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TOWARDS PERSONALIZED CONTENT OBSERVATION IN AN ANCIENT HISTORY VIRTUAL MUSEUM*

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For a long time, cultural heritage has been maintained in museums, galleries, libraries and research laboratories, where not everyone was able to access this wealth. Digital technologies that have been developed during the past couple of years introduced new solutions of documentation, maintenance and distribution of huge amounts of collected material. Among these new technologies are virtual museums, which have already proven their worth as a contemporary conceptual solution for access to and attractive presentation of cultural archives. This article aims to present the virtual museum, an advanced system managing diverse collections of digital objects that are organized in various ways by a complex specialized functionality. However, these systems often suffer from the lack of tools for improved content observation and enhanced learning experience. The paper present some solutions for effective usage in this context of virtual museum content for learning purposes.

1. Introduction. The development of the technologies during the last years provides new functionalities and advanced services to contemporary virtual museum (VM) transforming their static complex structures to environment with a *dynamic federation of functional units* [1]. This change resulted from the needs of the market, the emergence of new technologies, and especially from the request for wider use of the museum resources and adapting VMs content and services to the needs of different user groups.

Some key research questions, raised during the design and the development of these systems in the context of their usage for education, are:

- How to present the selected resources in a given context and to determine the conditions and use cases – cognitive or educational goals, analysis, creative use?
- How to help the user not just to view, but to also gain knowledge?
- How to provide knowledge in the most suitable way and form?
- How to adapt the offered information content for each individual user or group in order to achieve their learning goals and tasks?
- How to choose the most suitable resources for a specific situation and the method of introduction to the domain, which is subject to research?

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The difficulties in solving these research issues are related to the lack of common model and working solutions regarding the basic and the extended functionality, and synchronizing the solutions with the existing standards and regulations in the e-learning area; provision of functionality for learning analysis, understanding and better interpretation of digital cultural content; context-dependent use of digital cultural resources; increase and generalization of visitor experience, contextual techniques for personalizing visitor experience, etc. [2].

This paper aims to demonstrate some solutions for effective usage of virtual museum content for learning purposes through services to improved content observation and enhanced learning experience. Main factors, related to the VMs user experience and content usability issues are considered. Users' cognitive needs, goals, preferences, and interests have been carefully studied and have become the starting point for the new functionality. The paper tracks some services for improved content observation and enhanced learning experience, which could be applied in a virtual museum. Special attention is paid on the personalized content usage in the VM environment.

2. Virtual museum kernel. The virtual museum mainly contains service panels for *Museum content management, Museum content presentation, Administrative services* (see Fig. 1), jointed to a *Media repository* and a *User data repository* [3].

The *Museum content management* module refers to the activities related to basic content creation: add (annotating and semantic indexing), store, edit, preview, delete, group, and manage multimedia digital objects; manage metadata; search, select (filter), access and browse digital objects.

The *Museum content presentation* module supports objects and collections display. It also provides collections creation (incl. search, select/browse and group multimedia digital objects according to different criteria and/or context of usage), visualization, status of collection display.

Content presentation module aims to provide access to all virtual museum services through wide range of contemporary technologies and devices – not only desktop PCs, but mobile phones, tablets, TVs, VR devices, *etc.* Interactive media technologies are used to provide best user experience within the content of the virtual museum.

The *Administrative services* panel mainly provides user data management, data export, tracking and analysis services.

For every object all semantic and technical metadata are saved in the *Media repository.* These metadata are represented in catalogue records that point to the original media file/s associated to every object.

The *User profile repository* manages all user data and their changes.

3. User experience and content usability issues. When the VM user is a learner, or has learning purposes in the environment, "one size fits all" solutions are not enough to satisfy his/her needs. Different users have different learning needs and preferences that (should) affect the learning function outcome. Learners expect from the system a "personal facilitator" and not a "classroom" behavior, in which their personality and needs are known and taken into account. Based on [4] in *learning personalization* is most generally defined as an adaptation of the learning process and its content to the personal characteristics and preferences of the learner, as much as possible.

