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An Architectural-Model for the Mobile based E-Learning Environment

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Abstract— Mobile learning solutions have become a real interest due to the fact that mobile devices have a growing market share and have become somewhat indispensable to modern life. Our goal is to develop e-learning system that performs personalized delivery of course content according to learner contextual information such as learning style and characteristics of the learning device. In this paper we proposed architecture for a context aware adaptive e-learning system that performs adaptive delivery of learning material in course based e-learning environments.

Key Words: E-learning, Context-aware, Mobile devices, Architectural model

I. INTRODUCTION

M-learning is a concept that appears more and more often in the context of mobile devices and mobile technologies evolution. The learning process has evolved from the classical classroom teaching to the computer assisted learning and even further to e-learning and m-learning. The main advantage of computer based learning is that learning resources can be accussed anytime and anywhere by using wire-less or classical networks. Converging from computer based learning and mobile devices use; m-learning allows users to stay connected with the learning environment, learning resources, colleagues and teachers no matter where they are. Thus the learning process is no longer tied to a certain location and depends only of the willingness of the learner in accessing the learning resources. Devices classified as mobile vary from note-books to smart phones, PDAs and tablet PCs. Some of the main challenges that arise in the use of m-learning are: the access to information from devices that run on different plat-forms and the different capabilities of those devices.

II. BACKGROUND

Context data: Context information includes two categories: learner's request and learner knowledge. The first category is the information obtained from the learner's request such as location, interval of time to learn and concentration. These factors require the learners to fill in before they participate in the course. In this model, we define location as a place where the learners use mobile devices to take part in the course.

Learner modeling: One of the most important information in this layer is learner model data that is basic to select adaptive course content for different learner. It is designed from context factors as well as learner's knowledge. Because all context factors are represented by discrete values, the learner model also is described by them. In this model, we assume that learner model depends on context factors and learner knowledge.

Adaptation layer: Adaptation layer include some functions designed to adapt learning materials for each learner. Based on the results of test as well as learner's background, Learner's knowledge evaluating component used to identify how learner's knowledge level is. Learner modeling component is constructed to determine all of the context factors such as location, time to learn, and learner's knowledge of different learners affecting to adaptation. The heart of this layer, learning resource selection component, is used to select appropriate adaptive learning content for each learners according to their learner modeling.

III. LITERATURE REVIEW

Our literature review presents recent context–aware e-learning applications for selecting appropriate learning resources based on learner context. Now, we focus on several typical applications AL-MEKHLAFI, K., HU, X., ZHENG, [1], context-aware location-independent learning, teaches Chinese to the students whose language levels are not enough to make conversations in Chinese by supporting appropriate sentences to different learners based on contexts. The CAMCLL context includes time, location, activities and learner levels. Adaptive engine of CAMCLL is based on ontology and rule-based matching.

Cui, Y., Bull, S., [2] teaches English language to foreign students through meeting their demands. Learner model is designed based on four context factors: location, interruption/distraction, concentration and available time. Appropriate learning materials for different learners are selected based on the information represented in learner model.

R.G. J., Ogata, H., N. A.Saito, N. A., Yin, C., Yano, Y., Oishi, Y., Ueda, T. [3], context-aware location-dependent learning, supports students to learn Japanese while involving in real time situations. By monitoring the positions of the learners, teachers can establish the communication with the students and guide them. The context factor in LOCH system is location. English vocabulary learning Chen, C., Li, Y., Chen, M., [4] recommends vocabulary for different learners based on their location, time for their learning and individual abilities. This system uses WLAN to identify learner's position. In addition, it uses some techniques such as maximizing information

strategy, evaluating the score of time characteristics and estimating the amount of learning words to select suitable vocabulary for different learners.

Ogata, H., Yano, Y., 2004 [5] supports Japanese students to identify English words with physical objects via the use of mobile devices through RFID tag reader/writer. TANGO includes six modules to select appropriate English words based on learner models. LI, M., OGATA, H., HASHIMOTO, S., YANO, Y., [6] is designed to aids Japanese learners to learn Kanji or Chinese as a second language via SMS function or email. The learners send an email to the system in order to request a test. The system composes a test and feedbacks to them including adaptive English words as well as example sentences.

