enrich the user’s experience or to browse the Internet to access most current information as needed.

I. Design of Mobile Collaborative Framework

The Mobile Collaborative Framework (MCF) is a system framework consisting of central repository hosts and collaborative client applications for each class of mobile devices that the system supports. The number of central repository hosts in a MCF system framework depends on the nature and the size of workload. The function of a repository server is to store, to merge, and to distribute the teamwork information. Mobile computing devices usually have relatively less storage capacity available to use. Therefore, not all information that needs to be shared can be replicated for each individual member. The MCF system is designed to reduce the barriers encountered during the PBL implementation and to strengthen the advantages identified. The system framework is a mixture of centralized and replicated repository hosts to allow users to work either online or off-line and to minimize the amount of data transfers between hosts and mobile devices. It is intended to minimize the usage of the local storage on mobile devices.

There are three PBL oriented collaborative software components being developed: “Bookmark Sharing,” “Calendar Synchronization,” and “Collaborative Editors”. The components are designed and implemented to effectively utilize various capabilities provided by mobile computing devices. The Bookmark Sharing application is designed to demonstrate the capabilities in collaboration on Smart Phones and Pocket PCs. The Collaborative Editors is a component on Tablet and Laptop PCs. And the Calendar Synchronization component is designed for the Pocket PC environment.

The software in the Mobile Collaborative Framework consists of repository server software and mobile client software. The repository host is connected with a database, which can be of any kind of relational database management system. The Microsoft’s software development platform Visual Studio.NET is used to implement the MCF.

II. Distribution of Information

The MCF system framework is a centralized and replicated information system. Because the mobile users do not always connect to the network and are allowed to work off-line, the MCF is not designed to be completely centralized. If it were a replicated system, the performance would be inefficient and cumbersome. Sometimes all the intended users may not receive a broadcast message, as not all the users are continuously connected to the network. Thus, the MCF is designed to keep all the updated information stored at the repository servers, but the updated information is distributed to the users when their mobile devices are connected to the network.

COLLABORATIVE SOFTWARE: BOOKMARK SHARING

Knowledge sharing is one of the important characteristics of the PBL. The Internet is an efficient starting point to search for information. As a team member finds project related source information on the Internet, the link URL (Uniform Resource Locator) of the source is usually given to other team members by email or other manual methods for information sharing.

The Bookmark Sharing application allows a team member to quickly distribute a web link (URL) to other members’ bookmark information in their mobile computers. In each team member’s bookmark folder, there is a special “Team” folder in which all the identified web links can be shared.

The repository host contains a centralized bookmark folder where team members can download or upload their web links information. Once the team members are connected to the repository host, all new web links are downloaded to their local bookmark folders. Once a web link is added, modified, or deleted in the centralized bookmark folder, all the working on-line users can receive a real-time notification and bookmark update.

At the client side, the Internet Explore browser stores bookmark information in the “Favorite” folder, and each web link is saved in the .html file format. All web links in the “Favorite” folder are kept in the local database of the mobile computer. Periodically the client software analyzes the “Favorite” folder to look for bookmark updates. If there is an update found in the “Favorite” folder and the user is connected to the repository host, the client software would upload the new updates to the repository host. On the other hand, whenever the client software receives a bookmark update notification from the repository host, the change is reflected in the local “Favorite” folder. The client user is notified when there is a new link downloaded to the local bookmark folder.

CONCLUSION

A Problem-Based Learning team is a multi-disciplined team using the unique process to work on some designated complex problem. Although the traditional PBL approach is powerful and meaningful to the learners, some major barriers, such as communications and resource sharing, have limited the actual advantages and benefits.

The Mobile Collaborative Framework (MCF) provides an effective and robust mobile system framework to construct and to integrate mobile computing collaborative software components to enhance the PBL learning experiences and results. The Bookmark Sharing, Team Calendar Synchronization, and Collaborative Editors are the initial mobile collaborative components designed to demonstrate how the mobile computing devices can be used effectively to support various components PBL activities.

With the implementation of MCF platform and its mobile software components to support PBL approach, the major PBL barriers are significantly reduced in our pilot studies. The users have become more willing to use the process for their learning activities due to the attractive functions and features provided by the platform and the mobile software components. Moreover, the overall learning productivity of the team is significantly increased.