Multimedia for Cultural Heritage: Key Issues

Rita Cucchiara - Costantino Grana - Daniele Borghesani
Department of Information Engineering, University of Modena - Reggio Emilia
Via Vignolese 905/b, 41125, Modena, Italy
{*rita.cucchiara, costantino.grana, daniele.borghesani*}*@unimore.it*

Maristella Agosti
Department of Information Engineering, University of Padua
Via Gradenigo 6/a, 35131 Padova, Italy
maristella.agosti@unipd.it

Andrew D. Bagdanov
Media Integration and Communication Center, University of Florence
Via Santa Marta 3, 50139, Florence, Italy
bagdanov@dsi.unifi.it

Abstract. Multimedia technologies have recently created the conditions for a true revolution in the Cultural Heritage domain, particularly in reference to the study, exploitation, and fruition of artistic works. New opportunities are arising for researchers in the field of multimedia to share their research results with people coming from the field of art and culture, and viceversa. This paper gathers together opinions and ideas shared during the final discussion session at the 1st International Workshop on Multimedia for Cultural Heritage, as a summary of the problems and possible directions to solve to them.

1 Introduction

Cultural heritage preservation and exploitation have key importance to human culture, but at the same time, especially during periods of financial crisis, they are some of the most threatened activities. We strongly believe that, among all the fields in which modern multimedia research can yield a leap forward in data management and user experience, cultural heritage is undoubtedly one of the most promising and certainly one of the most important.

All the plurality of masterpieces (paintings, books, manuscripts, even photos of sculptures and architecture) can be effectively embedded into a unique "paradigm" through digitization. This allows a significant reduction in costs, an enormous expansion of public accessibility (and therefore income), and at the same time a tremendous freedom for data elaboration. In brief, digitization enhances pleasure for the public and usefulness to experts on cultural heritage assets. The use of multimedia technologies will allow the creation of new digital cultural experiences by means of personalized and engaging interaction. New

multimedia technologies could be used also to design new approaches to the comprehension and fruition of artistic heritage, for example through smart, context-aware artifacts and enhanced interfaces that support features like story-telling, gaming and learning. To these aims, open and flexible platforms are needed to allow building services that support the use of cultural resources for research and education.

The informal working day, in which the 1st International Workshop on Multimedia for Cultural Heritage[1] was held, was a valuable opportunity to involve a wide range of users of cultural resources in diverse contexts. It was a profitable way to exchange ideas, opinions, experiences, and to share knowledge between participants. It also provided a fertile breeding ground for laying the foundations for future collaborations.

In the following sections we describe the outcome of the open discussion session of the workshop. The discussion topics, suggested by the organizers were the following:

1. Dealing with people/users
2. Deep archives
3. Technology that is useful
4. Funds and profit.

These suggestions originated from the third ICT Work Programme under FP7 of the EU, which defines the research priorities for 2011-12 in the fields of "Digital Preservation" (Objective 3 of Challenge 4: Technologies for Content and Languages) and "ICT for access to cultural resources" (Objective 2 of Challenge 8: ICT for Learning and Access to Cultural Resources) [1]. Many participants shared their ideas and insight on these topics, in order to further explore the future involvement of multimedia within cultural heritage.

2 Dealing with People/Users

Modern multimedia systems must be centered on user needs rather than on simply providing content and tailoring technical requirements of processing and storage systems [2]. As pioneered with the well known concepts of personalization, profiling and content adaptation in web contexts, we believe in the opportunity to apply the same kind of approach to the new generation of multimedia systems. The user's inclusion in the loop, leveraging on an engaging user-interaction design, allows systems to offer participation (thus interest) without boring the user with repetitive or irrelevant tasks, capitalizing on interaction as a primary source of knowledge with which to improve and personalize the multimedia experience. The analysis of user expectations is somehow fundamental to correctly designing the multimedia experience. In a general sense, we can highlight three aspects within the analysis:

[1] http://imagelab.ing.unimore.it/MM4CH/MM4CH/Welcome/Welcome.html

– the "utility of a multimedia system", defined as the level of satisfaction that a user can experience in front of it based on the raw list of functionalities;
– the "engagement", defined as the level of emotional satisfaction, which is not strictly related to the functionalities but also the quality of the interaction; and
– the "personalization", defined as the level of adaptation of the multimedia system to user habits, tastes and expectations.

