

An Adaptation Framework for New Media Artworks

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ABSTRACT

In this paper, we are interested in adaptation mechanisms for the design, creation and experimentation of adaptive and interactive new media artworks. Through a concrete case study, we propose an adaptation framework that combines semantic and physical adaptation and that can be specialized to the specific needs of various new media artists. This adaptation framework is supported by an adaptation engine, the kernel of the software architecture we are currently building. We have validated our adaptation framework through the implementation of a prototype of the adaptation engine. This prototype integrates the management of various types of metadata and allows a representation of adaptation scenarios as policies of the form event-condition-action.

We present how we used our adaptation engine to reconstruct and experiment the adaptation model of *The Man of the Crowd*, an existing adaptive new media installation, where the artist introduces a semantic adaptation of the video content displayed on four screens, according to the relative position of the viewer in the artistic installation.

Categories and Subject Descriptors

H.3.4. [Systems and Software]: Current awareness systems; J.5. [Arts and Humanities]: Architecture.

General Terms

Algorithms, Design, Experimentation.

Keywords

New Media Artwork, Adaptation framework, Metadata.

1. INTRODUCTION

Producing multimedia content integrating texts, images and videos is complex, time-consuming and often reserved to expert users. Multimedia storytelling is then far from average users capabilities! On the other hand, in their everyday work, media artists face the complexity and difficulties of multimedia art creation, installation, delivery and archiving.

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Video art for example, has expanded significantly and creative video practices now take advantage of, and are influenced by, the many possibilities offered by new digital technologies [8, 3]. These include interactive and adaptive installations i.e. artworks that can modify their behaviour in response to changes in the state of the environment or the spectator. In this paper, we are interested in adaptive new media artworks where the adaptation is specified by the artist, the spectator not explicitly participating to the adaptation, leading to a passive, almost unconscious interactivity with the installation.

In computer science, a lot of research and development work has been conducted around the concepts of adaptive and adaptable computer systems [1]. More recently, in distributed systems, telecommunication networks and multimedia technologies, adaptation techniques have been proposed allowing to deliver audio-video objects to users connected with different types of equipment under different communication conditions [9, 12, 7]. Therefore, we believe that new experiments can then be conducted in order to take into account diversity, mobility and adaptability for new forms of narrative in audio-video artworks [6]. Experiments conducted in the framework of artistic creation put new requirements on existing software tools and technologies. Artists are interested in investigating adaptation mechanisms in focusing on the cultural, visual, artistic or aesthetic qualities of the delivery rather than focusing on the technical aspects or the available computer resources required for the delivery. Thus, the corresponding formalisms and mechanisms should be supported by flexible and easy to use software tools in order to facilitate exploration and experimentation of adaptation models.

In this paper, we propose an adaptation framework for adaptive new media artworks and we illustrate the use of this model for the reconstruction of *The Man of the Crowd*, an existing adaptive new media artwork. Our adaptation framework combines semantic and physical adaptation and it can be specialized to the specific needs of various new media artists. It is supported by an adaptation engine, the kernel of the software architecture we are currently building.

The rest of the paper is organized as follows. Section 2 presents *The Man of the Crowd*, an existing adaptive new media artwork we chose as our case study. In Section 3 we propose and explain our adaptation framework and the corresponding concepts and mechanisms. In section 4 we explain how we used our adaptation engine to rebuild and to experiment the adaptation model of “*The Man of the Crowd*”. Section 5 concludes and presents future work.

2. CASE STUDY: THE MAN OF THE CROWD

The work described in this paper is conducted in the framework of the research group: “New Forms of Narrative and Audio/Video Practice”, part of Hexagram, the Institute for Research/Creation in Media Arts and Technologies [4]. The artists and scientists of this group explore the relationships between video and the new technologies of producing and disseminating moving images and sounds. In this context, we have been collaborating to explore approaches and software tools for the design, creation and experimentation of adaptive audio/video installations. As a case-study, we took *The Man of the Crowd*¹, produced and exhibited by Paul Landon in 2003 and 2004.

