

Context-Aware Personalized M-Learning Application Using Multi-Agents

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ABSTRACT

In this paper we attempt to present a model for context aware personalized m-learning system using multi-agent platform. The system should be adaptive to the needs of different students; who has different, individual and personal preferences of mobile learning (we use the abbreviation 'm-learning' from here onward) preferences. Study of these m-learning preferences can be used as a basis for creating personalized m-learning platforms catered to the needs of individual learners. Here, we have interacted and interviewed the college students and collected their dynamic preferences and interests with regard to m-learning. Based on these factors, we propose context aware personalized m-learning application. Various scenarios have been identified to exemplify m-learning preferences of different students.

Keywords: m-learning, personalization, multi-agent, context-aware

1. INTRODUCTION

Modern students live in a time which is continuously driven by new methods of visualizing and gathering data and that information is increasingly accessed collaboratively with time. With the increase of computers, networks, and mobile devices like smart phones, people are more interested in distance and mobile learning. Breaking through the limit of space and time, reduce learning cost and improve teaching and in particular, learning efficiency, the technology has revolutionized from e-learning to m-learning. The m-learning focuses on the mobility of the learner, interacting with portable devices. Being in different locations, learning different topics with smart devices, with different social groups students may learn different topics.

The students are different in age level, sex, and social role, their culture, education background, attention, interests, hobbies etc. Giving corresponding learning content and tactics to realize the learning according to students' needs is very challenging task. With emerging mobile devices teaching/learning has to change in its entirety to adapt to this new mobile education.

The learning context is defined "*the circumstances in which or conditions that surrounds the learning*" [1] Context-aware is a style of computing in which situational and environmental information about places, people, and things is used to anticipate immediate needs and pro actively offer enriched, situation-aware and usable content, functions and experiences. These dynamic entities, relating to a learner are developed when learning on the move. Context awareness is a property of mobile devices that is defined complementary to location awareness.

Student learning preferences include individual preferred learning styles, preferred depth, and learning characteristics like motivation, personal background, strengths and weaknesses, interests, ambitions, responsibilities. For example; a conscious, ambitious student is interested in more detailed content than a non-ambitious student.

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Here, we are proposing a model or an idea for context aware personalized adaptive multiagent m-learning system. This model allows understanding and identification of student needs and preferences. By keeping interest of every user, this system can personalize its contents and deliver accordingly using available resources.

We also require to define a metadata [2] – an learning object which describes the types of content, and which helps in categorizing, storing and retrieving the contents.

The rest of the paper is organized as follows: Section 2, lists various definitions of m-learning.. Section 3 we attempt to find out the related work carried out in the field of m-learning. In section 4, we propose the methodology. In 5th section we discuss about implementation idea. In section 6, we list out few samples about student preferences. Finally we conclude.

2. DEFINITION OF M-LEARNING

M-learning tries to combine the possibilities provided by new mobile technologies, e-learning/distance learning developments and wireless infrastructure. Various definitions of m-learning are as following.

1. M-learning refers to “learning that may take place in multiple locations, across multiple times and addressing multiple content areas using static or portable equipments such as wireless laptops, smart phones or personal media players” [3].
2. From pedagogical perspective m-learning is defined as “any sort of learning that happens when learner is not at a fixed, predetermined location, or learning that happens when learner takes advantage of learning opportunities offered by mobile technologies” [4].
3. m-learning is one new learning mode that users can use the mobile communication terminals to assist them to learn [5].
4. m-learning can be defined as “the ability to learn independently without any constraint of place and time, facilitated by a range of mobile devices such as mobile phones, PDAs, iPod, pocket PCs and blackberries “[6].

3. RELATED WORK

Many web based learning and m-learning applications have been developed by researchers including Kinshuk and Lin [7] and Park [8] respectively. Felder and Silverman learning model [9] focuses on different learning preferences of learners based on four dimensions – (i) active/reflective, (ii) sensing/intuitive, (iii) visual/verbal, and (iv) sequential/global.

Many existing context aware and context based m-learning applications make use of learning content in order to suitably adapt and suggest learning activities to students. Prekop and Burnet [10] divided learning contexts into two dimensions – internal -surrounding the user and external- surrounding the application.

The Dunn and Dunn model [11] explores various learning styles/preferences a learner/student may have – *environmental, emotional, physical, sociology and personality*.

Mapping between these components against the context space [12] and context categories [13] had been already made in Yau and Joy [14].

Chan.T etc. [2] had identified Mobile Learning Metadata extended from the Learning Object Metadata (LOM). LOM [15] is an international standard used to describe learning objects. These learning objects can be stored, searched and retrieved efficiently. LOM consists of nine categories – General, Lifecycle, Meta-metadata, Educational, Technical, Rights, Relations, Annotations and Classification.

Hasan Omar Al-Sakran and co-authors [16] have proposed architecture for an m-learning system based on agent technology. The agent in m-learning system continuously monitors the learner’s action. It performs

two operations: identifies optimal learning conditions and notes the areas of weak knowledge. The pros of architecture are supporting the process of composing personalized content for an individual mobile user rapid course development and collaboration. They propose that use of mobile agent saves the communication time between the user site and server. Expanding the agent m-learning system to deal with wireless peer to peer system is challenging task.

