A2UN@: Accessibility and Adaptation for ALL in Higher Education

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Abstract. A2UN@ objective is to analyze the capability of developing a general framework based on standards and user modelling, to support the development of the lifelong learning services required to attend the accessibility and adaptation needs for all in Higher Education, with special attention to the diversity of requirements of adult learners and those who have the so-called disabilities. To this end the project addresses interrelated scientific goals in the following areas: standards and metadata, user modelling, design for all, psycho-pedagogy, accessibility in user interfaces, assistive technology, machine learning, multi-agent systems and ubiquitous computing.

Keywords: Adaptation, accessibility, ICT framework, technology enhanced learning, inclusion

1 Introduction

Learning ideally should be a personalised and adaptive process for all, which from the beginning to the end should consider the learner's specific needs. Strikingly though, students and professionals with specific needs, such as those with the so-called disabilities, have problems in accessing learning because of the diverse barriers that may exist in the various stages they must go through to realise their learning goals. In fact, while many physical barriers have been removed in Higher Education (HE) institutions, Information and Communications Technology (ICT) services are still not fully accessible to an increasing number of students whose main educational option is distance learning (in Spain roughly 50% of students with disabilities select distance learning). Actually, accessibility, adaptation and learning are three interrelated issues with a growing interest in our society.

More and more, HE relay on ICT to support their learning. For its nature, ICT can play an important role in removing accessibility barriers while providing adapted services for each individual. Thus, the goal of this project is to detect, extend,

interrelate, integrate and exploit as much as possible all the areas upon which a general, flexible, open, standard-based framework can be defined to support the development of the life long learning (LLL) paradigm, which supports the idea that the learning should integrate education and work in a continuous process in which all citizens should be able to access knowledge and perform work at any age. To tackle universal access to information in web based settings, there has been work endeavouring to ensure that all the elements were accessible to disabled people since its early days.

But above all, there has not been an overarching effort for developing the needed infrastructure to construct accessible and personalised learning services, which entails to face open issues in all the above interrelated research areas, including standards and metadata, user modelling, design for all, psycho-pedagogy, accessibility in user interfaces, assistive technology, personalization and ubiquitous computing. Thus, *the key objective of A2UN@ is to develop the required interoperable and layered-based infrastructure to facilitate the definition, development, deployment and evaluation of the services to be provided for supporting accessible and personalised learning in HE*.

2 The A2UN@ project

A2UN@[1] is a research project (TIN2008-06862-C04-00/TSI) funded by the Spanish Ministry of Science and Innovation and stands for Accessibility and Adaptation for ALL in Higher Education. The rationale behind A2UN@ is that learning is a personalized and adaptive process for all that should include the management of the needs that characterize the so-called disabilities as well as the specific needs of an increasing number of adult learners within the LLL paradigm. A more specific thesis to be researched is that a general, open, standard-based and layered framework can provide the flexibility, extendibility and required interaction support for developing LLL services to attend the existing accessibility and adaptation needs.

The research fields that support this view (see section 3) presents limitations, overlapping, lack of generality and difficulties in being combined and applied. In this context, the following open research issues are being covered in A2UN@:

1. Support for describing and managing accessible and adaptive learning scenarios.
2. Overlapping and contradictions between available standards to manage accessibility issues and dynamic support in terms of i) users' models, ii) learning scenarios, iii) interaction preferences, iv) devices capabilities, and v) metadata for specifying the delivery of any resource to meet users' needs.
3. Missing frameworks for providing the layered-based infrastructure covering the interoperability required to manage the whole range of standards, applications and services needed to meet accessibility and adaptations needs of LLL services.
4. Limited research on constructing adaptive learning scenarios to manage accessibility issues (including artificial intelligence techniques such as machine learning, web-mining, and multi-agent systems).

[1] http://adenu.ia.uned.es/web/en/projects/a2un

5. Shortage of best-practices in developing and providing accessible and adaptive learning scenarios that counts with the participation of different types of users on the demand side (students with special needs) and different existing roles on the supply side (administrators, faculty staff and specialized support people in providing the services).

A2UN@ project converges the research works of several projects and continues the collaboration among the aDeNu group (which stands for 'Adaptive Dynamic online Educational systems based oN User modelling') at the UNED (Spanish National University for Distance Education) and the BCDS (which stands for 'Broadband Communications and Distributed Systems') at the University of Girona started in the ADAPTAPlan project (TIN2005-08945-C06-00)[2], where aDeNu and BCDS worked together with other Spanish research groups aiming to analyse the capability of automatically solving tasks that need the integration of planning, machine learning and interaction with different agents (human or software) to ubiquitously and dynamically adapt to the evolving needs of the context in the domain of HE. In A2UN@ the experience of aDeNu and BCDS in the ADAPTAPlan project is complemented with the background of the Sidar Foundation, whose goal is to conduct research and activities leading to the development of an accessible and inclusive Information Society.

