ADAPTATION SCENARIOS FOR NEW MEDIA ARTWORKS

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ABSTRACT

Artists in new media arts explore the possibilities offered by digital technologies to create adaptive and interactive new media artworks integrating audio and video. In this paper, we are interested in adaptation mechanisms for such artworks and we focus on the design and implementation of adaptation scenarios. We formalize adaptation scenarios by using the event-condition-action paradigm and we introduce the concept of adaptation policy. We present the adaptation engine we have designed and prototyped to manage and execute adaptation scenarios.

1. INTRODUCTION

Video art has expanded significantly and creative video practices now take advantage of, and are influenced by, the many possibilities offered by new digital technologies [1,2]. These include interactive and adaptive installations i.e. artworks that modify their behaviour in response to changes in the environment or the spectator state. In this paper, we focus on 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.

Research and development work on adaptation focused on physical adaptation i.e., the delivery of audio-video objects to users connected with different types of equipment under different communication conditions [3,4,5]. 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]. 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 previous work [7], we proposed an adaptation framework for adaptive new media artworks and we illustrated its use for the reconstruction of The Man of the Crowd, an existing adaptive new media artwork. We defined semantic adaptation as aiming at determining which content and which semantic variation of a media object should be delivered. Semantic adaptation is triggered in reaction to changes in context and user characteristics.

In this paper, we focus on the formalization and representation of adaptation scenarios. These scenarios are the formal translations of what the new media artist imagines and how he wants his artwork to behave. For that purpose, we use the Event-Condition-Action (ECA) paradigm extensively used in active database systems [8].

The rest of the paper is organized as follows. Section 2 presents adaptive new media artworks and the Man of the Crowd, an existing artwork we choose as a case study. In Section 3 we briefly introduce our adaptation framework. Section 4 describes how we formalize and represent adaptation scenarios and section 5 explains how our adaptation engine manages and executes these scenarios. Section 6 concludes and presents future work.

2. ADAPTIVE NEW MEDIA ARTWORKS

Interactive new media artworks have the particularity of changing their behavior to react to actions of the spectator or to changes in the environment and viewer characteristics. In this paper, we are interested in a sub-category of interactive artworks, namely adaptive artworks where the interactivity is passive and unconscious: the spectator does not explicitly pose actions. Adaptation then refers to the possibility of modifying the behavior or the content of the artwork according to changes in the environment or in the spectator behavior. The artwork then includes media objects as well as adaptation scenarios. The creator is responsible for determining which content to use and what adaptation scenarios to consider. Adaptation scenarios specify when the artwork must change its behavior and how. The "when" part refers to the environment/user events triggering adaptation.

Fig.1 High Movement class sample

The "how" part refers to the operations and/or conditions on the content to be delivered.

As a case-study, we took the new media artwork: The Man of the Crowd[1], an attempt at analyzing and reconstructing the movements of a crowd, produced and exhibited by Paul Landon in 2003 and 2004 [9]. The content of this installation is made of video sequences, showing several superimposed individuals, going at various speeds, directions and depths, and accompanied by the sounds of footsteps. The video sequences (Fig.1) are organized in four classes characterized by the type of movement, the depth and the number of individuals: "No Movement", "Light Movement", "Medium Movement" and "Heavy Movement".

The adaptation scenario considers the movement of the spectator in the installation to deliver different video sequences. For example if the spectator is in the middle of the corridor, a "High Movement" sequence is streamed.

Designing adaptive new media artworks leads to challenges in the capture and description of videos as well as the specification of adaptation scenarios. For that purpose, we investigated approaches and mechanisms to be proposed in order to facilitate the creation and experimentation of adaptive new media artworks. 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

One of the most important steps in designing adaptive media artwork is to experiment and to tune the behavior of the artwork. This can be very hard to do as there are neither mechanisms to formalize this behavior nor tools allowing artists to specify their creative scenarios without reworking the artwork. To overcome this situation, we have proposed an adaptation framework [7] that includes three main parts.

The first one is the adaptation engine that permits the execution of existing adaptation scenarios and automatically takes into account newly specified and modified ones.

The second deals with context/user information. This information is used to fire adaptation events and to select the content to be delivered. Through a Context/User manager we are able to handle context and user descriptions. In addition, we have separated user from the concept of context as a user has the particularity to interact with both the context and the system. We also divided the context into consumption and delivery contexts. Consumption context stands for information describing the environment where the contents will be consumed by the user, such as information concerning time, lighting, as well as system characteristics affecting the semantic of the content. Delivery context stands for information necessary to achieve the contents delivery such as the network characteristics, the configuration, the equipment and the software.

