Access For All to eLearning

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The paper describes the authors' work (in collaboration with others) to establish a new technological paradigm for delivering access to e-Learning to all persons, including disabled students. The new paradigm complements a content-oriented approach to accessibility but shifts the balance and responsibility for determining access needs of an individual from the producer, supplier or author of e-Learning system and content towards the individual and the individual's supporting technological and human agents. Thus, instead of a producer or supplier effectively saying with technology "I know what you need" a learner will say "this is what I need".

Firstly the topic is introduced and set in context. Then an overview is given of the roles of the pertinent metadata specifications: personal needs and preference profiles (PNP) [1]; and digital resource descriptions (DRD) [2] (using the ISO terminology). An account is given of the work to develop and standardise these. A key implementation of Content Personalisation (CP), based on these metadata standards is taking place in the EU4ALL project. The project is introduced; its approach to CP outlined and implementation challenges are described. Concluding comments are made highlighting key points from the paper and noting the state-of-the-art.

Keywords Accessibility; e-Learning; Standards; MLE; LMS; VLE; Adaptation; Disabled People.

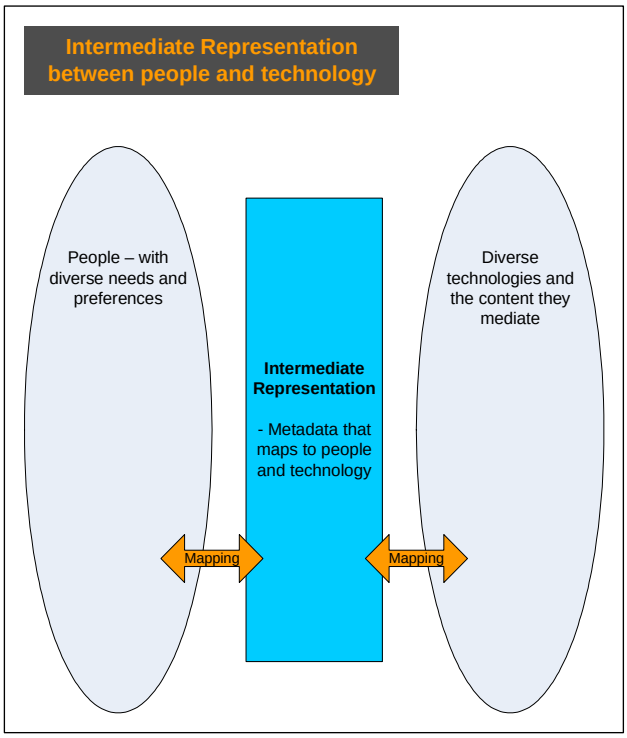
1. Introduction

In the last ten years there has been a burgeoning of systems for web based delivery of educational content, activities and services. Such systems are variously referred to MLEs (Managed Learning Environments), LMSs (Learning Management Systems) and VLEs (Virtual Learning Environments). In this paper the term VLE will be used generically to denote all such systems. Most universities, colleges and increasingly schools in the UK deploy such systems and the picture is similar throughout the developed world. These VLEs may be commercial products, Open Source (OS) or in-house developments. Many VLEs adopt some degree of personalisation whereby what is displayed to an individual student at any given time is automatically and individually determined depending on who they are; what courses they are registered for; and what they are supposed to be doing at that time. This paper describes an extension of such personalisation approaches that considers how the interface and content appears to the student depending on their personal need and preferences for computer interaction. This has great potential to increase access for disabled people to web based education as well as catering for students that may be working in different environments (e.g. hands free in a car or in a noisy environment) or working on different devices (e.g. PDAs, mobile phones, etc.).

The paper describes work to establish a new technological paradigm for increasing access to e-Learning for disabled people that embodies personalisation for accessibility. In delivering accessible interfaces and content it is inescapable that we must somehow match together very complex content and system characteristics with very complex individual requirements. However, there are different ways to approach that matching, some of which generalise individual requirements by addressing categories of disability and what a person fitting in each category might be supposed to need, some of which generalise technical requirements in the same way and some of which address the needs of individuals in an individualised way. It has to be said that a great deal of accessibility standards work to date has been focussed around what content and system producers can do without any specific knowledge of their audience – a one-size fits all approach. This is essentially a “push” approach. WCAG 1.0 [3] and even to a very large extent WCAG 2.0 [4] fit firmly in that category. The approach we describe here differs because it shifts the balance and responsibility for determining access needs of an individual away from the producer, supplier or author and towards the individual end-user and their supporting technological and human agents. What we will describe is a move towards a “pull” approach. The challenges here, including the very diversity and complexity of human requirements, the diversity of technology and the difficulties of mediating between the two, requires an intermediate representation to bridge in a cohesive way. This paper describes an effort to achieve such a standardised intermediate representation and then the implementation of this in a Content Personalisation (CP) approach that can be integrated to VLEs. The latter is the development of the EU4ALL [5] project which the authors participate in; they lead the Standards and Metadata work of the project. The paper gives a brief introduction to EU4ALL and its CP system.