Artist P. Landon explores the states of distraction and fascination the urban spectacle can inflict on the individual [5]. *The Man of the Crowd* is an attempt at analyzing and reconstructing the movements of a crowd. As the spectator entered a corridor, she would see four white screens. As she moved down the corridor, video sequences appeared on the screen, showing several superimposed individuals, going at various speeds, directions and depths, and accompanied by the sounds of footsteps. The videos sequences (see Fig. 1) are organized in four classes characterized by the type of movement, the depth and the number of individuals. The first class, “No Movement” (NM) comprises only one video of the empty white scene and is diffused when there is nobody in the scene. The other classes: “light movement” (LM), “medium movement” (MM) and “heavy movement” (HM) comprise videos containing a certain number of individuals (1; 2 to 3 or 3 to 4) with different depths. The class to which belongs the video to be diffused depends on viewer’s position and movement in the installation.



Figure 1. High Movement class sample

In order to produce this installation, P. Landon required the help of a programmer (Jérôme Étienne) who developed an application, using the *PureData* graphical programming environment. In this application, the description of the video sequences was limited to a significant naming of the corresponding files. The adaptation model was restricted to the movement of the spectator without any possibility to consider other of his characteristics. For the second exhibition in 2004, P. Landon had to hire another programmer (Mathieu Bouchard) who changed passably the code of the application. The experience in producing this installation was time-consuming, sometime frustrating and without any possibility of reusing parts of the application code, nor part of the video sequences set.

To face these difficulties and limitations, we investigated approaches and mechanisms to be proposed in order to facilitate

the creation and experimentation of adaptive new media artworks similar to *The Man of the Crowd*. We defined an adaptation framework, allowing the formulation of adaptation scenarios in terms of the involved media objects, the events triggering the adaptation and the actions to be performed.

3. OUR ADAPTATION FRAMEWORK

Our adaptation framework is organized along the following basic concepts: *content*, *context* and *actors* and supported by three mechanisms: the Data/Metadata Manager, the Context/User Manager and the Adaptation Engine.

3.1 Basic Concepts

The adaptation approach we propose is focused on the semantic characteristics of the media objects, rather than on the physical ones. This permits the delivery of an artistic message adapted to the specific context of a given spectator.

3.1.1 Content and Semantic

We consider that the content or the elements of an adaptive artwork convey two types of semantic information: the *semantic core* and the *semantic details*.

The *semantic core* corresponds to the main semantics, or message associated to a content. This message is preserved even if some changes appear in the details of the content or in the physical quality or modality. The semantic core can be defined as the higher abstraction level of the information conveyed by a content. In *The Man of the Crowd*, the video sequences identified as “medium movement” (MM), all have the same *semantic core*, being that they present two or three individuals with different depths walking at medium speed.

The content does not convey a single and pure semantic value and thus, the *semantic details* carry the richness of the content. The semantic details allow for different perceptions of a same content. In *The Man of the Crowd*, the number of individuals, the amount of noise or the color of their shirt can be seen as semantic details. Some of them are used to define the semantic core of the elements of the artwork.

The semantic core can be regarded as the definition of a contents class. The elements of this class all have an identical semantic core but different semantic details.

3.1.2 Adaptation Types

In multimedia applications, adaptation refers to the ability of the system to change its behaviour according to the changes occurring in the processing environment. In our work, we consider adaptation from the application perspective and we consider two types of adaptation: *physical adaptation* and *semantic adaptation* to be supported by our framework.

Physical adaptation refers to the fact of optimizing the modality and/or the physical quality of content delivered under the constraints imposed by the context. We define semantic adaptation as the fact of altering, hiding or giving prominence to the semantic details of the contents, in order to satisfy the user’s requirement, to impose a particular interpretation of the content or to translate the artistic message.

¹ *The Man of the Crowd* was inspired by the short story of the same name by Edgar Allan Poe written in 1850

Semantic adaptation as we conceive it, mainly aims at determining which content and which semantic variation to deliver. The semantic variations of a given content all have the same semantic core and thus belong to the same contents class.

