Navigation in Past Museum Exhibitions using Multimedia Archives

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ABSTRACT
Many exhibitions that occurred in the past in art museums left a large amount of records (pictures, videos and texts), which are distributed over several documents or places. This paper proposes a multimedia system to reconstruct the heritage and space from such exhibitions. The virtual reconstruction is based on collecting and recovering the documents and making them accessible using an integrated interface. The evolution of image and photograph visualization allows the virtual reconstruction of physical spaces, offering a new dimension of interaction with the user. Through image analysis techniques, the spatial relation between each photo in the archive is accessed allowing the semi-automatic construction of a virtual artwork exhibition.

Categories and Subject Descriptors
H.5.4 [Hypertext/Hypermedia]: Navigation.

General Terms
Documentation, Design, Experimentation, Human Factors

Keywords
Web Interface, Cultural Heritage, Image Processing

1. INTRODUCTION
The preservation of the historical heritage has been one of the major roles of museums internationally. Art museums in particular have been responsible for the acquisition, inventory, study and exhibition of a large number of cultural and artistic artifacts through the last two centuries. Currently the memory and heritage of these old exhibitions lives mostly unorganized in museum archives, or in the minds of some of the organizers and participants.

The main questions that are addressed in this project are, first, the creation of a digital documental framework able to centralize all the information, and secondly, the creation of a multimedia visual interface that can recreate an exhibition from the past.

Creating a visualization system for an exhibition that occurred many years ago, poses additional challenges that need to be addressed. The first obvious difficulty is that it is impossible to visit the exhibition; sometimes even the building where it occurred is structurally different or no longer exists. The reconstruction is entirely dependent of documental photos, from that time, old building blueprints, and archive listings.

This paper presents a system to organize a digital catalogue from an art exhibition. The old images from the exhibition are analyzed using computer vision techniques to detect overlaps and continuities between them. These continuities can later be explored in the semi-automatic reconstruction of the exhibition spaces. The visualization module is a web-based multimedia application with an interactive interface to virtually explore the exhibition. To test and validate our system, a use-case exhibition was considered. The current prototype was developed for a modern art exhibition that took place in 1957, from which there are only some black and white images, a catalogue (in paper) and a film of the opening.

The current research focuses on the digital presence of virtual museums online [3,4,5], how artworks are presented and visualized, and what challenges museums face [2]. Additionally, methods for image analysis [1] and scene reconstruction [6] were studied in order to enhance the visual interface model. The exploration of photos from the past was also subject of discussion.

2. DESIGN PRINCIPLES
The main goals of this project were to create a tool for expert users to centralize information about an historical event or exhibition and create a standard form of visualization and navigation that would enable access for a wider audience. The expert users can be historians, archivists, artists or any person with access to archive data. The data is composed of images, videos, artwork descriptions or texts. Images from the exhibition floor and from the artworks will contribute to a rich navigational environment.

The expert users supply the system with all archive data and some relational information. With the archive data and especially with the images, the system should be able to infer some relations on its own. On each exhibition floor image the artworks can be automatically identified, by comparing the floor images with the artwork images. Comparing the floor images among each other, it should be possible to infer which pictures belong to the same room or which pictures represent a contiguous area. Since most of these images come from historical archives, and cannot be repeated, they can have a low quality or may not exist in enough quantity. As such, the automatic detection system is not sufficient to create a full reconstruction of the exhibition. Some of the
relations between images may have to be introduced manually after the automatic process runs.

Using the collected documents and the extracted information, the goal is to use the database to visualize different aspects of the museum. It will also enable public authorities, museum directors and professionals to reflect on museum activities by providing easy access to a solid historical background.

3. IMPLEMENTATION

The architecture was implemented with several technologies, following the design presented in Figure 1a. The use of HTML 5 and Processing.js was necessary to make the graphical and visual part of the application. The interface and the management system of the application, which communicates with the database and interface, were constructed using Java Server Pages and Rich Faces. The data and its relations are stored in a XML database. The offline analysis of the images is done using a server based on OpenCV. One of the main principles in the design of this project is to reconstruct the exhibition from archive photographs. The navigation in the reconstructed scene is based on the overlaps between each photo. Using photo-stitching techniques ([1], [6]) (SIFT + RANSAC + Homography) a prototype was constructed, as seen in Figure 1b, to find the relation between images and the corresponding distortion necessary to present a photo-stitched panoramic view of the scene. This is important to show the surroundings of the scene and increase the immersion sensation of the user. Our system assumes that there is a large quantity of images per room, and there is a small amount of overlapping in the photos. The entire set of archive images is pre-analyzed offline to detect continuities on different photos.

Figure 1. a) System architecture design (the system considers two main roles, expert and regular user). b) Proof-of-concept prototype: with the homography between images it is possible to graphically arrange the pictures spatially; in this example two pictures are spatially aligned.

3.1 Visual Interface

The graphical, visual, part of the system makes the communication with the user. It is necessary that the virtual exhibition is understandable by the visitor, so in order to do this the navigation in the interface is made through links that connect the main components of the system. There are five main sections in which this exhibition is divided. The sections are: (1) Video, (2) Navigation, (3) Search, (4) Details and (5) Administration. All these sections, except administration, can be accessed through the main web page links. The administration access will be made outside this page, only for the administrators of the system.

The (1) video section contains media files that display, when running, dynamic information about what is shown in the movie at that moment. The (2) navigation section allows the user to visit the exhibition through pictures and observe the artworks. The (3) search for a specific word or artwork name is possible by consulting the search section where there are methods that enable fast access to information. The information that is going to be shown to the user will include some specific details (4) where it is possible to obtain information about current artwork, such as the artist name or the artwork title. In the (5) administration area there are options to control the artworks information and the navigation visualization. Next, it will be explained how each part is integrated in the overall system.

Figure 2. a) Panoramic navigation example, left and right image plus overlapping images. b) Artwork detailed information sheet. Below, thumbnails link to the exhibition pictures where they appear and above a link provides access to a high-resolution image

4. CONCLUSIONS AND FUTURE WORK

The current platform has proven to be flexible enough to catch the attention of both archivists, on the database side, and historians, on the interface exploration side. The explored use-case, which is of most importance to one to our partners, was fundamental to test and improve the generic platform. Contacts are currently being made to explore other exhibitions using the same system and concepts. Although almost finished, the use-case web site still requires some additional test and security related checks, before opening to the public.

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5. REFERENCES