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MPEG-7 Compliant Community Hosting

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Abstract: Community hosting engines support professional, scientific and recreational communication and collaboration for communities of practice on the Internet. The success of community hosting for professionals and scientists in engineering disciplines or the humanities depends on the community engine's capabilities to reflect the discursive hypermedia knowledge in cross media sets, drawings, animations, pictures, digital videos, texts etc. The rapidly changing needs of the community, the trend for multidisciplinary work and research, and the challenges of sophisticated multimedia technologies demand novel approaches to flexible, evolving, adaptable, and interoperable community engines. Thus, we introduce a novel, self-reflexive information system architecture called ATLAS to support communities by multimedia services on the basis of the multimedia content description interface MPEG-7. As a proof of concept we present in this paper a variety of communities of practice supported by ATLAS.

Key Words: Community Hosting, Multimedia Management, MPEG-7, Web-Services
Category: H.3.0, H.3.4, H.5.1, H.5.3, H.5.4

1 Introduction

Community hosting support for communities of practice [Lave and Wenger, 1991, Wenger, 1998] for engineering, science, the humanities and even for recreation is a challenge for several reasons. Principles like legitimate peripheral participation, group knowledge, situated learning, informality and co-location have to be taken seriously in the design of the community engine. The community engine should also reflect the social learning processes taking place. In addition, demands change from community to community while communities may not be able to express these needs in the beginning. Finally, multimedia technology is rapidly developing, creating new requirements on hardware and network capabilities. How can community system developers design domain-independent information systems efficiently for the rapidly changing community needs? How can the hosted communities effectively participate in the development of their community portal? The hosted community requires an information system architecture that allows them to add, remove and exchange services in their community portal anytime and anywhere. The support of domain-independent, community engines as described before, consequently leads to increased efforts in maintaining and developing these information systems on-the-fly. These complexity issues come along with content issues, as the full spectrum of multimedia technologies needs to be supported. Since digital contents have a dedicated semantics for

each user and each community, dynamic context management concepts are required. Therefore, multimedia metadata descriptions are a key component for transparent and flexible multimedia management in and between communities. Even more, the maturity of community hosting is increased by providing the compliance to one or more metadata standards.

In this paper we introduce the concept of a self-reflexive information system architecture, called ATLAS. Thereby, we will point out the novelty of our approach compared with the state-of-the-art community hosting implementations. We will present a range of applications from cultural heritage management to entrepreneurial e-learning and even up to scholarly education in the humanities. The paper closes with conclusions and an outlook on further research.

2 ATLAS: A Self-reflexive Information System Architecture

The semantics of non-verbal digital multimedia contents are very hard to capture either manually or automatically for any community of practice (CoP). The episodic knowledge represented by a multimedia artifact is a not necessarily shared set of interpretative acts emerged from discursive assignment of narrative acts [Nonaka and Takeuchi, 1995, Klamma et al., 2005a]. The conceptual knowledge of a multimedia artifact is the set of terms created or linked in the practice of discourses which forms the multimedia ontology of the discourse. The development of a shared practice integrates the negotiation of meaning between the members as well as the mutual engagement in joint enterprises and a common repertoire of activities, symbols, and multimedia artifacts. By joining conceptual and episodic knowledge creation processes with semantically enriched multimedia, we extract a community terminology to categorize multimedia artifacts and put them in the context of organizational knowledge creation processes. This keeps the discourse ongoing, while metadata captured by metadata standards serve as the vocabulary of transcribed multimedia artifacts. Part 5 of the MPEG-7 metadata description standard [ISO, 2003] provides advanced multimedia description schemes to describe and manage multimedia artifacts and collections. Hence, MPEG-7 features are used to capture the explicit knowledge and to allow users browsing by categories. In this aspect an MPEG-7 inherent graph description is used to express the semantic and episodic relations between objects. MPEG-7 can be extended for arbitrary purposes through the data definition language XML Schema [Brown et al., 2001]. This guarantees interoperability of the community engine with other information systems.