These aspects do not have clear boundaries. The utility of a multimedia system is heavily influenced by the engagement they create through the user interface, the design of the application and the context in which it is proposed, the quality and the clarity of the interactive experience, and so on. Personalization can be seen by the user as a valuable and useful functionality (therefore influencing the perception of utility). Moreover some users could find engaging the possibility of personalizing the content and the interactive experience.

The utility of a multimedia system can be quite precisely evaluated in technical terms. In other words we can readily define, given the current literature background, which could be the most important functionalities to be included in the system, and we have metrics to evaluate the effectiveness of proposed results [3]. Nevertheless, academic research results sometimes are not (and typically do not have to be) instantly useful to the public. Most scientific research outcomes need time and effort to be engineered correctly, to become useful products and tools for users and not only for researchers. This could be a problem in the times of *instant experience*, i.e. the historical period in which the progress of technology and the interconnection of society boosted the demand of innovations, and add as a desired requisite the possibility of gathering in short times the benefits of innovations, in terms of great products and fulfilling experiences instantly available to customers.

The relation with users, in the design of the multimedia application for cultural heritage, should be profound: the user should be involved from the beginning of the innovation process itself, defining the functionalities, the boundaries and the interactions keeping the user constantly at the center of the design itself. Among all, interactions seems to be a key point to consider. The user interface and the user interaction paradigm is a fundamental aspect for every multimedia system, because it is the only part of the system which will actually link directly to the user's emotion. For this reason, if the proposed user interaction is good, the user will be pleased to come back and use the application again: good features with a bad interface are often rejected by users. This is also an highly desirable outcome especially if we want to pursue funding or self-funding in order to keep research and innovation alive.

We have to make technology work in the way users expect, employing natural interaction paradigms. The intuitiveness of a natural interface is therefore necessary even because most of these systems are oriented to public environments, with people passing through that begin interacting with the system moved by curiosity [4, 5]. Consider, for example, the interactive navigation in the archaeological site of Shawbak proposed by Alisi *et al.* in [6], or the hand pointing under-

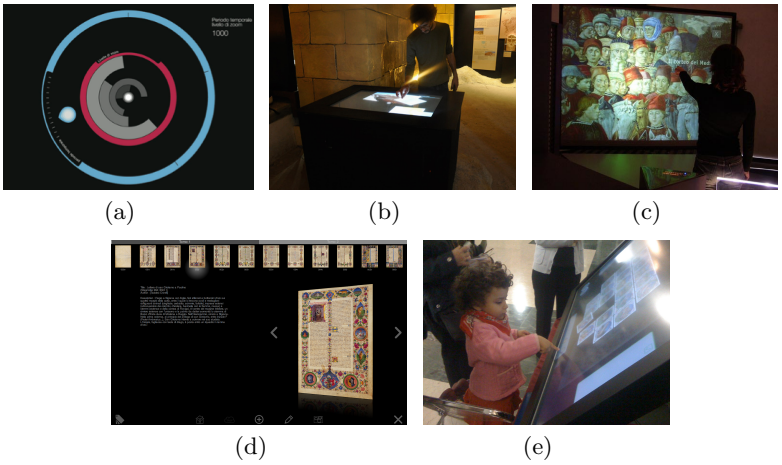

Fig. 1. Some example of innovative interactive installations for cultural heritage applications. In (a) and (b), a natural interaction based system designed to represent multimedia content related to the archaeological site of Shawbak (situated in the Petra region of Jordan) is presented. In (c) a nonintrusive system based on computer vision for human-computer interaction in 3D is exploited to augment the information recovery (of artists and artworks) while visiting a museum. In (d) and (e) Rerum Novarum, a multitouch installation for the interactive exploration of illuminated manuscripts.

standing system in 3D environments proposed by Colombo *et al.* [7]. Grana *et al.* [8] showcased a multitouch media station for the interactive exploration of illuminated manuscripts, using classical image processing techniques, such as color features used in different contexts [9] and fast connected components labeling [10], combined with novel relevance feedback approaches. These are exemplars suitable for innovative interactive installations of interest for cultural heritage resources (Fig. 1).

