Exploring Collaboration in the Realm of Virtual Museums

Nelson Baloian[1(✉)], Wolfram Luther[2], Daniel Biella[2], Nare Karapetyan[3], José A. Pino[1], Tobias Schreck[4], Andres Ferrada[1], and Nancy Hitschfeld[1]

[1] Department of Computer Science, Universidad de Chile, Santiago, Chile
{nbaloian,jpino,nancy}@dcc.uchile.cl
[2] University of Duisburg-Essen, Duisburg, Germany
{wolfram.luther,daniel.biella}@uni-due.de
[3] American University of Armenia, Yerevan, Armenia
nkarapetyan@aua.am
[4] Graz University of Technology, Graz, Austria
tobias.schreck@cgv.tugraz.at

Abstract. Virtual museums have been very popular since the early days of the World Wide Web and many scientific works have been published on this topic. Although the rich variety of possibilities for supporting collaboration among the users of virtual museums, today very few implementations offer support for such kind of activities. This paper aims at settling the value of collaboration in virtual museums by means of depicting and classifying collaborative organization and co-curation activities in establishing, designing, planning, realizing, operating, deploying and visiting a virtual exhibition applying action research. As a use case, we present ongoing work to realize a virtual museum devoted to Armenian cross stones (Khachkars).

Keywords: Virtual museums · Taxonomy of collaborative activities

1 Introduction

A virtual museum VM is a software artifact that presents a reconstruction of physical museums or parts of them; it displays digital reconstructions or born digital art in an exhibition, room and museum setting. Hazan et al. [4] define a VM as "a communication product accessible by a public, focused on tangible or intangible heritage. It uses various forms of interactivity and immersion, for the purpose of education, research, enjoyment, and enhancement of visitor experience. VMs may be typically but not exclusively denoted as electronic when they could be called online museums, hyper museum, digital museum, cyber museums or Web museums".

The realization of a VM goes on in several stages: Establishing, designing, constructing, running, and operating a VM within its lifespan. Different skills are needed from people working on these various stages; even for one stage, several persons may be related to it. Main roles are curators, software engineers, instructors, architects, experts, sponsors/authorities, and visitors; the latter ones may be museum enthusiasts, special user groups, tourists, students, etc.

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Collaboration in virtual museums has not been explored as much as it should, despite the various interesting possibilities which were highlighted in [1] already in the year 2001. Therefore, in this work, we would like to focus on collaboration possibilities involving stakeholders with different roles in the process of creation, administration and visiting a virtual museum.

2 Collaboration in a Virtual Museum

We focus on interdisciplinary collaboration; no contribution to collaboration inside groups is intended. The stakeholders concerned in the collaborative co-curation process encompass the coordination of group building, task allocation, motivation of team members, communication in the context of collaborative evaluation and testing, knowledge generation and problem solving via information processing in the creating and visiting process of virtual exhibitions.

Group members are often distributed across a wide area; they constitute a multidisciplinary, multi-professional team. Individuals have various motivations and goals when working together. Co-curation within the generation process is paired with collaboration during a visit to an exhibition. Sacher et al. [7] explain: "The generated data from collaboration can range from visitor's annotations or comments regarding specific exhibits up to complete exhibit models and room (re-)designs created in a virtual environment. … Collaboration (in virtual environments) is implemented as users being co-located in the VM, which enables information exchange and awareness of user actions via face-to-face communication." Recently, a new metadata standard and new modeling language for virtual museums, the VM and Cultural Object Exchange Format (ViMCOX) has been developed in order to provide a semantic structure for exhibits and complete museums [8]. It combines community contributions to administrative and descriptive metadata with technical and use metadata provided by the institution operating the museum. This partition implies the following classification:

- Level 1: Organizational collaboration
- Level 2: Descriptive process-related collaboration, i.e. co-curation

Level 1: Communication about the nature of the problem (classification, identifying and describing the problem solving approach, depicting the process workflow: hierarchical description and generative metadata-based process modeling, call for crowdsourcing). Coordination: team composition (team description & parameter selection, e.g., team size and structure, task distribution, crowd participation, motivation, remuneration), evaluation planning, etc. [5].

Level 2: Co-curation activities: Exhibition space design (designing VM, expositions – spatial, metaphoric design, software tools, metadata acquisition, tour planning, interaction design), information processing (created, used, modified), communication/interaction (various forms of communication and interaction between group members as well as persons and items during the whole collaborative co-curation process – formal description, mode, technical parameters like frequency, quantity, reliability, intent [10]).

