Towards "anytime, anywhere" Learning: The Role and Realization of Dynamic Terminal Personalization in Adaptive eLearning.

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Abstract

Bruner, J describes the method of learning as actively processing past and current knowledge and information to form new ideas and concepts. Personalization of learning involves the presentation of a learning experience that is customized to the preferences of the learner. Personalization of learning can involve the tailoring of tools, terminals, communications, content, etc. to the needs of the individual. Personalization of learning is potentially beneficial in terms of time, money and, although somewhat controversially, effectiveness [*Conlan, O., Dagger, D., Wade, V. (2002): Forbes (2000)*].

Introduction

Personalization can be based on multiple paradigms. Context Personalization is adapting to the preferences of the learner and semantics of the learner's current environment. Competency Personalization is adapting to the learner's prior knowledge of the information domain being presented. Prerequisite Personalization is adapting to the currently required prerequisites of the learner such as pre-session defined learning objectives and learning goals.

One sub-category of context personalization is terminal adaptivity, adapting information to the characteristics of a device. A feature of today's lifestyle has been the increased mobility of learning situations. Learning takes place in flexibly timetabled sessions at work, at home and when commuting. With the revolution of mobile devices the learner's demand for "learning on the go" must be supported. One of the key challenges of this mobile learning environment[*] is to deliver the appropriate learning resource to the learner. This can be achieved by adapting the content to the preferences of the learner, the characteristics of the current terminal and the appropriately selected narrative template.

Terminal personalization will occur on a per session basis. Personalization can be achieved by applying many axes of adaptation effecting both the navigational structure and appearance of the learning experience.

This paper describes an architecture and methodology for producing personalised course offerings with terminal awareness. This paper starts with a background of adaptive eLearning using Adaptive Hypermedia techniques. The paper provides a description of terminal personalization and example architecture for the delivery of such personalization.

Background

Personalization

Terminal Personalization involves the tailoring of a resource to the current environment of the learner. The need for personalization arises from the "one size fits all" paradigm. A resource developed for one terminal, such as a PDA, mobile phone, tabletPC, laptop or desktop, may not be suitable for a dissimilar terminal. One of the key challenges of personalization is granularity. Granularity follows the divide and conquer archetype. By splitting coarse resources into fine grained resources and their appropriate metadata, the potential for reuse and personalization is increased. Personalization in a learning context provides the learner with a learning experience tailored to their needs and preferences. Personalization can increase the potential for information processing, storage and retrieval.

[*] This mobile learning environment is broadly referred to as mLearning

Adaptivity

Adaptivity is the ability to change ones appearance with relation to current context. Two main categories of adaptivity have been identified, namely Adaptive Navigation (AN) and Adaptive Presentation (AP). AN is the adaptation of the navigational structure of the resource being delivered to the learner and AP is the adaptation of the presentation of the resource. AP and AN techniques are applied to adapt to context.

eLearning is a vast and expanding field. From the earliest Intelligent Tutoring Systems (ITS), namely ELM-ART [*Weber, G and Specht, M. (1997)*] and INTERBOOK [*Brusilovsky, P and Schwarz, E, Eklund, J. (1998)*], sprung the new field of Adaptive Hypermedia (AH) with such systems as AHA![*DeBra, P., Stash, N. (2002)*] and APeLS[*Conlan, O. Wade, V. (2002)*]. With the emergence of ubiquities computing, wireless and ad-hoc environments such as Smart Spaces (SS) bring forth the need for terminal adaptivity.

CC/PP (Composite Capabilities/Preferences Profile)[*Butler, M. (2001)*] was created to transmit a device's profile and user's preferences to some web service for adaptation. The web service's job is to interpret the profile and instantiate communications with the device based on the device's profile. One of the main advantages of CC/PP is that it does not specify how candidate resources should be described or how the candidate is selected. CC/PP is a W3C working group and is in a phase of ongoing development and extension. A device profile is created by using Resource Description Framework (RDF). With the latest working draft the CC/PP working group have created a vocabulary to describe use case values for the application and an exchange protocol for communication over HTTP. UAProf (User Agent Profile), also known as Capability and Preference Information (CPI), is another W3C initiative attempting to mark up device capabilities in a WAP (Wireless Application Protocol) environment.

Architecture for Terminal Adaptivity in Personalised eLearning

Multi-Model Approach

Traditional development methods of Adaptive Hypermedia Systems describes many diverse approaches to implementing AHSs but these approaches have one common feature that limits the reusability of their learning resources. This limitation stems from the design approach taken in these systems whereby the learning resource is intertwined with the logic for producing adaptive effects. By combining the learning resource and logic these systems limit the reusability of that learning resource as the embedded logic often has dependencies on other learning resources or requires a context dependent engine to execute the rules logic.

Such embedded logic also restricts the course authors when adding new learning resources to a course as they must have a complete knowledge of the possible outputs of the rule system and how this new learning resource (and embedded logic) will impact on the service execution. This requirement for complete knowledge of the system and its execution logic also limits the possibilities for collaboration between course authors (knowledge domain experts), learning resource designers and instructional designers (pedagogical experts) as if any modifications have to be made to the system they must each have a complete overview of how the learning resource and sequencing logic interacts.

Considering these limitations on traditional approaches to designing AHSs the multi-model approach has been designed to –

- Divide the learning resource and the sequencing logic into separate models.
- Enable the integration of additional models to support the adaptive process.
- Facilitate the collaboration of course author, learning resource designer and instructional designer at the system level.
- Utilise metadata to aid reuse of models.

