Chapter 14
Content Adaptation in Mobile Learning Environments

Sergio Castillo
Universidad de las Américas Puebla, México

Gerardo Ayala
Universidad de las Américas Puebla, México

ABSTRACT

In this paper, the authors present their proposal for adaptation of educational contents of learning objects to a particular mobile device and a specific learner. Content adaptation in mobile learning objects implies user adaptation and device adaptation, and requires additional metadata categories in comparison with SCORM 2004. This learning object content model, ALMA (A Learning content Model Adaptation), inherits from the SCORM standard a subset of metadata categories, and extends it with three top level metadata categories for content adaptation, i.e., Knowledge, Use, and Mobile Device Requirements (Castillo & Ayala, 2008). For user adaptation, the authors developed NORIKO (NOn-monotonic Reasoning for Intelligent Knowledge awareness and recommendations On the move), a belief system based on DLV, a programming system based on Answer Set Programming paradigm. For device adaptation the authors designed CARIME (Content Adapter of Resources In Mobile learning Environments), which uses transcoding and transrating to adapt media content to suit the device characteristics.

INTRODUCTION

Content adaptation is the process of automatically modify the characteristics of the learning object educational contents, in order to enhance the user experience, considering her/his interests and specific mobile device. User adaptation implies a learner model and a personalization process in order to select and present to the learner contents appropriates to her current interests. In the other hand, the number and variety of mobile devices characteristics, makes very common to vary the details of format of images, image sizes, or bit-rate of media when delivering content to mobile

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devices. We consider a mobile learning object (MLO) as an information entity, digital, interactive, adaptable and reusable in different contexts, designed to support an educational objective through a mobile device in situated or collaborative learning activities (Castillo & Ayala, 2007). ARMOLEO (ARchitecture for MObile LEarning Objects) is the architecture for the design, development and use of learning objects in mobile learning environments. In this paper we discuss our proposal for content adaptation, both user and device adaptation, as we designed in ARMOLEO (Castillo & Ayala, 2008).

ARMOLEO (ARCHITECTURE FOR MOBILE LEARNING OBJECTS)

ARMOLEO is our proposal for the design, development and use of learning objects aimed to be used in mobile learning environments. With ARMOLEO we have proposed three models for the design and use of LOs in mobile learning environments, based on their respective learning strategies and the required awareness support (Ayala & Castillo, 2008):

1. Personalization model, based on Personalization Learning and supporting Knowledge Awareness.
2. Interaction model, based on Situated Learning and supporting Context Awareness, and
3. Collaboration model, based on Collaborative Learning and supporting Social and Knowledge Awareness.

The architecture (see Figure 1) is composed by the following components:

- The deductive database of Learner models,
- Database for Device's Profiles,
- MLOs repository, composed by ALMA Packages and Metadata database,
- Database for Collaboration scripts,
- Learner and Device identifier,
- NORIKO, the learner's models manager,
- MLOs selector,
- CARIME, the MLOs device adapter,
- Collaboration Script selector, and
- ALMA Packager.

In ARMOLEO, the personalization model implies a deductive database of learner models and is maintained by a beliefs revision system named NORIKO (NOn-monotonic Reasoning for Intelligent Knowledge awareness and recommendations On the move). This Java based system interacts with DLV, a programming system based on Answer Set Programming paradigm, and allows us to insert, remove and consult beliefs, and performs a beliefs revision process any time a new belief is included or removed to/from the inductive database. Beliefs are relevant because a computational model of beliefs is suitable to include both, cognitive and psychological aspects of learners, which permits to obtain a more comprehensive and whole-person model of the learner. In the other hand, ASP paradigm has been recognized as a contribution and a significant evolution in the areas of Logic Programming and Artificial Intelligence. ASP is more expressive than normal (disjunction free) logic programming and allow us to deal with uncertainty. It uses two types of negation: weak negation (not X), that means "there is no evidence of X", and strong negation (~X) which means "there is evidence that X is false". These features made this programming paradigm a powerful tool for knowledge representation, commonsense reasoning and modeling of incomplete knowledge (Leone et al., 2002). NORIKO keeps the learner model updated by monitoring his/her interaction with mobile learning objects in order to keep a registration and deduction of the interests and capabilities of the learner based on his/her selection and use of mobile learning