There are several benefits of thinking about and trying to understand learning preferences [5]:

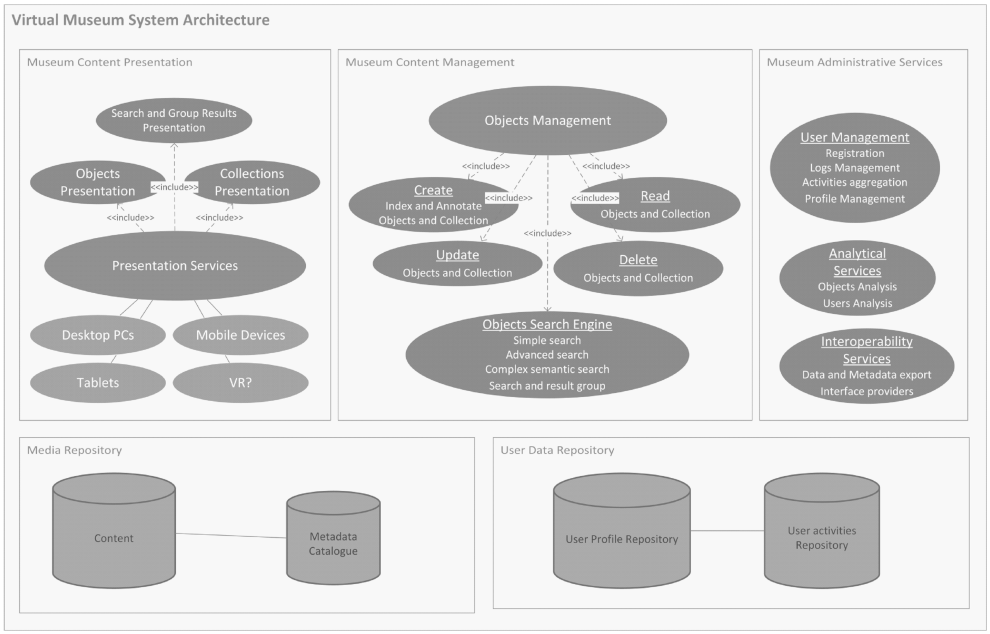

Fig. 1. The functional units of the VM System Architecture

- People learn most effectively when the strategies used are closely matched with their preferred learning style.
- Sometimes we can improve our learning by knowing what our strengths are and then doing more of what we're good at.
- Often we can improve our learning by knowing what our weakness are and trying to enhance our skills in these areas.
- Different situations and learning environments require different learning strategies, so it's best to have a large repertoire from which to draw.

But which are these educational needs and preferences that essentially should be considered as input parameters in personalization processes and what is their role in the construction of a learning plan and the selection of appropriate learning resources [6]? Authors of [6] identify and analyze a number of factors that can influence the extent and outcome of learning such as the learning style, learner goals/objectives, previous knowledge, educational level and difficulty, technical and other preferences (*e.g.* language, *etc.*).

Our research practices point to various factors that should affect even more the learning activities and selection and usage of the VM content for learning, such as:

- The space in which learning takes place, its aesthetics and athmosphere, user interfaces, visual elements, input devices, interaction with other learners/mentors, options of dynamic changing of the learning place, even its realism.
- Interactivity and immersion learning.
- The "interplay" between the learner and the learning's narrative or the learning place as a whole.

- The *learnativity content model* – the concept of assembling content into higher-level objects, as it is defined by Wagner [7].
- The set of challenges the learner will face within the learning space; synchronization of the challenges with the ability of the learner.
- Keeping interests by: a) implementation of multiple difficulty settings for the different learners, and b) usage of non-trivial learning objects – applied games, puzzles, stories, conundrums, *etc.*
- Transforming the boring learning activities in adventures. The quality of the learner experience – whether learners enjoy working with the e-system, or find it frustrating.
- Setting awards for the efforts – reward the learners for skill, imagination, intelligence and dedication.
- Enhancing the motivation by encouragement, diversity, and extended curiosity.
- Eventually, conscious awareness of the learning as a key engine for the future success.