Qin and Zhou [17] discuss that cloud technology can be advantages to anytime, anywhere, completely free, personalized and diversified m-learning into effect.

S.R.Mangalwede and D.H.Rao, [18] in their paper have discussed the importance of personalization and content delivered to the learner. And have proposed the use of Artificial (or computational) intelligence techniques such as Case-Based Reasoning, Stochastic Process Model and Bayesian Networks. And paper focuses on future work where personalization content delivery possible in m-learning and use of AI in m-assessments.

Mohammad Y., Mazen, Tom G. And Ramesh S. [19] in their paper discuss VARK learning model—visual, aural, read/write, kinesthetic – learning preferences. Paper also studies about the two cultures – the Austrelian and the Soudi Arabian contexts; and comapre the these two cultures based on characteristics of the students. They find, learning-material with practical examples is more preferred just than a mere video.

Dejan P. and Marjan K. [21] have proposed a design of m-learning material for Slovene language on two levels. This motivates that any language learning can be designed for m-learning material.

4. METHODOLOGY

The Fig.1 depicts basic architectural model for proposed work. We ideally list the following sequential steps -

1. Personalization
2. Standardization
3. Content Packaging and Tutoring system
4. Assessment system

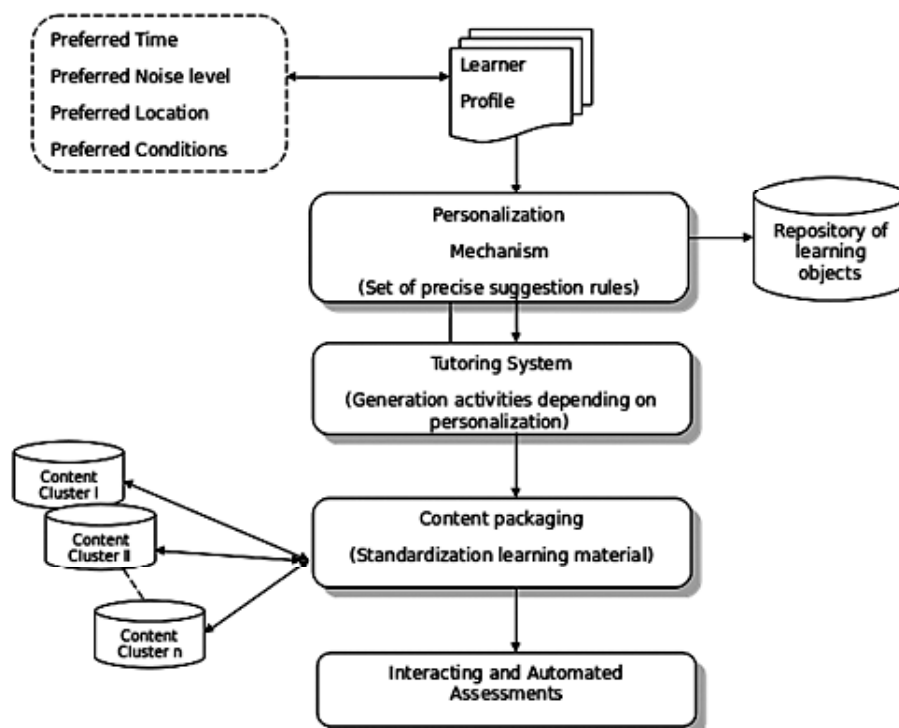


Figure 1: Architectural model of proposed system

1. *Personalization*: To provide personalized learning depending on the learners' profile; profiles are constructed based on the various factors of students' characteristics, like:
 - (a) What does students' know already?
 - (b) Does the student need motivation to learn?
 - (c) What is the students' knowledge level?
 - (d) Has the student difficulty, in understanding the programming?
 - (e) In which location student prefers to study—home, college, library, park, laboratory, office, lounge etc.
 - (f) Preferences for sensed distractions within locations – noise, activities in surrounding, environmental factors, light, temperature, layout of the room, nearby attractions ,seating,
 - (g) Personal factors like -Family background, education, friends, working culture, food, drink, time of the day, likes to be alone , in group.
 - (h) Whether student likes, audio, video, animations in learning.
 - (i) How is students' handedness – right, left?
 - (j) How student thinks- brain dominance.
 - (k) What are IQ and EQ levels of student?
 - (l) What time student prefers to study for the time of the day- day time, morning, afternoon, evening, night, mid night.

Collecting all such characteristics will be through interviews, troubleshooting and questionnaires. Learners' profiles are built from various suggestion rules. The suggestion rules suggest what level of personalization is required for the individual learners.