2. Overview of Personal Needs and Preference profiles

Whenever we have a problem that needs to map a very detailed complex domain to another very detailed and complex one, we can obtain an enormous simplification and many advantages by introducing an intermediate representation. This approach is illustrated in the concept diagram of Figure 1.



By expressing individual functional accessibility requirements in an intermediate representation, an information model encoded in metadata, we can obtain many advantages including:

- suppliers have something concrete and explicit to aim for
- individuals have a kind of representation to the system
- content and interface can be personalised to meet the requirements of the individual profile and …
- we can separate the requirement from any notion of disability, effectively extending its use to all persons. (Requiring captions on a video, for example, may not be an indication of deafness - it may be that the individual is in a noisy environment or it may simply be a personal choice.).

To be effective such metadata requires the following properties, that it is: in a standard form; machine-readable and understandable by suppliers and supplying systems.

Fig. 1. Concept diagram of the role of an intermediate representation in metadata

In the context of the work described in this paper information model has been developed for both personal needs and preference profiles and content accessibility metadata has been developed. From this information model the respective metadata specification, PNP and DRD have been defined. The intermediate representation is the Personal Needs and Preferences Profile (PNP) for the learner. Metadata conforming to this is a set of machine-readable functional accessibility preferences to which content and system can adapt.

3. Content metadata and device profiles

The approach requires a matching of content to a user's PNP profile. It uses Metadata to label resources and associate adaptations with those resources. In the main, the labelling is of the modalities of the media (such as Visual or Auditory) and the adaptations are replacements for those modalities, such as an auditory adaptation for visual content (e.g. for an audio description). The mechanism is quite general and by matching resources and adaptations to the learner's functional preferences we can deliver content with more confidence that the learner can access it than if we had designed it in isolation from the learner. The Metadata of choice here is the Digital Resource Description (DRD). From the outset this Metadata has been designed to match with Personal Needs and Preferences (PNP) Metadata. There is a pressing need now to match also with Delivery Context Metadata for the device profiles, particularly that designed by the W3C Ubiquitous Web Applications [6] group. Work to achieve this is underway but not yet complete, as mentioned below.

4. Standards work and implementations

The importance of standardisation of the profile and content metadata has already been highlighted. In combination the two complimentary sets of metadata PNP and DRD are known as the AccessForAll specifications. The AccessForAll work began at the Assistive Technology Research Centre in Toronto, was developed by the IMS Global Learning Consortium, led to an ISO standard "Individualized Adaptability and Accessibility for e-Learning, Education and Training" [7] and is currently being integrated with the work of the

W3C Ubiquitous Web Applications group in order to integrate the matching of resources and adaptations to both personal requirements and devices. In Europe the EU4ALL project is implementing it in a framework that will be available to universities, building code that extends the VLEs Moodle and dotLRN and which will be made available as part of those Open Source efforts. In this paper as AccessForAll originating in IMS and PNP/DRD standardised in ISO are considered as one, there are however minor differences between them. The authors have been involved with the development of the work since its early days in IMS (c. 2000).

5. Implications for organisations adopting AccessForAll

Educational establishments in most developed counties are now subject to anti-discrimination legislation that means they have to meet the needs of disabled students. They of course wish to do this as cost effectively as possible. Systems based on the AccessForAll specifications hold the potential for greatly improving the efficacy and efficiency of how organisations can manage alternative formats for disabled learners. A further key advantage for educational institutions adopting or developing systems based on the AccessForAll specifications is a lot of the hard thinking and detailed metadata design work has been done for them. Further still, this is standardised so will promote interoperability with other systems and external content repositories.