The provision of creative experiences, learning-by-doing and role-playing scenarios could be also mentioned.

Moreover, a key factor to define the model of the proper learner: the "who", or the degree of specialization in defining who is modeled and what the learner history is; the "what", or the cognitive goals, plans, attitudes, capabilities, knowledge, and beliefs of the learner; "how" the model is to be acquired and maintained and the "why", including whether to elicit information from the learner, give assistance, provide feedback, or interpret the learner's behavior [8]. Callan et al. [9] commented in their paper that the user models should take into account also the overall information space – the context – including:

- Cognitive abilities, e.g. learning styles, perception.
- Individual differences, e.g. experience, education, age, gender.
- Individual and group behavior patterns and history.
- Subject domains.
- Work tasks, e.g. writing an essay, choosing a movie, planning a holiday.
- Work environments, and
- How all of the above change over time.

Callan et al. (ibid.) emphasized on investigating methods for building more robust, flexible and portable models of the complexity of users, tasks and contexts to inform the diverse possibilities for personalization. Targets for learner personalization include developing implicit rather than explicit methods for learning user preferences which form the user models as well as user models portable across applications, devices and systems. Perhaps the biggest challenge in this area will involve the development of user models that will drive personalization and recommender systems, that are rich enough to capture as much of the user's task environment (context, task, situation), history, contribution to communities and individual preferences as possible while conforming to a person's privacy choices.

Major problems appear during the design of the software solutions (services, components, *etc.*), closely capturing the above discussed factors. Some of the problems concern the communication between the user and the software environment. Other are related with the formal presentation of the subjective issues such as learner skill, imagination,

motivation, intelligence, dedication, *etc.* Moreover, in order to provide effective forms of personalized learner experiences the focus must be on the design of the interaction per se as an integral part of the whole system. There is a need to develop multi-modal mixed initiative interfaces that draw on a range of user information seeking models. The requirement is thus for research to develop theories of interaction which underpin the design of applications and vice versa, and which go beyond issues of simple elicitation, presentation and feedback [10].

4. Services for improved VM content observation and enhanced learning experience. A very important trend of the future is that any learning content from any source (virtual museums, digital libraries and repositories with digital objects, knowledge grids, *etc.*) will be available anywhere at any time – via natural interaction – on any interactive learning platform, in any format desired by the user, which implies that a specific attention should be paid to services for learning content delivery, creation (production), adaptation, personalization, storage, *etc.* In a world where content on demand is available everywhere from any providers, *finding appropriate learning content for the user needs (for short – discovery)* becomes of most importance. Discovery can be both of specific pieces of content and also packages of related content. The discovery engine should have some intelligence, remembering previous choice selected and that information to steer new searches. The usual current use of *discovery* is for a search to be conducted, followed by the subsequent download of the information being sought. This is the way most people expect discovery in a search context to be used. An alternative view is that the VM search service could be based on an example or based on searches one has made previously (based on a profile that could be stored in the network or in the learning platform) or on some consensus view.

The mission of VM developers should be to facilitate the *production of new audiovisual content* that takes maximum advantage of the new technological capabilities. The production of interactive learning content will become the most important element of content production. The learning content will requires contributions from individuals, and individuals will wish to personalize and adapt content to their needs. The main requirement is the realization of more economical and more easily usable tools for content production. It is therefore crucial that content developers have better access to technology that enables them to create content and implicitly opens the way to distribution channels.