In order to let communities decide on the features of their community portal during constantly monitoring the impact of these activities onto the community, we have developed the novel self-reflexive information system architecture ATLAS (cf. Figure 1) together with a community-centered development

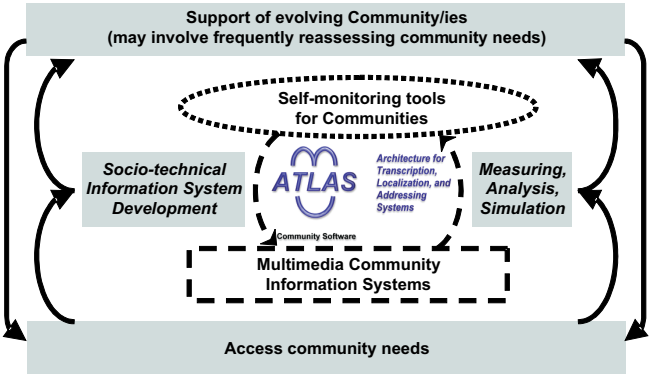

Figure 1: Self-reflexive Information System Architecture ATLAS

process. The Architecture for Transcription, Localization, and Addressing Systems (ATLAS) therefore combines approaches from various disciplines (such as software engineering, sociology and cultural sciences) led by the idea of transcriptivity as a design principle of computer science [Jarke and Klamma, 2005, Jäger, 2002]. The development process is built on ideas of joining usability and sociability [Preece, 2000] by constantly assessing and supporting community needs. In its reflexive conception the socio-technical information systems developed on the basis of ATLAS are tightly interwoven with a set of media-centric self-monitoring tools for the communities. Hence, communities can constantly measure, analyze and simulate their ongoing activities. Closing the cycle, communities can better access and understand their community needs, which leads to a tighter collaboration between multimedia community information systems designers and communities. Even more, the server architecture of ATLAS allows communities to add, remove and exchange services in their community portal at runtime. Next, we introduce several communities hosted by ATLAS. The wide range of application domains proves the flexibility and adaptability of ATLAS.

3 Community Hosting with ATLAS

Community hosting with the ATLAS information system architecture is based on the LAS (Lightweight Application Server), a highly extensible lightweight middleware server. LAS is a platform independent Java implementation that can be flexible (re-)combined among various tools and communities. The open LAS Java API and its concepts can be used to extend the server's functionality based on a community's specific needs. Core services cover user and community management, management of access control lists, security and authorization management. A variety of databases and internet services like FTP are connected as well. For collaborative support we use the BSCW system [Appelt, 1999] which is connected via XML-RPC. In order to support multimedia-centric commu-

nity hosting, LAS provides a set of MPEG-7 services that offer methods to create, retrieve, update and delete persistent XML based MPEG-7 documents. These MPEG-7 services use the Apache XMLBeans XML Binding framework [Apache, 2006] for convenient navigation on the MPEG-7 documents. Each service derived from this class inherits support for accessing an XML database and for using the MPEG-7 binding class library generated from the MPEG-7 XML-Schema [Brown et al., 2001]. Hence, LAS MPEG-7 services only allow valid operations to be performed on the MPEG-7 documents. The MPEG-7 documents of LAS are stored in an XML database such as IBM DB2 Version 8 [IBM, 2005] that can be accessed via a built-in LAS component DB2Connector. In addition, retrieval and update services are provided by XQuery [Boag et al., 2005] and/or Xpath [Berglund et al., 2002] expressions on the MPEG-7 database. Next, we present several LAS hosted community information systems to show the applicability of LAS in versatile areas of applications.