6. The EU4ALL Content Personalisation system

Introduction to the EU4ALL Project

The EU4ALL (European Unified Approach for Accessible Lifelong Learning) project is ongoing, running for 4 years from October 2006. The European Commission's IST eInclusion programme is providing overall funding of € 7.4 million; equating to about 100 person-years effort across the project. The EU4ALL consortium consists of 13 partners with the Open University taking the lead on the Standards and Metadata aspects of the project.

EU4ALL addresses systemic issues in providing access for disabled learners to Lifelong Learning particularly where this is mediated by technology. Where such technology is inappropriately introduced with insufficient support, disabled people face further exclusion from the interlinked worlds of education and work. The project is focused on distance learning, principally at the Higher Education level. The consortium's two lead academic partners are the largest distance teaching universities in Europe: UNED (Spain) and the OU (UK).

The project has coined the term Accessible Lifelong Learning (ALL) uniting three key strategies: 1. That the technology that mediates lifelong learning does so accommodating the diversity of ways people interact with technology and the content and services it delivers; 2. That this technology is used to bring specialist support services to disabled learners; 3. By providing support services and technical infrastructure that enable staff of educational institutions to offer their teaching and services in a way that is accessible to disabled learners. The EU4ALL project's aims are to improve the efficiency and efficacy of implementing the above strategies by developing an open service architecture for ALL. To achieve a wide impact the approach taken is not to develop a single EU4ALL system but a standards-based framework that facilitates the integration of the approach with a wide range of e-learning systems. The framework will be validated in large scale implementations and at a European level with the involvement of students and other relevant stakeholders. The EU4ALL approach to accessibility is one of providing to people appropriate resources to their needs; i.e. Content Personalisation. The EU4ALL project brings both this and the more traditional approach of universal access together to achieve widespread accessibility to online learning resources and support services.

The EU4ALL Content Personalisation System

A schematic of the EU4ALL Content Personalisation System is given in Fig 1. In this schematic the EU4ALL CP Module is the decision engine of the system. It decides what content is served to the student through the VLE following a given request, depending on their expressed needs. The VLE has embedded or associated a content repository of some form where the resources including any alternatives are stored. The User Model (UM) stores the preferences and needs of all registered students (PNP) and Device Model (DM) standardised descriptions of device properties. Because the EU4ALL approach is to develop a flexible framework and not a dedicated system a Metadata Repository (MR) is included in the system to facilitate the storage of suitable indexed metadata sets of the content metadata needed for personalisation (DRD). It is envisaged long-term that such content metadata will reside in the VLE or repository, with the content.

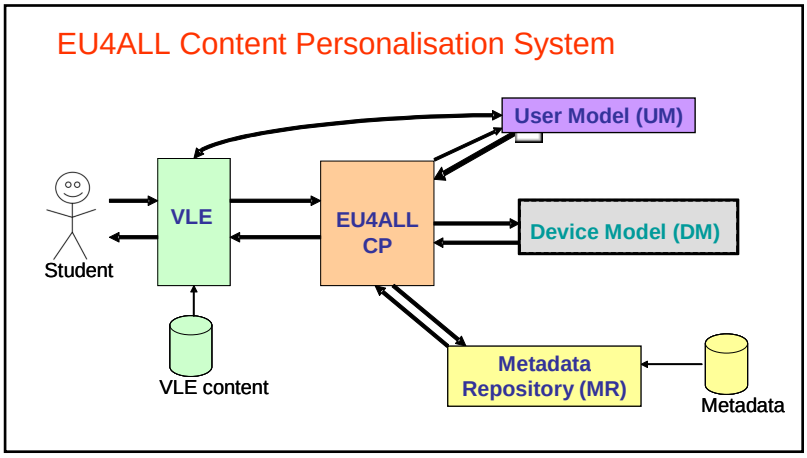


Fig. 2 Schematic of EU4ALL Content Personalisation System

At run-time the CP module creates a series of relevant facts from the instances of the metadata. The CP module determines if there are alternative resources available on the system for the one being requested that better meets the user's profile and the device they are using. The CP module gets the identifier for the best resource, and if this is valid for the user and their device sends its identifier to the VLE. If no valid resource is identified a message is sent to the end-user and the systems administrator so remedial action can be taken as required.