People do not want to get bored learning how to interact: it should be a natural consequence of the interaction itself, with the system allowing the user to easily find out what is going on, maybe learning by imitation and thus encouraging the social aspects of the interaction.

Personalization can be considered another precious addition: the system can learn the needs, the expectations and even the artistic tastes of the user through logs and historical usage mining [11]. However we have to foresee how much this personalization is useful and, instead, the boundary beyond which personalization falls behind intuitiveness. In the same manner, we have to foresee the level of detail with which the functionalities must be implemented, evaluating correctly the user, his expertise and his expectations, and provide him with the right user interface. An example is "visual search" itself, one of the most attractive functionalities in such systems. This functionality is clear from the technical point of view of researchers in the field of multimedia retrieval but could be quite confusing from the users' perspective in some cases. Occasional users and

visitors mainly interested in browsing an image collection could be frustrated, lost in the information sea without a specific goal. On the other side experts in the field of art and culture could find it far too rough, not sufficiently efficient for the specific searches they need.

This is the reason why, as multimedia researchers having by definition a very complex language, we have to change it. We must start adopting a more user-friendly and simple way of communicating innovation, both to art experts and people, learning for example from how Darwin's books (despite the fact that he was a scientist) were absolute bestsellers. We must improve our ability to explain to people how useful and fun the technologies we are able to produce are, and to experts the way in which they can be included in their research workflow and the positive impact they could have on it.

However, a complete and effective analysis, even from the marketing point of view, of this whole context is undoubtedly very complex. This is even more true considering that in some cases the general public might not be the main public we are referring to. Is it thus possible to achieve a single design able to fit the generally simple needs of normal people and at the same time the specific ones of experts, without sacrificing either the intuitiveness of the interaction and the power of advanced functionalities? Despite the fact that such a design could be considered a remarkable outcome, scientifically and economically and also in the eyes of users (interested, as mentioned before, in instant experiences), the risk is substantial. In fact we risk building a system which is inadequate for everyone. The alternative should be differentiation, but this opens up the dichotomy between general public models (cheaper but with a lower quality of experience) versus more costly and qualitatively better models but potentially segregated from most of the users and with negative impact on possible financial outcomes.

3 Deep Archives

An important category of recipients of such multimedia systems, within the class of experts, is the archivist. Probably this class of people is the most difficult to satisfy, basically for three important reasons:

- the level of detail for the required functionalities;
- the level of quality of results; and
- the amount of data they require to manage adequately.

Cultural archivists come from the cultural heritage community and they are used to particular *modus operandi* in their data management workflow. They require very specific functionalities and are used to a fine grained control over the database that manages data, rich metadata, and, sometimes, the documents in digital form. In Fig. 2 an example of user interaction with a specialised archive system, which manages both manuscript illustrations and rich metadata, is show [12].

Fig. 2. User interaction/interface of an archive system specialised in the management of illuminated manuscripts.

From a technical point of view, this may require a complication in the user interface and a major overhaul in the core logic of the multimedia system. This is a much more complex task considering the nature of the data we have to deal with – that is multimedia data like images, video and audio, in addition to text – and the amount of data. Efficient routines for the management of such sources are necessary. Moreover, people used to the quality of the results they can obtain in a controlled and structured context with SQL-based textual queries just expect the same quality of results moving to multimedia data. As researchers in this field, we should assure this level of quality.

