Applying Multi-Sensory Learning Model with Mobile Handheld Devices to Pervasive Learning

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Abstract

The objective of this paper is to provide a personalized multi-sensory learning model with mobile handheld learning devices to enhance pervasive learning. This paper distinguishes itself by solving several challenges that the current mobile learning research is facing and unsolved. Our research consists of three phases: Phase one is to develop an ontology and agent based knowledge network framework with content management mechanism for learning content structure, description, representation, retrieval, reuse, revise, retain, exchange and sharing. Phase two is to develop intelligent mobile handheld learning devices with universal access mechanism with personalized learning experience for adaptive and seamless pervasive learning. Phase three is to develop a multi-sensory learning system with compelling examples of pen based, annotation based, context driven, and location based learning service and applications for pervasive learning.

Keywords: *multi-sensory learning, pervasive learning, intelligent mobile devices, handheld devices, ontology*

1. Introduction

Learning can be in a multi-sensory way. Through human's various sensations such as visual, auditory, touch (tactile), movement (kinetic), and reasoning capability, people can accomplish learning process in the modals of hearing, speaking, reading, and writing. We conceive a pervasive learning environment consists of a group of instructors and learners through the use of a variety of leaning devices connecting to learning resources and access learning content from the resources. Researchers of learning and instruction can develop their learning models and learning plans, accompany with learning content, and practice their theory on this pervasive learning environment.

A pervasive learning environment can be in the form of a stand alone learning resource or a network of geographically diverse learning resources. We think each learning resource can contribute different learning contents, learning plans, and learning activities, as well as personalized information of learners' and instructors'. In our research, we are developing a framework to connect all these learning resources to form a knowledge network. Learners and instructors can access to any one of the learning resources within the knowledge network and connect to the rest of learning resources manually or automatically. With the knowledge network and universal access mechanism, learners will be able to carry their learning in an adaptive and seamless way with minimum limitations of scale, time and space.

Our research consists of three phases. Phase one: Developing an ontology and agent based knowledge network framework with content management mechanism for learning content structure, description, representation, retrieval, reuse, revise, retain, exchange and sharing. Phase two: Developing intelligent mobile handheld learning device with universal access mechanism with personalized learning experience for adaptive and seamless pervasive learning. Each learner is distinguished by their learning experience, the learning effectiveness will be limited if using the same content for every learners. That means the necessity of preparing a personalized content, learning plan, and learning portfolio for each individual learner. A personalized mobile handheld learning device will have great chance to improve the situation. Phase three: Developing a multi-sensory learning system with compelling examples of pen based, annotation based, context driven, and location based learning service and applications for pervasive learning.

2. Theory and Practice

Ontology [1] defines a common vocabulary for information sharing in a certain domain. It includes machine-interpretable definitions of basic concepts in the domain and relations among them. Many disciplines now develop their own standardized ontology that domain experts can use to share and annotate information. Why developing ontology? Some of the reasons are: 1). to share

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common understanding of the structure of information among people or software agents; 2). to enable reuse of domain knowledge; 3). To make domain assumptions explicit; 4). to separate domain knowledge from the operational knowledge; 5) to analyze domain knowledge.

We make these repositories share and publish the same underlying ontology using OIL [2] and OKBC [3,4] for ontology exchange language and knowledge connectivity, respectively. A mobile agent can extract and aggregate information from these different repositories. The agents can use this aggregated information to answer queries or as input data to other applications.

In our approach, content server needs to consider content adaptation *a priori* by taking into account users profile and device capability in such a way to create one copy of content with multiple presentation styles for various devices. Our mechanism consists of four subtasks: content manifestation, content adaptation, content delivery, and content presentation, which are designed to connect the four access channels: content access, network access, service access, and device access, respectively.

We utilize universal access concept and mechanism to build a middleware driven content adaptation, including network infrastructure and network roaming with wireless and mobile technologies; seamless learning session with indoor/outdoor positioning technologies with the consideration of quality of service (QoS). To enhance personalized learning experience, we collect personalized learning portfolio through learning devices, build personalized learning repository from knowledge network, and design and monitor a seamless learning session.

Content adaptation is the foundation for realize universal access. Content adaptation is a mechanism of dynamic adjusting content presentation to meet the constraints of network bandwidth, user preference, and devices limitation, thus it is necessary to know network, user, and devices information prior to the content rendering. Ideally, such information can be described with user/device profiles and be stored at content server, client only keeps a profile reference for accessing its profile. [5,6,7]

Our research aims in two perspectives: intelligent agents and personalized adaptive learning. Intelligent agents will automatically provide guidance to the learners and record detail information during learning session. In personalized adaptive learning, intelligent agents need to know the learners' preference, experience, habit, or behavior by studying their learning portfolio, then could render learning content based on the learners' latest learning experience in order to provide an adaptive learning content. In Multi-sensory learning, intelligent agents will use learners' learning portfolio to guide the learners utilizing their various sensations such as visual, auditory, touch (tactile), movement (kinetic), and reasoning capability to accomplish a learning objective. The intelligent agent will prepare the most suitable material and acceptable content format based on the learners' portfolio to achieve the goal of multi-sensory learning experience from various perspectives of auditory, speaking, reading, and writing.

3. Conclusion

Using this rich function's multimedia learning device, we can help learners proceeding multi-sensory learning. All the information exchanged among learners' measurement, learning experience, and community communication will rich the related researching works. For every specific requirement, we will provide necessary support and a personalized learning method. It is necessary to encourage learners to use the learning experience and content sharing from others to remove the obstacles on the way to leaning.

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