Content adaptation is the ability to tailor content to the current circumstances of the user. Content adaptation is related to content personalization, which is concerned with tailoring content semantically to the user's requirements. Several international research efforts are focused on the design and implementation of middleware infrastructures for content adaptation. Most of those proposals tend to adopt an adaptation approach based on static content selection, some research activities have already addressed real-time content production, and only a few research efforts consider dynamic binding to resources and service components (e.g. [8]). The promising vision is that: (a) the adaptation should be autonomous and on-the-fly one, with no human intervention; (b) adapters should be capable of self-description; and (c) a pervasive support infrastructure should take the appropriate context-based adaptation decisions, without affecting the design and implementation of multimedia servers and client applications.

Content personalization is the ability to tailor the content to the user's preferences

as well as the context of usage. This type of personalization is a means of meeting the user's needs more effectively and efficiently by making interactions faster and easier. Furthermore, content personalization is closely related to knowledge management, data mining, and learning objects annotation and indexing.

User experience personalization will be effective when the users receive highly relevant content available exactly when they want – any type of media available at anytime and in the most efficient way.

This 'context awareness' is much more than location awareness alone, or merely the immediate situation.

A very important objective in the field of personalization is the development of a system that is aware of the user's situation. Such a system will interpret the contextual information in the light of preferences previously declared by the user or choices previously made to supply appropriate 'tagged and targeted content'.

A support service infrastructure should be able to properly aggregate data about the context, in order to distil a context view at the proper level of abstraction depending on who/what is in charge of taking decisions on the basis of that view. Sometimes, those context data should be migrated, possibly proactively, with the learner they apply to, depending on user movements during the service session [11].

5. Conclusions and future work. The further investigations in the above-discussed domain point to a wide variety of directions:

- To create of workable methods and tools, aiming to increase and generalize the visitor experience in the virtual museum. Moreover, creative user experiences will support the effective on-line learning through VMs.
- Contextual techniques for personalizing its experience in these platforms.
- To develop of new digital and transmedia storytelling solutions for learning purposes, creation of interactive virtual exhibitions, gaming and gamification, virtual worlds, live simulations, animations, interactive media previews.
- Multimodal interfaces and intelligent visualization of complex information relying on enhanced user experience and usability (incl. user-centric visualization and analytics, real-time adaptable and interactive visualization, real-time and collaborative 3D visualization, dynamic clustering of information, *etc.*), *etc.*

Moreover, the design and improvement of the learner' experience in the changing cases would not be restricted by the available technologies, platforms and tools. The field has great potential for innovations especially in our world of active imposition of e-devices, e-literacy, and e-content. The focus will be in the research and exploitation of new or emerging technologies (e.g. 3D, augmented and virtual reality, visual computing, smart world, environments and devices, media convergence, social media, *etc.*) for the development of innovative products, tools, applications, and services for creative digital content production, usage and management. The aims is to transform and customize the valuable parts of mankind's cultural and historical ancestry into digital assets, whose integration and reuse through research-lead methods has high commercial and non-commercial potential for learning and cultural institutions, tourism, creative and media industries.

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КЪМ ПЕРСОНАЛИЗИРАНО РАЗГЛЕЖДАНЕ НА СЪДЪРЖАНИЕТО ВЪВ ВИРТУАЛЕН МУЗЕЙ ЗА ДРЕВНА ИСТОРИЯ

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Дълго време културното наследство се е съхранявало в музеи, галерии, библиотеки и изследователски лаборатории, където не всеки е имал достъп до него. Дигиталните технологии, разработени през последните няколко години, дадоха нови решения за документиране, поддръжка и разпространение на огромни количества събран материал. Сред тези нови технологии са виртуалните музеи, които вече са доказали своята стойност като съвременно концептуално решение за достъп и атрактивно представяне на културни архиви. Тази статия има за цел да представи виртуалния музей като усъвършенствана система за управление на разнообразни колекции от цифрови обекти, които са организирани по различни начини чрез сложна специализирана функционалност. Тези системи обаче често страдат от липсата на инструменти за подобрено наблюдение на съдържанието и подобрен опит в образованието. В този контекст в настоящата статия са предложени някои решения за ефективно използване на виртуално музейно съдържание за учебни цели.