AMMICO: social recommendation for museums

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Abstract. We present recommendation techniques used in AMMICO, an ongoing project to develop *smart* audio-guides for museums. We propose several recommendation approaches relying on social network analysis and discuss how such techniques could address museum-specific issues and enhance museum visitors' experience. We present a prototype of such a technique which has been implemented in the *Great Black Music* exhibit.

Keywords: museum, audio-guide, recommender system, social network.

1 Introduction

Museums have collections of artworks which they present to the general public in exhibits structured by curators to showcase the most important pieces in their collections. Visitors can use audio-guides for assistance during their visit, providing them with descriptions of the artworks. However, present systems generally are very static with little room for interaction with the user. The AMMICO project http://ammico.fr/, funded by the French FUI 13 program, aims at endowing audio-guides with various smart functions exploiting advanced digital information techniques, so as to enhance the visitor's experience. These functionalities, developed by partners in the AMMICO consortium, include geolocalization (to help visitors find their way and know which artwork they're looking at), contextual search (to provide links to sites related to the items viewed), recommendations (to suggest potentially interesting items, in complement to the selection elaborated by the museum curators), social network (to foster collaborative interactions about the exhibit) and after-visit book (to provide visitor with personalized content about their visit). The project has started in January 2013, with various museums acting as Partners or Observers. In this paper, we present recommendation techniques used to help the user find artworks he might like.

When they visit an exhibit, people usually have a limited time to spend in the museum and therefore they should choose which artworks to see. First-time visitors in a museum do not exactly know what they should see or what would best match their interests. Their route may not be optimal for the time they have and they would end up seeing artworks they do not like very much while missing others. The order in

which works are presented to the public also has a significant influence on the satisfaction visitors get from their visits. A museum may propose some routes to follow, but they are not personalized to each visitor. In addition, if many visitors follow the same route, crowding may be an issue. It is thus important to propose *personalized routes*.

Recently, mobile phones with Internet capability and advanced functionalities (*smartphones*) have become widespread. They enable fast answers to visitors' questions inside the museum and offer geolocalization-based services. People have started to use them in lieu of traditional devices provided by museums. Developing on such devices museum-specific applications with dedicated services (indoor map with geolocalization, artwork search and curated additional content) may benefit visitors by giving them with a more personalized experience, while helping museums to improve their collections exposure and better exploit their digital contents.

We propose to introduce in the AMMICO platform context-based recommendations, based on current position, social profile and time constraints. In this paper, we report about a first phase of this project where a simple prototype has been implemented in the context of the *Great Black Music* exhibit (www.greatblackmusic.fr).

Several academic and industrial projects have introduced recommender systems in museums. We will not detail them here due to space constraints: an extensive comparative study is presented in [2].

2 Scientific issues of recommendations in museums

Recommender systems are designed to select, from a given large set of items, some items most suited to a given user. In a museum, items are the artworks, and we want to make suggestions to visitors. There are two main categories of recommender systems, either based on content or based on *Collaborative Filtering* (CF) [1]. Content-based systems rely on building a "profile" for users which is then matched with items descriptions. CF systems include user-based or item-based versions. In *user-based CF*, one finds users with a similar viewing behavior to the current user and then recommends a list of items these users liked. In *item-based CF*, one finds items similar to those the current user liked and recommends them. These systems produce a score for the items and order them to recommend the N most relevant (in practice, $N=3$ or 5). Formally, for a set U of users and I of items, we define similarity measures S_{user}: $U \times U \rightarrow \Re$ and S_{item} : $I \times I \rightarrow \Re$ among users and items and produce a scoring function R: $U \times I \rightarrow \Re$ where $R(u,i)$ is the score given for user u to item i.

Proposing recommendations in a museum raises several issues. Some are generic and largely described in the literature on recommender systems [1]; while others, specific to the museum context, are poorly covered in the literature [2], [4].

- The *cold-start problem* happens when too little information is available about items or users to find similar users/items and make relevant recommendations. This will be the case in museums: while artworks are very well described, most visitors come for the first time, and thus their past viewing behavior cannot be used.

- Data *sparsity* comes from the fact that there are many artworks and visitors, while each visitor only sees a few of the artworks.
- While providing personalized recommendations is a goal for our system, it should not *over-specialize*. If the system only proposes items similar to those which were previously liked by the user, the risk is to always recommend the same ones, which may prevent the visitor to discover other objects she would have liked.
- In the museum catalogue, a few artworks are liked by most visitors, while others are only liked by specific categories of visitors. These *popular* items will likely be often proposed in the set of recommended items. However, introducing less popular items is important for museums to showcase all their collection; and to visitors who might like to discover artworks they would not have heard about otherwise.
- Proposing a *sequence* of artworks, i.e. works to view in a specific order, is especially interesting in a museum because of geographical constraints. Artworks are located in specific rooms and we cannot expect a visitor to follow a zigzag route to visit them. A challenge is then to obtain sequences of recommended items and evaluate them not only on the basis of the individual scores of the artworks, but also on the basis of quality indices, such as length of route, time to go from one artwork to another …

3 Social recommenders

The recommending approach we develop in the AMMICO project is based on the analysis of a social network of visitors. This network can either be an *explicit* social network ("friends" or acquaintances), or an *implicit* network derived from the viewing behavior of the museum visitors.