2. *Standardization*- Standardization of material/content is one of the important and challenging process. Learning objects play important role here. Meta data i.e. leaning objects should be dynamically constructed based on the profiles built from personalization process as discussed above. And also there are varieties of mobile devices available with change in their hardware and software. Presenting the material/content on various mobile devices' screens, which differ in dimensions, is very difficult. So the need is standardize the material/content according the devices' portfolio and representing it effectively with personalized touch. The contents or material are the successful predictions based on the user's actions.
3. *Content Packaging and Tutoring* : A suitable, adaptive content delivery system requires grouping of the similar contents from various sources and present before the students on their mobile devices . Context-aware content will be fetched according to the needs of students and presented. To store the content cloud storage can be used. Based on the similarity of content, data can be organized and grouped into various clusters [20] and easily accessed.
4. *Automated assessment*: For learners to test their ability, assessments play important role. Already there are many assessment tools available which mainly concentrate on objective type question and answers. So we focus on building an automated and self- innovative m-assessment using fuzzy logic which will try to address all types of questions and answers. And also aim to design a safe, secure exam /assessment management system for m-leaning.

5. IMPLEMENTATION DETAILS

We are planning to use multi-agent technology and cloud technology, in developing this system.

Cloud technology is capable of providing flexible dynamic IT infrastructure; QoS guaranteed computing facilities and configurable software services. So cloud technology can be used for developing this system.

An agent is a software program that assists people and acts on their behalf. They function by allowing people to delegate work to them. They have the ability to interact with their execution environment and to operate asynchronously and autonomously upon it. An agent is a software object that is situated within an execution environment. It has the following characteristics:

- Reactive: It senses changes occurring in the environment and acts accordingly.
- Autonomous: It has control over its own actions.
- Goal-driven: It happens to be pro-active.
- Temporally continuous: It is temporally continuous in that it is continually executing.

In addition to the aforesaid properties, it may possess one or more of the following orthogonal properties as well:

- Communicative: can communicate with other agents.
- Mobile: It can travel from one host to another.
- Learning: Adapts in accordance with previous experience.
- Believable: Appears believable to the end-user.

The Fig. 2 depicts the 3 tier communication in multi agent platform for accessing services through mobile devices. User mobile devices request for contents; this request is carried by agents to the content center. Contents are searched and this data is carried to sub content by agents. This structured data is carried to respective mobile devices again through agents.

6. SCENARIOS

We have identified various scenarios to illustrate m-learning preferences of mobile learners. Few samples are given below:

1. Student A prefers medium pace to study in quite room even though he can concentrate in noisy place. He prefers in a room at home. He wanders in the room while studying. His time of day is morning.

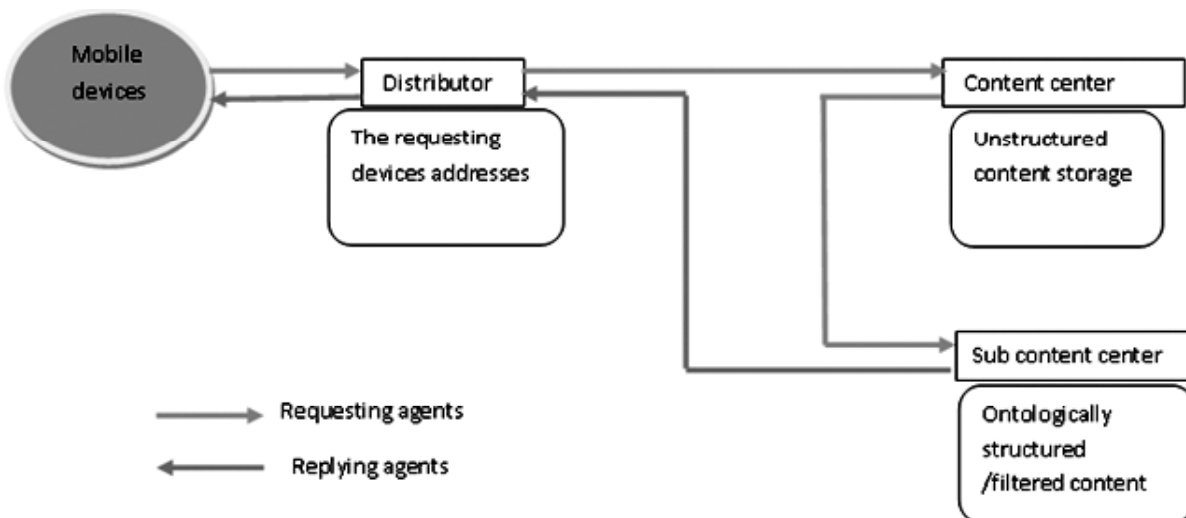


Figure 2: The three tier Communication using multi-agent platform for content delivery

2. Student B can study while listening to melodious songs or light music with a small audibility. Her time of day is evening.
3. Student C , studies in library with concentration. She feels to study alone. Her time of day is early morning.
4. Student D has strong preference to study in noisy atmosphere. Locations like lounge, cafe or corridors. Any time is preferred.
5. Student X, prefers very quite environment. He cannot concentrate even there is small disturbance. Preferred time of the day is late night.

7. CONCLUSION

In this paper we have we have made an attempt to understand the meaning of m-learning. We proposed a model of a personalized context-aware m-learning application to be developed using multi-agent technology. We tried to identify various preference of students, which help us to build their profiles; based on which the adaptive tutoring system will present the contents on their mobile devices. Future work includes the actual implementation and result analysis of this proposed approach.

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