The collaborative work of promoters, curators, and intended users mainly concerns communication and coordination on level one including motivation, aim, need, team building and further administrative tasks. Sacher [8] suggests the use of a conception matrix linking issues, curators and other groups like team building & experts; room design, installation & architects, software engineers; themes & sponsors; presentation goals & museums' enthusiasts; administrative tasks & experts. Activities are in detail:

- Thematic classification, content conception, motivation, need.
- Team building.
- Reviewing old exhibitions.
- General design consideration – participatory design.
- Artwork selection and maintenance throughout its lifecycle (incl. metadata).
- Gathering of spatial constraints.
- Administrative tasks: financing, regulations, rights, insurances.
- Monitoring the museum narrative, conflict management and tool support.

2.1 Designing and Planning the Virtual Museum

In level two as defined above, the major challenges in the collaborative work process faced by curators and software engineers are collaborative problem solving and information processing. This includes the creation of sketches, drawings, mind maps, storyboards, plans and models with respect to the following issues:

- **creation of exhibition space designs** and **digitization/selection of exhibit:** it involves the crafting or selecting of room models, buildings and outdoor areas as well as their connectors,
- **import** of metadata instances, **collection** and **positioning** of artifacts, interactive/animated exhibits, content and information,
- **floor planning and tasks layout, metaphorical design:** ground plan, lighting, wall layout, guiding visitors, i.e. navigation aids. Spatial parameters and architecture can influence content and form of the digitized content, thus re-scaling may be necessary,
- **presentation, publication and dissemination:** virtual exhibition/museum (local/web), selection of widgets and input/output peripherals, HUD (minimap), monitor, projector, keyboard, touch, gamepad or other VR devices. Preview on-the-fly utilizing various navigation modes and avatar sizes, exhibition catalog, archiving construction plan, archiving user behavior.

To support metadata-based content construction, in our application example of a Khachkar museum we have to build a XML-formatted list of Khachkars with the following metadata: Name/item, century, master, style, ornaments at the bottom, back side, text, motif, size, purpose for erection, first location/monastery, actual location, function, surrounding, stone parameters, source, etc.

Among the many tools for collaborative software development there is *gitlab* [9], which integrates a complete workflow from writing down an idea, issue tracking, commenting, planning, code managing, documentation to testing, reviewing, deployment and feedback management. Tools like issue trackers, wikis, distributed software

repositories with version control, continuous software integration servers, and deployment engines have already existed before but gitlab makes all of these accessible in a single web-based platform.

Gitlab's features are not limited to software development but can also be used for the configuration management. The built-in user management allows the assignment of curators and software developers to the roles they need to plan, design, code, and evaluate a VM in a distributed and collaborative environment.

2.2 Constructing the Virtual Museum

This stage concerns the following tasks for software engineers, curators, the crowd, museum enthusiasts and experts in the context of co-curation in galleries, libraries, archives and museums (GLAM) with the aim of using the inspiration/expertise of non-professional curators to create exhibitions:

- Digital 2D/3D model creation: Digitization and reconstruction of Armenian Khachkars mainly done by students and anonymous collaborators in a crowdsourcing modality, collection of metadata, artwork description and classification respecting the ViMCOX standard with the aid of experts.
- Design of artwork settings: Placement in appropriate surroundings with respect to typical arrangements.
- Web-based interface for checking and transferring artworks, metadata and rights.
- Various presentation modes using WIMP or post WIMP interaction devices.
- Attendant evaluation and requirement validation during the whole workflow.

2.3 Operating the Virtual Museum

This stage encompasses contributions by various user groups, engaged visitors, instructors, and the use of reconstruction software and collaborative tools: Tour selection, construction and publication, metadata-based artwork linking, knowledge creation (affecting creator, époque, original-replica discussion, style, material, dedication, inscription etc.), interactive artifact (de)construction, storytelling, collaborative scenarios with shared workspaces.

- **Commenting, improving and publishing** (e-guest book opportunity, evaluating visitor's annotations or comments regarding specific exhibits, exhibit models manipulation or completion, considering room (re-)designs elaborated in a virtual environment, publishing individual tours and preferential artwork [2].
- **Navigation and interaction** (proposing, tours, points of interest, interacting with artifacts, changing their geometry, scaling, translation, rotation or changing the internal structure).
- **Institutional collaboration** utilizing standardized metadata from other museums or experts as well as social media integration.
- **Technological progress** in VM generation, new presentation forms, museum instances operated by multiple users and attendant evaluation should contribute to a virtual museum lifecycle in the long term.

3 A Collaborative Virtual Khachkar Museum

As stated in the first section, we began this long-term research with an action research approach. For this purpose we have already developed an application which implements virtual 3D environment in which curators can set up Khachkars exhibitions in a collaborative way and visitors can explore them interacting in various ways with the curators and other visitors. The application was developed using the Unity framework, originally intended for developing 3D collaborative games. It was chosen given its versatility to include various types of 3D models, the way it allows users to navigate and interact with the created environments (including multi-user features) and the fact that the created application can be exported to web format.