APeLS

The multi-model approach outlined in the preceding section lead to the development of (Adaptive Personalised eLearning Service) APeLS. It is used to deliver personalised eLearning in the academic

domain of Trinity College's computer science department. The adaptive engine is fed by N models, content model(s), learner model(s), narrative model(s), terminal model(s), service model(s) and possibly any other model that is required. The Adaptive Engine (AE) then interprets the N models to produce the personalised output.

Learning resources are abstractly grouped to form Candidate Content Groups (CCG). Each CCG can be used by the AE to teach a required concept. CCG abstractly describe the learning resources required to teach a concept. CCG are used to create MetaSCO objects which are an abstract and context-based mapping between CCG and physical learning resources. This idea of MetaSCO allows for a learning resource repository to be searched not only on a keyword basis but on a context basis. MetaSCO are the abstract embodiment of knowledge pertaining to the prior use of the learning resource to teach a particular concept. MetaSCO could prove very effective in the domain of authoring tools for Adaptive eLearning.

The Narrative model is the encapsulation of a pedagogical or andragogical strategy. The narrative model is used by the AE to produce the personalised content model for the learner. The process whereby the AE selects physical learning resources to populate the personalised content model is called the Candidate Selection Process (CSP). The narrative, which is represented in JESS rules, instantiates the CSP. The rules perform an ontologically supported matching between the learning resource metadata, the learners' learner model and the current terminal model. This matching process selects the appropriate learning resource(s) to be delivered to the learner.

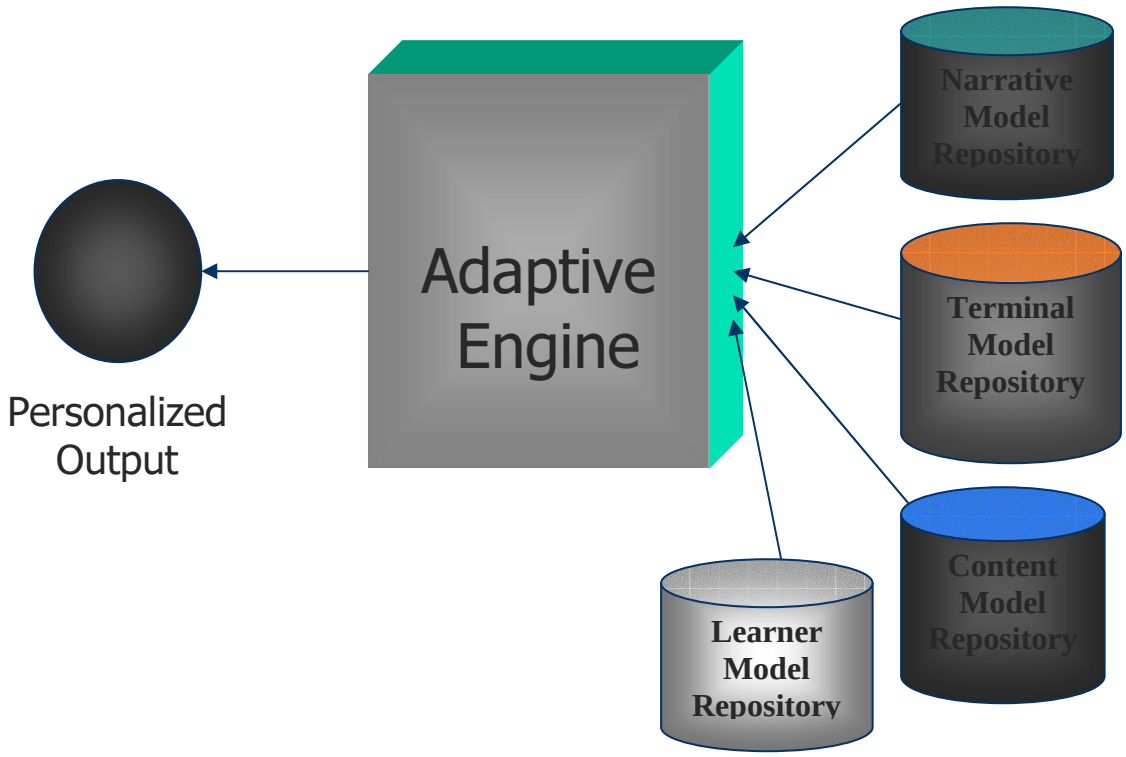

Fig. 1) APeLS Delivery architecture

Terminal Model

The terminal model should capture the traits and capabilities of the current terminal being used by the learner. The terminal model should follow a stereotyped approach for the initial capture of the terminal traits and capabilities and dynamically alter if the terminal changes. The simplified model shown below can be interpreted by APeLS during the candidate selection process to choose the appropriate learning resource.

```
<terminal type=”high_spec”>
        <browser>
          <screen_size>1280x1024</screen_size>
            <color>yes</color>
            <sound>yes</sound>
            <scrollable>yes</scrollable>
          <CcppAccept>
            <li>text/html</li>
            <li>text/plain</li>
            <li>image/jpeg</li>
            <li>……..
            ……..</li>
          </CcppAccept>
        <browser>
        <network>
          ……
        </network>
        ……
</terminal>
```

Fig. 2) an example terminal model

Efforts are being made by W3C to produce publicly available terminal profiles to aid in a standardisation process. Currently there are examples of mobile phone profiles on the CC/PP website.

Summary

This paper describes research into the role of terminal adaptivity in the personalization of adaptive eLearning. It gives an insight into the architecture used for the delivery of such adaptive personalised course offerings. The terminal model described above can be interpreted by APeLS during the candidate selection process to choose the appropriate learning resource to be delivered to the learner.

References

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