IV. PROTOTYPE IMPLEMENTATION

There are many mobile devices available in the marketplace. Each of these mobile handsets has different screen sizes, resolution. Therefore, usage of mobile phone is increasing with varied size and resolution. This creates a set of challenges for the web author. It is impractical to design multiple version of a web site, each for a particular device. Therefore, several techniques of content adaptation such as Direct Lookup, LCD, and Stylesheet Selection are used. These techniques have some advantages and some disadvantages. A model is proposed to overcome the present problem. This model will work keeping in mind these constraints:

Device size and capabilities- Mostly all mobile devices can be categorized in three sections; common handheld devices, PDAs and smart phones having Wi-Fi or 3G connections to internet and palmtop or other high-end computing devices. So, for different sets of devices, different rules are needed for content adaptation. Large text chunks are difficult to read in small screen sizes, text formatting capabilities also varies for different mobile browsers. Common scripting languages like Java Script do not run in mobile browsers. All these limitations have to be overcome to provide the user with the optimum result. Content Adaptation Server: When any device requests any web resource then Content Adaptation Server checks the device type from the HTTP header. HTTP header has a field named X-Wap-Profile, which has null value for desktop computers and for mobile devices an address of a website or URL is given there. This URL actually targets to an xml file stored in the device manufacturers (of that particular mobile set) database. This stores all hardware configuration of that device; like screen size, resolution, video support capability, etc. Following is an example of an X-Wap-Profile header to the HTTP request: X-Wap-Profile: http://nds1.nds.nokia.com/uaprof/N6230r100.xml.This line tells the server where to find device profile [7]. Content adaptation server fetches the profile from the device profile repository and may store it in its own database for later use. The proposed architectural model of context aware adaptation mechanism in course based e-learning environment is as shown in Fig.1.

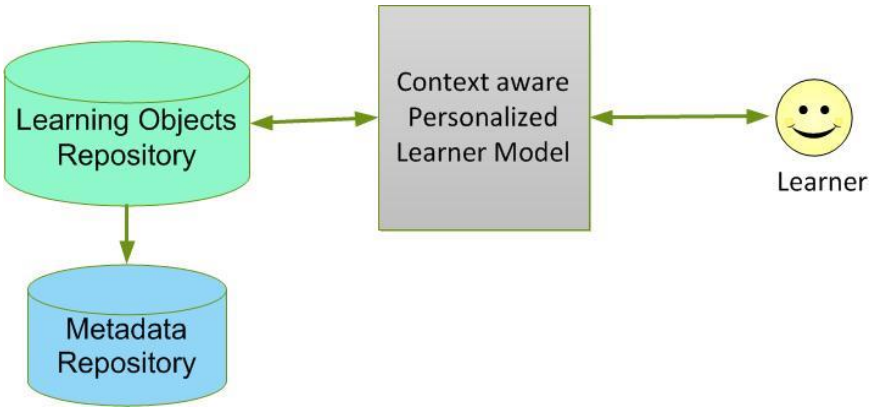

Figure 1: Overview of Architecture

V. EXPERIMENTAL EVALUATION

To evaluate the proposed prototype approach, we have implemented a web-based prototype in research center of computer science department in Akshaya Bharathi Institute of Technology, Kadapa, India. The screen shots of various execution environments such as of feature phone, of smart phone and general PC based web environment are as shown in Fig 2, Fig 3 and Fig 4 simultaneously. The study of evaluation approach was organized on different subjects of the same branch, to retrieve concerned learning materials. The retrieved contents are ranked based on their similarities to the given query and concerned subject. The proposed system is analyzed through the calculation of information retrieval metric "precision" to measure its performance. Experiment is performed through Intranet and using local university database as Data-set for learning materials. Precision and recall are the two standard statistical measures for calculating performance of information retrieval models. Precision indicates the capability of system to retrieve the relevant items.