3.1 MECCA & MEDINA

MECCA is a multi-dimensional multimedia screening and classification platform. Its basic idea has been taken from "Berliner sehen" developed at the MIT [Fendt, 2000] and the Virtual Entrepreneurship Lab [Klamma et al., 2002] developed by RWTH Aachen and Fraunhofer FIT. MECCA is specially designed for community hosting in multimedia-centric, interdisciplinary knowledge exchange. The scientific user community of MECCA has diverse educational backgrounds, such as film studies, history of art, graphical design and is on diverse levels of profession, i.e. full professors, research assistants, and students. Therefore, the interpretation of multimedia contents differs, depending on the individual user's context. Figure 2 shows the front end of MECCA, used for multimedia screenings based on previously annotated media. The categorization schema on the right allows metadata mediated browsing by switching between digital contents and contexts. In order to ensure exchangeability of the contents and due to multimedia-centrism, the system is based on the LAS MPEG-7 services. As the creation of new knowledge is a discursive and multistage process, the user requirements rapidly change and several new components (e.g. an open and collaborative courseware component, cf. [Klamma et al., 2005a]) have to be integrated into MECCA. Hence, we - as the community hosts - identify these requirements from the feedback obtained and develop additional MPEG-7 services of LAS. Consequently, the hosting by LAS helped us to react on these requirements more rapidly. However, the next step is to empower non-technically trained user communities to adopt MECCA individually.

The MPEG-7 Encoding of Dublin Core Information and Naming Application (MEDINA) has been developed to support collaboration in communities by exchange of multimedia contents and their low- and high-level semantic de-

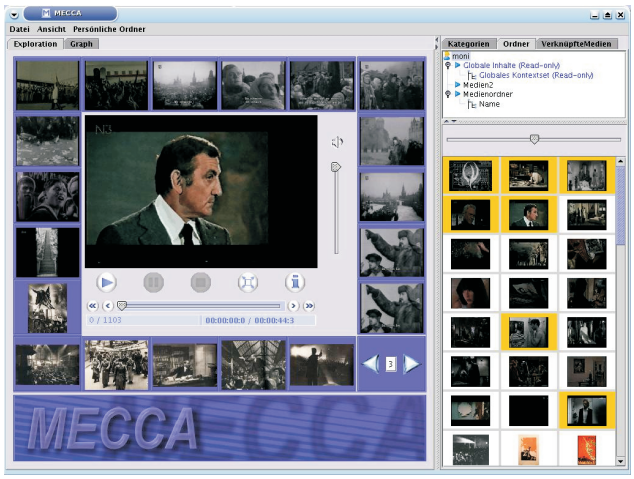

Figure 2: User interface of MECCA applied in scholarly learning communities

scriptions [Spaniol and Klamma, 2005]. In its conceptualization, MEDINA tries to bridge the gap between "folksonomy-style" high-level semantic information about multimedia and purely technical low-level content description. In this aspect, the Dublin Core (DC) metadata standard [Dublin Core, 2005] is a step forward, as it is an easily understandable and concise method for resource description on the web. However, this standard is not designed to describe temporal and media specific information connected with multimedia resources in general. In order to overcome these limitations we combine the benefits of a loose classification scheme such as in DC with more sophisticated description elements for time based media in MPEG-7. Thus, MEDINA is based on an excerpt of the extensive MPEG-7 multimedia metadata standard with an integrated semi-automatic DC to MPEG-7 conversion functionality. The mapping between the DC Metadata Element Set [Dublin Core, 2001] and the MPEG-7 multimedia metadata standard is described in [Spaniol and Klamma, 2005]. In addition, an affiliated FTP-server is used for an automated up- and download of multimedia artifacts by the community to the common repository.

3.2 VEL 2.0

The Virtual Entrepreneurship Lab 2.0 (VEL 2.0) is the further development of its predecessor, the VEL [Klamma et al., 2002]. Since entrepreneurship is a domain that should be considered from various viewpoints and can be solved in many different ways, the problem of starting an enterprise does not involve one distinct solution. Hence, entrepreneurial knowledge is hard to formalize and best presented by success (or even failure) stories. For that purpose, a key point of the VEL 2.0 is its non-linear story-telling functionality, which is based on the Movement Oriented Design (MOD) [Sharda, 2005] principle. MOD is a novel