The third part deals with information involved in the composition of an adaptive new media artwork i.e. content and adaptation scenarios. A Data/Metadata Manager is responsible for accessing and updating descriptions of content and scenarios. With the help of this component, artists are able to add, modify or delete adaptation scenarios.

To validate our framework, we developed a prototype, where we use XML Schema to model and manage events, adaptation policies and contents descriptions and we store them in a XML native database, eXist [10]. The Data/Metadata manager then offers services to the adaptation engine to access information through queries formulated in XQUERY [11] within the eXist API.

4. FORMALIZING ADAPTATION SCENARIOS

We formalize adaptation scenarios based on descriptions of content, adaptation events and adaptation policies.

Content represents media objects and their description. Providing a suitable content description is essential since designing media artworks includes knowing when and how using a particular media object.

As we have said before, an adaptive new media artwork reacts or adapts to changes in context or user characteristics and thus changes its behavior. To describe what triggers an adaptation, we use the Event concept. How an event affects the system behavior is specified in adaptation policies.

The specification of events and adaptation policies must be as flexible as possible in order to test, maintain or evolve the artwork. We then want to specify adaptation scenarios without having to code them into the artwork. For that purpose, we use the ECA paradigm, where rules have the general syntax: ON *event* IF *condition* DO *actions* [8]. This paradigm has been used in active database systems and leaded to database trigger mechanisms.

4.1 Content

The content of an adaptive artwork corresponds to the media objects such as video sequences, and they are stored in the corresponding files. In [7] we proposed to organize these objects in semantic classes. Objects of the same class share the same semantic core and have different semantic details. For example, In the Man of the Crowd, the video sequences identified as "medium movement" (MM), all has the same semantic core, but differ in persons number and

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

```
<EventDescription
<Name>ViewerMovement</Name>
<Priority>100</Priority>
<Type>user</Type>
<StateVariables>
        <StateVar>ViewerMoved</StateVar>
</StateVariables>
<ValidationConditions>
        <ValidCondition>
             <VarName>ViewerMoved</VarName
                <Relation>=</Relation>
                <Value>true</Value>
        </ValidCondition>
</ValidationConditions>
</EventDescription>
```

Fig.2 "ViewerMovement" event description

movement directions which can be seen as semantic details.

The description of the media objects is separated into general, semantic and physical description, and is used in the different execution steps of the adaptation engine.

The General description gives general information on the media objects. Generally, it includes information such as the content identifier, information concerning the creation of the objects, as well as information about the possible transformations that can be processed on that object to provide adaptability. The Physical description gives information on the intrinsic characteristics of the object. Such information will be used for physical adaptation.

For our prototype, we retained only certain descriptors among those possible, such as the URL and the image resolution. The Semantic Description gives information on the semantic of the media objects. In The Man of the Crowd, the semantic description associated to the video sequences concerns the type of movements and the number of characters in the video sequence.

4.2Events

We define an event as a significant change of an adaptation parameter which value is compared to a reference value. An adaptation parameter is related to real-time descriptions of context and user. We called them state variables. It is up to the creator to define an event based on these state variables.

For example, in the Man Of the Crowd, there is a direct mapping between the adaptation parameter (spectator position in the corridor) and a state variable *UserPosition* that is part of the description of user characteristics.

In our prototype, the description of an event (c.f. Fig.2) integrates the name or identifier of the event, the associated state variables, the priority of the event and its type. The priority is used to resolve conflicts in the choice between two competitor events. The type expresses which contextual information is relevant for that event: the user context ("User"), the delivery context ("Delivery") or the consumption context ("Consumption").

```
<PolicyDescription>
<Name>UMAdapt2</Name>
<Importance>60</Importance>
<Type>user</Type>
<Event>
        <Name>ViewerMovement</Name>
</Event>
<Conditions>
        <ValidCondition>
             <VarName>ViewerPosition</VarName>
             <Relation>=</Relation>
              <Value>2</Value>
        </ValidCondition>
</Conditions>
<Action>
        <ActionName>select1</ActionName>
        <ActionType>Select</ActionType>
        <CriteresSelection>
                <Descr>Classe</Descr>
                <Rel>=</Rel>
                <Value>MediumMovement</Value>
        </CriteresSelection>
</Action>
</PolicyDescription>
```

Fig.3 Adaptation policy description example

4.3 Adaptation policies

The adaptation policies are related to the events triggering the adaptation and describe how the adaptation process is executed. We use the Event-Condition-Action formalism since it gathers all information related to a policy.