Before developing the actual application we had to build a library of Khachkars which would be available for curators in order to create their expositions. For the first stage of the work we selected about 80 stones according to this criterion: they must be easily reached, there is some interesting data available about them, and they should be of various styles, ages and regions. We used mainly two different methods: the first one was a lightweight approach, in which photographs are taken from the front, back, two lateral sides and from above. Then a graphic model is created "by hand". The second is taking a set of photographs covering a 360 degrees view and reconstructing the 3D view using online services like MeshLab.

In order to add a stone to the application's library, metadata should be provided according to the description in Sect. 2.1. There is also the possibility to add text to explain some particular characteristic of the stone. All this information will be used by the application and shown to curators and visitors by request. A ground perspective of this work is that the addition of new Khachkars to the library remains open to additions during the museum's lifecycle using a crowdsourcing modality.

A new exposition is created by entering the name and a short description about what is intended to show with it. Then a main menu lets curators choose the scenario where the exposition will be deployed. Currently there are five options: a countryside, which has two variants, with or without a church on the background, a wall with niches where the stones can be put, an alley and on a rocky mountainside. These are the most typical settings in which Khachkars can be found in the real world (Fig. 1).

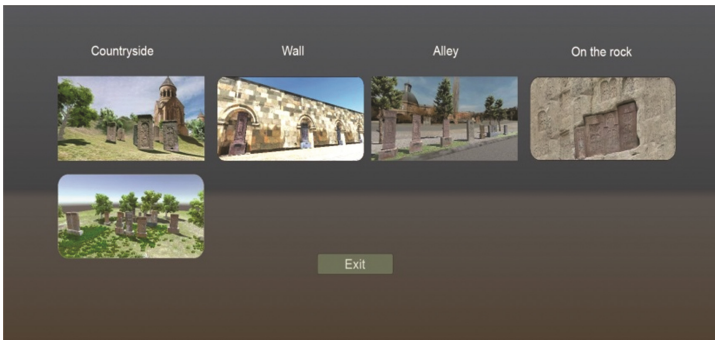

Fig. 1. Access to Khachkar formations and arrangements

Then, a collaborative workspace is accessed in which the chosen scenario is shown without any stone. At the left hand side there appears a scrollable menu with all the available stones which have been previously digitized and included in the Khachkars library of the application (Fig. 2).

Fig. 2. Curators' collaborative environment

Curators can place a stone in the chosen scenario by dragging it from the icons menu and dropping it on the chosen scenario. They can also re-arrange the original setting by rotating and moving the stones. Various awareness elements have been incorporated into this workspace to support the collaborative work among co-curators. One of them is the set of icons representing each one of them, which is surrounded by a frame of a particular distinctive color. When one curator is working with a particular stone on the scenario (e.g., by moving it) this is highlighted with the color associated to the curator's icon.

The most basic interaction for visitors to the exposition is by clicking on each stone and seeing its metadata. A more elaborated interaction with the application is the implementation of suggested "viewpoints" which can be used indistinctively by visitors and curators. Navigation in 3D environments can sometimes be difficult, especially for beginners, and they may miss some interesting characteristics of the exhibition. In order to help visitors not to miss a certain important view of the exposition curators can include points of view in it, by saving a certain location and view orientation in the scene. These points of view will be shown as avatars in the form of human silhouettes when a person visits the exhibit (Fig. 3).

Clicking on an avatar, the visitor's view will be "teleported" to that location. Each "viewpoint" has a blog associated in which the author can explain the reason for visiting it and visitors can leave comments and feedbacks.

Fig. 3. A scene with viewpoints shown as human silhouettes

Based on experiences in former projects [6, 7], we will make an evaluation concerning establishment, design, and system realization. This evaluation will take into account the viewpoints of all relevant stakeholders [11].

4 Conclusions

Collaboration is fundamental to ensure quality and limit costs in building and operating virtual museums. This paper proposes a two-tier classification of collaborative group activities framing the creation process and use of virtual exhibitions. It highlights a new interdisciplinary project devoted to the realization of a virtual Khachkar museum. The paper also presents a preliminary development of a virtual museum which implements most of the activities mentioned in this classification. This implementation will allow us to conduct further research about the way stakeholders of a virtual museum would benefit from cooperating inside the environment by introducing this tool in the community. For this purpose, we have already made the relevant contacts with experts in the area of Armenian ancient architecture and art, including Khachkars, and we have their commitment to support the testing. Further work should examine intergroup and intra-group collaboration, the automatized co-curation and GLAM as special form of crowdsourcing, create a worldwide motivating and remuneration concept, and address the question of how we could measure and rate collaboration with respect to the various quoted forms [3].

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