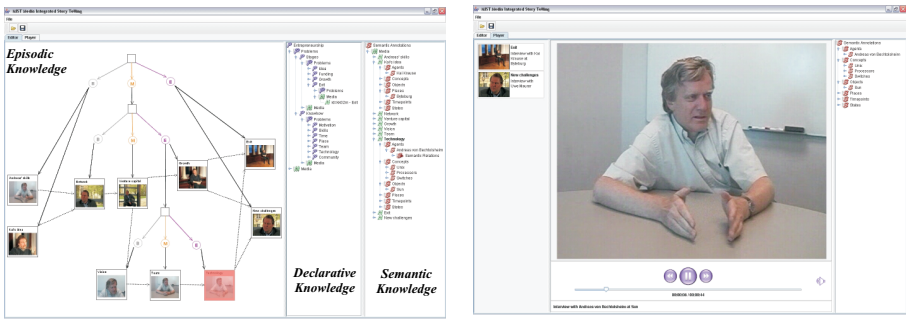

Figure 3: Multimedia Story Editor (left), Multimedia Story Player (right)

methodology and formalism to create multimedia stories by combining three facets of stories: Motivation (verbal and non-verbal knowledge), Exigency (semantic knowledge) and Structure (episodic knowledge). Besides LAS MPEG-7 services, VEL 2.0 contains additional LAS MPEG-7 story-telling services which provide features in order to create MOD compliant non-linear multimedia stories. Thus, its user interface allows the authoring and consumption of non-linear multimedia stories, by an editor and a player (cf. Figure 3). The contents are interviews of different entrepreneurial players from high-tech companies like Sun Microsystems, MetaCreations and ByteBurg. The interviews deal with different aspects of entrepreneurial activities like finding the right team, identifying the right opportunity, looking for start-up money etc. These issues can be temporally arranged as they depend on a distinct stage of a funding and can be associated with problems to be solved. At creating a story the author can specify paths along the entrepreneurial interviews, covering different problematic aspects of entrepreneurship. Thus, the problems addressed depend on the path selected and lead consequently to different results in an entrepreneurship.

3.3 ACIS

The Afghan Community Information System for Cultural Heritage Management (ACIS) hosts an inter-cultural, -generational, and -disciplinary community from all over the world in order to preserve the cultural sites and monuments in Afghanistan [Klamma et al., 2005b]. The aim of this interdisciplinary cooperation is to provide a networked community with a cheap, long-lasting, and flexible environment, which allows them to rebuild the disaster-struck area more or less self-organizing, without the requirement for the users to be on-site. As for the previously introduced systems, multimedia is crucial for ACIS. Since the community needs to be aware of the current physical conditions of the monuments and sites, a variety of multimedia files are used for documentation. Thus, the user interface employs LAS MPEG-7 services for the input of contents. Again, high-level semantic LAS services are used to capture the Dublin Core & MPEG-7

compliant metadata, while low-level semantic LAS services extract the technical information automatically. Designated features of ACIS are the geo-spatial services which are used to perform geo-spatial queries on an Oracle database. Thus, relational tables and object-oriented tables are applied in the same relational object-oriented database that employs spatial database, multimedia database, and XML database technologies. Summarily, ACIS hosts a community of experts and professionals by helping them manage and share the knowledge via a multimedia geo-spatial information system.

4 Conclusions & Outlook

There are many commercial implementations and research prototypes for community engines available. Many of them offer impressive multimedia capabilities. But we are not aware whether these engines have the capabilities of serving the special and changing needs of communities of practice, or whether they support multimedia services based on MPEG-7. We have demonstrated that our community engine architecture and development methodology are capable of assessing the needs of communities over time and of involving community members in the evolution of the hosted community by several means. We have proved the concept by hosting several communities ranging from scientific communities in the humanities to cultural heritage management experts all over the world.

Our approach simplifies the community support process for the communities of practice drastically and at the same time offers more influence on the development process. What we have learned is that direct support by computer scientists and community designers is still needed. In future we want to explore end-user computing support and graphical editing support for community web sites to leave more responsibility on the community side. Especially, we want to focus on self-monitoring tools for communities to provide more reflexive insights on the 'mechanics' of communities, assisting the community members to help themselves. As we have seen in the past, some of the best communities have not been created, they have emerged.

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