3.1.3 Actors

We identified three actors involved in the adaptive artwork life cycle: the artist, the transcoding expert and the spectator.

The artist is the creator of the contents in their original form and aims at delivering an artistic message by specifying the corresponding semantic and physical adaptation rules. The transcoding expert decides which transcoding operations to apply to the contents for physical adaptation if necessary. The spectator is the consumer of the contents to be delivered. Some information relative to the spectator can be used for adaptation. Such information can include language preferences as well as voluntary or spontaneous actions and feedback.

3.1.4 Context and user

Context has been identified as a key concept for the development of adaptive applications in pervasive computing. A context specifies the facts and circumstances related to a situation or an event. Most of the works on context categorization [2, 10, 11] regard the user as an element of the context. In our work, we make a clear distinction between the user and the context. We consider that the user and the application are involved together within a given context and that all three interact mutually. The user definitively plays an active role since his actions, intentional or not, can modify the context.

We also consider the different steps required for conveying the content to the user and we propose a new context categorization: the *delivery context* and the *consumption context*. The *delivery context* gathers information necessary to achieve the contents delivery such as the network characteristics, the configuration, the equipment, the software... The *consumption context* gathers information describing the environment where the contents will be consumed by the user, such information concerning time, lighting, as well as system characteristics affecting the semantic of the content.

Our categorization makes a clear dividing between the types of context, corresponding to different optimization objectives during the adaptation process. Adaptation to delivery context ensures that the contents are delivered and presented in an optimal way under the constraints imposed by the infrastructure and configuration. Adaptation based on the consumption context ensures that its consumption proceeds under the best possible conditions and provides the user with an optimal experience.

3.2 Our Adaptation Framework

The framework, as illustrated in Figure 2, is supported by three different mechanisms.

3.2.1 Data/Metadata Manager

The Data/Metadata Manager is responsible to store and manage the different types of information involved in the composition of an adaptive new media artwork. This information concerns the contents: media objects and their description, the adaptation strategies and the events triggering an adaptation. The

adaptation policies describe how the adaptation process is executed and they are related to the events triggering the adaptation. We define an event as a significant change of an adaptation parameter which value is compared to a reference value. To model and manage data and metadata, we use XML SCHEMA and store them in a native XML database.

3.2.2 Context/User Manager

The Context/User Manager deals with the descriptions of the contexts and users; it is responsible for managing their models and for detecting events that may fire adaptation policies. Adaptation parameters are defined based on these descriptions which may depend on the artwork being created.