A2UN@ aims at devising and building a general open and standard-based framework to support the development of accessible and personalized learning services. The framework is based on a layered-based service oriented architecture (SOA) combining standards to deal with 1) learning scenarios, 2) users' needs, 3) interaction preferences, 4) devices capabilities, and 5) metadata for specifying the delivery of any resource to meet users' needs. The required interoperability of applications and services in the framework goes beyond current approaches in a twofold way:

- providing the layered-based infrastructure to manage the whole range of standards needed to meet accessibility and adaptations needs of LLL services
- covering the current limitations of adaptive and accessible scenarios.

Developments are being validated by different types of users on the demand side and different existing roles on the supply side by Spanish universities with the largest number of students with disabilities.

3 Related research areas

The project objectives refer to the following research areas: 1) software accessibility standards, 2) user modelling for accessible and adaptive learning, 3) device modelling and adaptive interfaces, 4) content accessibility and adaptation, 5) service oriented architectures and artificial intelligence support, and 6) adaptive learning flows and psychological support. Next a brief description of each of the above research lines is provided.

[2] http://adenu.ia.uned.es/adaptaplan/

3.1 Software accessibility standards

Standards integration to deal with accessibility and adaptation are considered, including the management of individual's ability and needs with respect to computer mediated instruction (ISO Personal Needs and Preferences –PNP–), content accessibility (ISO Digital Resources Description –DRD–), device profiling (W3C Composite Capabilities/Preference Profiles –CC/PP–), learning scenarios (IMS family of specifications), variety of interaction contexts (home, classroom, mobile, PDA…), learners needs including educational objective and learning styles.

The following open issues are being addressed: 1) matching standards using RDF and tree-structured XML representations, 2) use case modelling for a user to locate content with a specific modality, 3) difference between representations and need for metadata not yet been constructed, 4) overlapping descriptions, 5) structure versus flatness amongst standards, 6) suitable representation for the same storage approach for every standard, 7) metrics for managing the degree of matching, 8) combining mainstream standards with those focused on accessibility issues, 9) gaps between standards to cope with the whole range of items required, etc.

3.2 User modelling for accessible and adaptive learning

Different methods are considered for matching users' accessibility and learning needs with the appropriate adaptation strategies considering their preferences and the context at hand. To mention but a few: i) user modelling for multimodal interactions, ii) dynamic building (i.e., data mining and machine learning) of standard-based stereotypes for the different kinds of accessibility profiles, iii) recommendation strategies to promote dynamics for students with special needs, iv) ontological matching versus rule-based matching for mediating among diverse, overlapping and partial models of users, devices, resource descriptions and context, which hamper accessibility and adaptations requirements, v) scrutability of user and group models to support user and group awareness of accessibility issues in collaborative scenarios, vi) security and privacy aspects in the management of user models, vii) management of accessibility and learning impasses through recommendation techniques, and viii) multi-agent architectures to support adaptive and accessible scenarios.

3.3 Device modelling and adaptive interfaces

Several issues are being covered, which include i) working on languages that describe abstract user interfaces and consider accessibility needs, ii) developing device-independent description of e-learning services, iii) managing device presentation adaptations according to users' accessibility needs in terms of device-independent presentations, iv) building service oriented architectures for managing the interaction between user and device profiles, v) investigating the coverage of CC/PP descriptions to manage users' accessibility needs and users' agents, vi) building and managing access device repositories based in CC/PP profiling, vii) providing in-depth characterizations of the interaction capabilities including potential assistive

technologies which support users with functional limitations, and viii) managing devices in noisy environments, locations with inadequate lighting, etc.

3.4 Content accessibility and adaptation

Alternative ways to support user control over what is delivered are required, so that precise requirements can be matched, and makes users more effective by helping them reach their goals. In particular, contents in different formats are required to cover the variety of needs and following the W3C Web Content Accessibility Guidelines (WCAG) for their construction as well as DRD metatags for their description. Methods being researched include i) assembling alternatives into a delivery unit, ii) selection among alternatives and transformation of content to derive an alternative (for example speech synthesis from text or font-scaling), and iii) selection and transformation of content to match specific contexts, particularly those of the learner and of the device.

3.5 Service oriented architectures and artificial intelligence support

A general and open framework based on a SOA is being developed for supporting the interoperability and integration of standard-based accessible services. It covers the entire life cycle of e-learning (i.e., design, publication, use and monitoring). Adaptation agents can manage the personal needs of users against the wide variety of services provided. Furthermore, different types of agents are being developed to support the open set of services and their required adaptations.

3.6 Adaptive learning flows and psycho-educational support

A combined approach that considers design time and runtime adaptations is considered. The former focuses on the applicability of IMS Learning Design specification and its compatibility to LLL requirements to cope with psycho-educational support. The later attempts to overcome the lack of support for dynamic adaptation though recommendation strategies that follow a user-centred approach.

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