To solve this problem the preferable choice should be the definition of content in a structured manner, using metadata and categorizations. Structured content leads us instantly to a situation in which interoperability is not just possible, but also easy to accomplish. Among the most used structured approaches, ontologies can be a good horse to bet on. Ontologies, and structured content in general, provide very good results, and a large volume of scientific literature has been produced to efficiently tackle the problem of management and querying. Nevertheless it is also known that the process of definition, design and building of the underlying architecture is long and costly, mainly due to the required

standardization efforts. This problem can also become worse considering that different needs might demand different kinds of archives, in other words that the actual usage of an archive is somehow tailored to the design approaches. Is generalization possible in this situation? And how much time and money will it take?

An alternate solution is to rely on social metadata [13], very popular in recent years. The exploitation of the collaboration of a huge number of users, obtained by enticing them with appealing interaction paradigms, would allow the collection of a plethora of precious information that might benefit the level of engagement in the system and boost the possibility of personalization.

The other side of the coin is the social nature of such information. As covered by many works in the literature, especially in the field of social tagging and classification using social metadata as source of annotation, the information collected by users is noisy and unreliable. For this reason effective algorithms should be employed to filter them, maybe in collaboration with experts as "system administrators".

It finally must be noted that there are actually two kinds of perspectives in this situation: the people who build and populate these archives, and those who use them, i.e. the final users. It is therefore important to underline that, however complex the database architecture is, and however complex the routines to manage and query the database are, the final outcome of the interaction should be pleasant, both in terms of quality of retrieval and speed. In other words, the entire architectural complexity should be hidden from the user, and again appealing user interfaces should be provided to help the user to access the functionality of the system and the data it manages.

4 Technology that is Useful

The last problem we need to tackle is purely an engineering one. In fact, by observing the situation from a birds-eye view and being aware of the aforementioned underlying problems, we need to provide solutions capable of covering these three aspects:

- the technological aspects, which is the set of technologies which are able to manage the data, accomplish the desired functionalities and present them to the user in an effective yet appealing way;
- the sociological aspects, being the set of policies required to deal with content; and
- the "philosophical" aspects, which deal with the amount of semantics, created and maintained by experts and researches in the field of the cultural heritage, which can be provided to the users as an immense added value to the artwork.

The technological, social and cultural substrata to sustain such aspects are indeed already available.

Modern technology, in terms of multimedia content analysis [14–17], large scale retrieval [18, 19], multimodal aggregation of information sources and annotations [20] and finally database access and management approaches are available. These technologies offer quite generalizable solutions which can be easily adapted to work in very different contexts, and this is an important characteristic of a multimedia system for cultural heritage. In fact, the possibility of reusing the same system we developed for one museum with its particular focus and also for another museum or an exhibition, just because the underlying design has a structure that supports a number of different situations, is incredibly advantageous.

Standardization, even in this context, may be the best way to accomplish this outcome. Standardization, especially if derived from an international effort driven by important organizations and governments, allows a high level of interoperability between data and software components which will in turn represent a precious saving of money. Moreover, the use of platform independent software allows a great adaptivity, which gives the opportunity to apply the same solution to museums, exhibitions and libraries whichever information system they have. The openness of the platform and the software, even in this case, could result further savings in the long term.

The interoperability of data, partially included in the sociological aspects, means that the data should be open, not necessary in terms of ownership of the content but at least in terms of openness in the policies to access them, potentially encouraged and promoted by influential organization interested in the common good and aware of the importance of the spreading of culture. The content and the restrictions applied to it for copyrights, licenses and fees, in all these situations, is the weak ring of the chain. Some form of awareness campaigns, in the governments and in the public opinion, could be useful.

The inclusion of the world of the cultural heritage in the innovation process, so the participation of experts and researches in the fields of art, culture, history etc., should be extremely useful to bridge the "semantic gap" created by the community of engineers and researchers in multimedia retrieval. Collaboration could bring all these people to express directly to the actual developers what they like, and what they consider important in such applications. On the other hand, they should be the first beneficiaries of those innovations. This will provide to them advanced tools to make their research easier and more effective. In the end, the final user would have the possibility to enjoy in a more involving way the cultural content enriched by the use of advanced technologies and precious and detailed commentaries provided by experts.