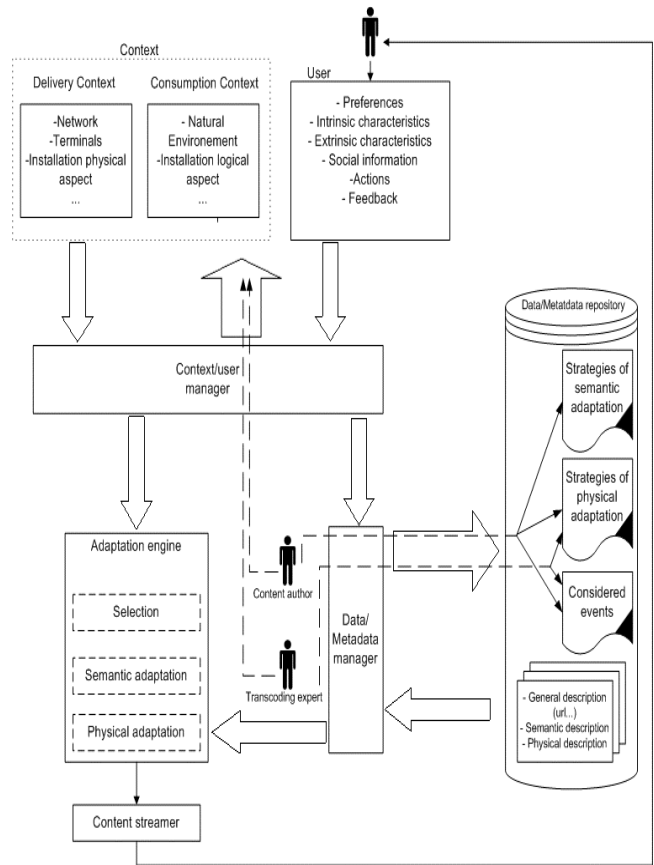


Figure 2. Adaptation Framework

3.2.3 Adaptation Engine

The Adaptation Engine is the key component of our framework. This engine is responsible to manage and execute adaptation policies following an application well-suited strategy. We propose a strategy based on a classification of the media objects having the same semantic core into a given semantic class. This strategy is divided into four different steps. The first step, *Selection*, consists in the selection of a semantic class of contents, according to events and existing semantic adaptation policies. In the second step, *Semantic Adaptation*, the engine chooses among the media objects composing the semantic class, one semantic variation to be delivered. The third step, *Physical Adaptation*, fixes the constraints on the desired physical variation, i.e. the real media object to be delivered.

4. EXPERIMENTATION WITH THE MAN OF THE CROWD

Our adaptation framework is supported by a software prototype we developed and which was used to conduct different experiments with the new media artwork *The Man of the Crowd*. Our objective was to define the initial adaptation model derived from our general framework and to make different changes in this model, specifically in changing the corresponding adaptation policies or in integrating new ones.

4.1 The Initial Adaptation Model

This model specifies the media objects to be presented to the spectator, the relationships between those involved in the adaptation process, the information concerning the spectator, the delivery context, the consumption context, and the adaptation policies. The physical description of the contents includes the URL and the frame size for each available physical variation of a video sequence. The semantic description provides necessary information to conduct semantic adaptation i.e, semantic class and number of characters. The general information contains a key description which is the content identifier. The spectator is described by his positioning and movements. The *delivery* context may include the description of the infrastructure used for the installation: screens (size, colors...)... The *consumption* context may include the number of spectators.

The movement of the spectator in the installation was the event considered in the adaptation policies defined for the initial model. Two state variables were defined: “ViewerMoved”, a Boolean variable indicating that the user has changed his position and “ViewerPosition”, indicating the new position of the user. The adaptation policies then express rules such as for example: “if the spectator is in the middle of the scene, then the video clip to be delivered is selected in high movement class”.

4.2 Experimentation

Thanks to the genericity of our adaptation engine, it was possible to change the adaptation model of *The Man of the Crowd*. We kept the same media objects and contexts and we defined a new event to be considered. This event still concerns the movement of the spectator in the installation, but we add a new state variable “ViewerSpeed”, indicating the speed of the viewer’s movement in the scene. The spectator can move with low, medium or high speed or she can be still. This only required the definition of the event and the corresponding adaptation policies. We envisage making intensive experimentations of our framework and prototype in order to design new adaptive artworks based on the media objects of *The Man of the Crowd* but with different contexts and events. We also plan to work with other artists to design and implement interactive artworks.

5. CONCLUSION AND FUTURE WORK

In this paper, we have proposed an adaptation framework for the design and experimentation of adaptive new media artworks. We have presented the basic concepts of this framework which support both semantic and physical adaptation. We also explained the three fundamental mechanisms supporting this framework: the Data/Metadata Manager, the Context/User Manager and the Adaptation Engine.

We are currently working on the implementation of different mechanisms dedicated to the artists in order to facilitate the specification of adaptation policies as well as the description of the infrastructure and simulation of the installation. These tools will help them to experiment different adaptation models for different artworks. In addition we are planning to develop two user interfaces: the first one associated to the Contexts/User Manager to allow an artist to define new adaptation parameters based on descriptions of the contexts and the user; the second one associated to the Data/Metadata Manager to allow an artist to manipulate the descriptions of contents and policies.

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7. ACKNOWLEDGMENTS

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