7. A review of technical challenges in implementing and applying AccessForAll

Implementing these ideas in EU4ALL has presented a number of technical challenges. Some of these challenges are manifest at the level of organisations, some in detailed Metadata design and some are matters of detailed mechanism design. Here we list of some of them:

Organisations, Domains of Interest and Technologies

As explained above, the best picture can be obtained with a matching of resources and system to both personal requirements and delivery context. One way to deal with delivery context is in terms of device properties – such as screen width, audio codecs accepted, etc. Equating delivery context and device properties is simplistic because there is far more in any real context but it is a step forwards. Unfortunately one finds that different groups of people are engaged in designing Metadata in the different areas. Thus W3C are doing work on modelling device properties (in Ubiquitous Web Applications group) whereas IMS and ISO are doing work in Metadata for Personal Needs and Preferences and Digital Resource Descriptions. It is highly desirable that these organisations harmonise their work so as to facilitate matching across the three domains and this is in fact happening but given that they are discrete organisations with discrete work schedules, have not initially factored their work in a way that matches across the three and have modelled Metadata with different technologies this is no mean feat. The approach being taken to the host of difficulties that this raises is to establish first a Core (small) set of common elements drawn from PNP, and a Core set from DRD that work for matching across the domains. The relation with the device profile is then being worked out for this Core first.

Missing Metadata Schemes

A consequence of metadata being developed by different groups without a coherent cross-group harmonisation strategy is that not all needed metadata has been constructed. One obvious component missing and that EU4ALL is designing is metadata associated with content that is designed to match device properties. For example – audio codecs required, screen size required, etc.

Granularity

The ISO Metadata for Digital Resource Descriptions is defined very loosely with respect to the kind of objects for which adaptations might be specified. In general those standards take the approach that anything that can be referenced with a URI can be the subject of adaptation. In practice implementation requires more precision about what is referenced for there not to be ambiguity and we need to know that we are not mixing granularities of adaptation in the same system. EU4ALL has dealt with this by defining Media Objects as the potential

subject of adaptations. These are rigorously defined in terms of properties that must hold, such as the property that a Media Object may have at most one, or be considered to have at most one, instance of each modality kind. (For example, it can have a maximum of one component of type "visual", not two, or otherwise each would be treated identically as if there were only one causing problems when substituting an alternative.)

Metadata on Composites of Media Objects

An issue the world has yet to solve is how to roll-up Metadata from simple objects to the Metadata of aggregations of them. In this case that might mean Media Objects and html pages that contain them for example. In EU4ALL we are focussing mainly on the Media Object level for the reason that this is the granularity needed to be addressed to deliver accessibility. However, issues at a higher level are starting to appear and we are expecting to address at least in strategy the relation between the levels.

Identifiers and Authentication

A significant issue is the need to provide stable identifiers for Media Objects. In many VLE systems, such as Moodle, it is not easy to associate stable identifiers with these. This is compounded when one considers that the mechanisms for structuring parts of learning content may not sit well with the proposed definition of Media Objects – the granularity of parts of the Learning Content may have implications for where the Media Objects can be defined. The requirement for static identifiers is made worse when one considers that learner authentication might need to be part of the retrieval process. Not only does this make the needed identifiers somewhat complex it raises the possibility that the identifier for a given Media Object might be differently mapped for different learners. This can be dealt with but it is difficult to obtain one simple strategy that will work with the wide range of VLE's that are in existence.

8. Concluding comments

There is a marked distinction between Content Personalisation (CP) for accessibility approach outlined in this paper and Universal Access to a single resource typified by the WCAG Guidelines. (However the two approaches are complimentary.) The advantage of the CP approach is that needs can be individually met rather that attempting a "one size fits all" approach which is often unattainable especially in an eLearning context.

In summary the development of the AccessForAll specifications/ISO standard to enable CP has been described in Section 4. of this paper and the implementation of these in EU4ALL has been outlined in Section 6. The state-of-the-art is such that: first prototype implementations are currently being evaluated in EU4ALL but already demonstrate the successful realisation of the approach. Key work still to be done includes: creating the Core AccessForAll profile and harmonising this with the Device Profile metadata; resolving the granularity issue and addressing metadata roll-up when resources are aggregated.

Content Personalisation holds great potential for improved accessibility for disabled people in eLearning or more generally any web based delivery context. The EU4ALL project has demonstrated an implementation of CP for accessibility and will continue to develop and evaluate this to the project's conclusion in September 2010. We look forward to a widespread uptake of the approach given this and the sound international standards basis for the work.

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