5 Funds and Profit

Cultural heritage covers culture, art and education. Nevertheless all these activities can be supported only with a sufficient amount of funds to bootstrap, and a sufficient forecast of profit. The most common way of funding cultural heritage is pretty straightforward: regional, national and international funds to support

culture are available, promoted by governments, organizations and foundations. The European Union itself appears particularly interested on this topic with the ICT Call 9 of the FP7, an opportunity to submit proposals in the field of "Digital Preservation" or of "ICT for access to cultural resources" [1]. These funds are however quite difficult to obtain, and sometimes may be not sufficient to satisfy the entire range of opportunities, especially in locations where the richness of history and culture is considerable. An ideal way to bootstrap these projects would be finding out a way to self funding the research and the activities. "City marketing" could be one possible way to do that.

City marketing consists in a strategic promotion of a city or a part of it, aimed at encouraging certain activities to take place there. The promotion of the overall image of the city can be a good means of promoting tourism, attracting new potential residents, and enabling business relocation. Therefore, it can also be used to attract inward investment and government funding to be devoted to cultural initiatives.

Self funding is the renewable energy of cultural heritage, but it supposes that some profit has to be achieved in order to make it possible. In the most common web-based business companies, the solution for this kind of problem is basically unique: advertising. The 98.7% of Google's turnover in 2010, for example, was obtained by advertising using the pay-per-click model. But does advertising fit with cultural heritage? Can we surround cultural content with advertising, however close to the users' interests, without sacrificing the importance of the work and the greatness of the artistic message, thus avoiding bothering him? Is there any kind of meaningful advertising content, maybe somehow related to other artistic content, that can be placed around artwork to generate significant revenue? The problem of profit is also related to who is actually supposed to make profit out of cultural heritage. The market in this context should be reserved to services and not content: in order to let the system work in the real world and to avoid that cultural content lose value and nobility (becoming a mere product), the content should be free, open and available everywhere. The services available with the content instead could be subjected to a fee or a payment. Instead, also the content could become a product: it is not so unusual to imagine selling cultural content in a way non dissimilar from what we are beginning to know in these years with the music and the movies (which are for all intents and purposes forms of art).

Nevertheless, in this situation, it is very important to analyze how people actually react to these proposals. The response of people is fundamental to create promising plans about how to make profit out of cultural heritage. Analyzing user expectations, as will be pointed out in the next section, could provide valuable information to prepare the content, to test the fruition methodologies, and to determine if a particular solution could lead to profit (because people will like it) or not. This kind of market study is necessary also because most of the people potentially interested in this kind of content (thus products and experiences) are not ready for the digital media/experience. Especially in the field of printing productions, including but not limited to cultural heritage ones, there

is a significant problem regarding the transition from the physical format (i.e. the paper book) to the digital one (i.e. an e-book, or a multimedia application presenting in an augmented way his content). If the market is not ready, therefore if the potential customers are not really willing to change their perspective of usage and experience of such a content, there is a risk of proposing maybe very interesting prototypes from the scientific point of view but not sufficiently able to gather out profit.

6 Conclusions

As a concluding remark, we can state that the multimedia community has advanced technologies to apply to the field of cultural heritage, technology that can provide in an open and interoperable way software solutions and architectures. Intuitive interfaces will be able to capture both the public interest and the usefulness required by experts. From the other side of the river, the sense was that the community of art and cultural heritage is particularly interested on all these new possibilities. Listening to the participants of the workshop and their view of the situation, given their national or international experience, the overall perception was that, despite the economical difficulties, solutions are possible. The design of systems with a strong and long term strategy, including all protocols for the open exchange of information, will lead to impressive solutions that can radically change the way in which all people, at all level of expertise and expectations, interact with cultural heritage content.

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