An online social network will be set up for the museums in the AMMICO project[1], with connection to external social networks (to avoid recreating already existing friendship networks). In combination with this explicit graph, we can also use implicit networks, based on the behaviors of visitors (time spent in front of a given artwork, likes). Such a graph is obtained from a *bipartite* graph linking a visitor to the artworks he viewed (as registered on the audio-guide). The bipartite graph is projected onto a Visitors and an Artworks graphs: visitors are linked if they have viewed at least K same artworks; artworks are linked if they were viewed by at least K' same visitors (Fig. 1). These implicit networks thus represent the viewing behavior.

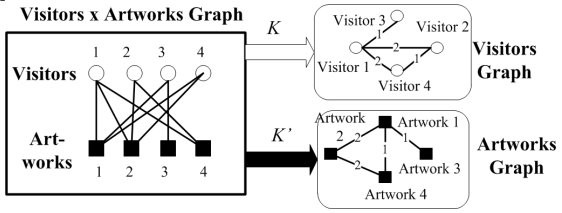

Fig. 1. Bipartite graph Visitors – Artworks, and projection onto the Visitors (white), and the Artworks (black) graphs.

[1] by Jamespot, a partner in the project.

Analysis of social interactions can be used to provide recommendations [3]. Similarly to traditional CF, our process first consists in finding visitors/items similar to a given visitor/item: this is done by looking at the neighborhood of the visitor either on the explicit or the implicit Visitors networks. Then preferences of these similar visitors for the various artworks are ranked to produce a list of recommended artworks. In the same fashion, we find similar items in the neighborhood of an item in the Artworks graph. We can thus build both user and item-based CF.

4 The Great Black Music exhibit

The Great Black Music exhibit (GBM) is on show at the Cité de la Musique from March 11 to August 24, 2014. It is an enriched version of a previous exhibit, *Les Musiques noires dans le monde*, which was held in Dakar, Saint-Denis de la Réunion and Johannesburg. Both Cité de la Musique and the curator, M. Benaïche, are members of the AMMICO Consortium. At the entrance of the exhibit, the visitor gets a smartphone, running a specifically developed application, and a stereo headset. The device allows the visitor to interact with some of the audiovisual contents (there are 11 hours available); the visitor can create his custom playlist and later retrieve it online.

We have developed a first prototype for the recommendation application using data from the Johannesburg exhibit. We had 3,689 visitors, 45 media common with the present GBM exhibit and 33,557 interactions (viewings). In this prototype, we did not try to take into account geolocalization (not available in the existing data); nor produce sequences of recommendations (for a route), but simply lists of recommended media; nor used an explicit social network which is not deployed yet. We also limited the prototype to recommendations during the visit and not after, even though this is an objective of AMMICO to enrich and extend the visitor's experience, and promote better exposure of the museum digital catalogue. These different extensions will be incorporated in the demonstrators which will be implemented in the last year of the project (2015). The purpose of this first prototype is essentially to test the technique and check how visitors receive and interact with provided recommendations.

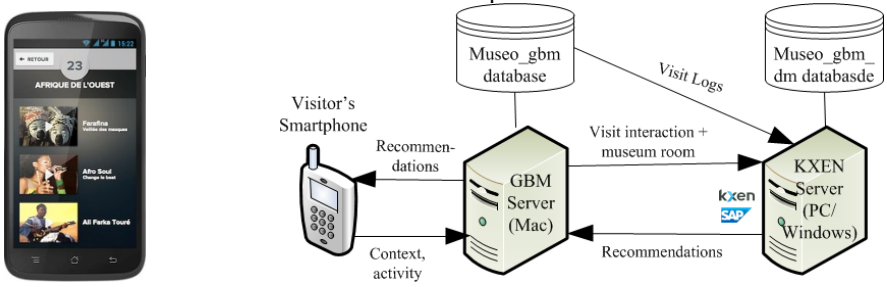

Fig.2. The smartphone at GBM (left) and the architecture of the recommendation application

The recommendation algorithm is an item-based CF, implemented with KXEN-SAP Infinite Insight: association rules of support at least 2 are extracted from the

Artworks graph and ranked by decreasing confidence. For each visitor, a list of 3 recommendations is generated with media he has not seen yet and which are in the room he's in (as detected from his interaction with his smartphone). For example, in the room "Legends", a visitor will get the list: *legends_presley_song4, legends_davis_itw7 and legends_hendrix_song6*. Fig.2 shows the smartphone used at the GBM exhibit (left) and the architecture of the application (right): the GBM server hosts the general exhibit application, with all interactions logged in the Museo_gbm database; while the recommendation application is hosted on the KXEN server, which, when prompted by the GBM server, computes recommendations and send them back to the GBM server which forwards them to the smartphone.

The application is ready to be deployed at the exhibit and should start logging visitors' interactions in June.

5 Conclusion

We have presented in this paper, a recommendation functionality which has been prototyped for the Great Black Music exhibit. We will analyze the results of the interactions of visitors with the application to refine it before deployment in 2015 of two demonstrators planned at Cité de la Musique and Musée de la Shoah. In these demonstrators, the recommendations application will be enriched with geolocalization information and social network relationships and will produce a sequence of recommendations as a personalized route to be followed by visitors. We expect to address the scientific issues listed in §2 and to be able to measure impacts of these techniques on visitors' experience, thus demonstrating to museums the interest of using up-to-date digital technologies to develop their audience and their catalog exploitation.

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