Figure 2: Screen shot of feature phone

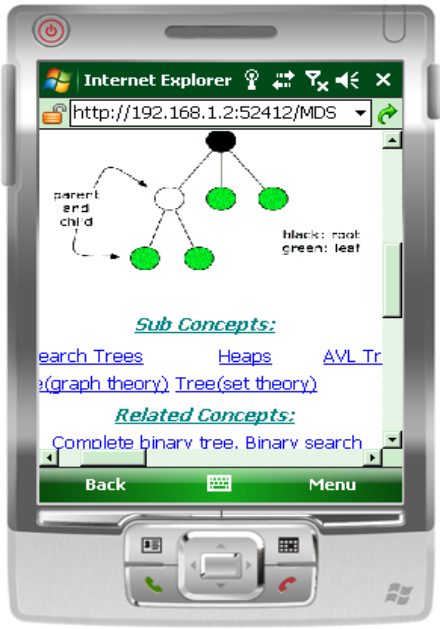

Figure 3: Screen shot of smart phone

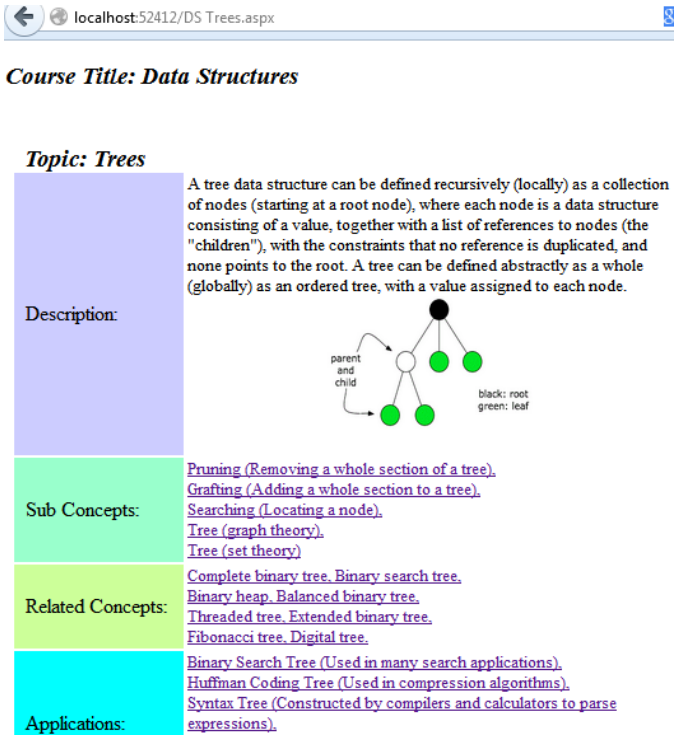

Figure 4: Screen shot of general web page

$$\text{Precision} = \frac{\text{Number of relevant retrieved documents}}{\text{Total number of retrieved documents}}$$

The analytical graph of the measured precision for the proposed system is as in "Fig.5", it shows only for six subjects of computer science department. In each subject the average precision is calculated for ten different topics that have been searched.

The graph shows that there is considerable improvement in precision with the use of proposed system to compare with direct search approach.

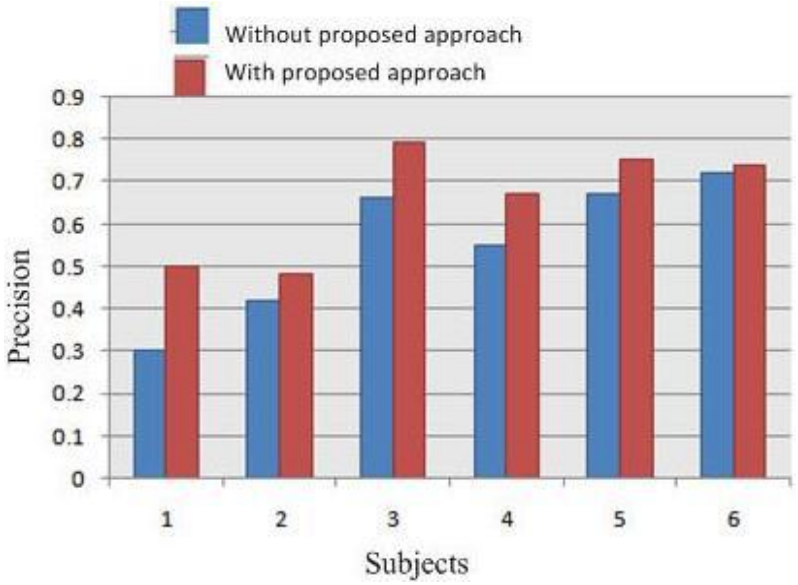

Figure 5: Comparison of precision for various subjects

VI. CONCLUSION

Advances in mobile technology create challenges for content authors. Devices with different screen size, features give a real problem. To overcome such problem several content adaptation technique has proposed.

In this paper we proposed an architectural model of e-learning system that performs personalized delivery of course content according to learner contextual information.

The proposed system is able to perform adaptive delivery of learning content as per the context of learning device and also is useful for personalized accessing of learning materials in e-learning domain.

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