Each adaptation policy is related to a unique event. The reverse is false as we can assign as many policies as we need to one event. An adaptation policy also has validity conditions (c.f. Fig.3) that differentiate it from other policies associated to the same event and that ensure that its application is suitable in the current context. The policy action part specifies actions to be processed when this policy is triggered. This determines the system behavior.

In our prototype, the description of an adaptation policy comprises three sections. The first corresponds to general information: the importance, allowing defining priorities between different adaptation policies and the type which associates a unique event to this policy. The second section specifies conditions under which the policy is valid, that is the validity conditions based on the state variables specified for the corresponding event. The last section is action specification. Presently, our prototype supports *Select* actions allowing contents selection according to conditions expressed on the corresponding descriptions (c.f. Fig.3).

5. 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. The execution of adaptation policies is triggered by events related to the user and contexts.

5.1 Event Manager

From the real-time capture of descriptors for contexts and

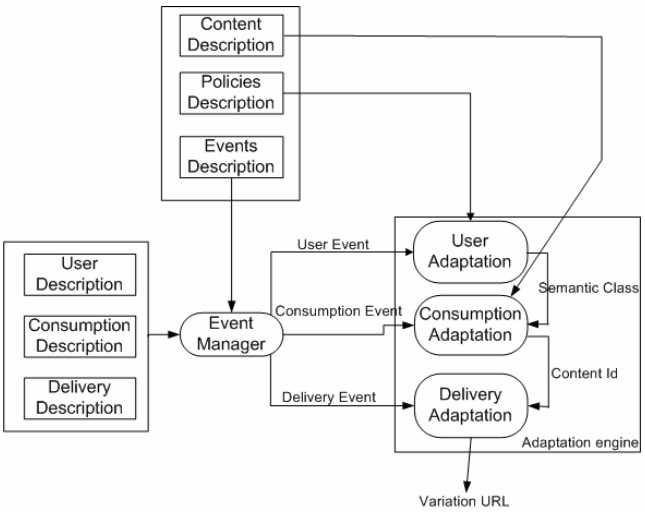

Fig.4 Execution schema of our adaptation system

user, the event manager is responsible for the selection and the ordering of the corresponding events. For that purpose, it submits a request to the database system to obtain the list of the valid events. Event validity is defined according to conditions specified on state variables associated to adaptation parameters. Then, according to the types and the priorities of the events, only one event is selected. The priority between events is as follows: (1) events related to the user; (2) events related to the consumption context and (3) events related to the delivery context.

5.2 Adaptation execution

Each type of adaptation follows the same execution steps: (i) select the most prior adaptation policy through a request to the XML database and (ii) extract the criteria for the selection of the target content/variation of the media object.

When an event concerning the user is chosen, the system launches the adaptation to the user. Thanks to the name of the event, the adaptation policies are selected and the most relevant is retained. Among the criteria, if there is one related to the semantic class, then the name of this class is returned. In all cases, all the criteria related to physical or semantic characteristics are preserved and passed to the following step (c.f. Fig.4).

The adaptation to consumption context is triggered following an adaptation to the user or an event of the type "Consumption" (c.f. Fig.4). Thanks to constraints extracted from the selected consumption policy, a textual request is launched towards the contents descriptions database, resulting in a list of contents having the same semantic class and which satisfy the desired criteria. Contents are then selected randomly. At the end of this step, the semantic adaptation ends since we have at our disposal the class of content (thanks to the adaptation to the user) and its identifier (c.f. Fig.4).

The remainder of the criteria is useful to choose the physical variation of the content i.e. physical adaptation.

The adaptation to delivery context is triggered following an adaptation to consumption context or an event of the type "Consumption" (c.f. Fig.4).

Once the selection criteria are extracted (from a "Delivery" policy) and the resulting request executed, we obtain the URL of the physical variation of the contents to be diffused.

6. CONCLUSION

In this paper we have illustrated the use of the ECA paradigm to formalize adaptation scenarios in adaptive new media artworks. We have introduced the concept of adaptation policy and presented the adaptation engine we have prototyped to manage and execute adaptation scenarios. We are currently working on user interfaces to help artists in the design of adaptation scenarios.

We have also noted that XML Schema lacks flexibility to describe events and adaptation policies. So we plan to investigate specification languages for adaptation policies and examine other possible solutions such as RuleML. This will include a mechanism for the management and resolution of conflicts.

7. REFERENCES

[1] Graham, B.: *Digital Media. Directions in Art Series*, Oxford: Heinemann Library, 2004

[2] Manovich, L., *The Language of New Media*, MIT Press 2001

[3] Mohan R., Smith J. and Li, CS.: “Adaptive Multimedia Internet Content for Universal Access”, *IEEE Transaction on Multimedia*, March 1999, pp. 104-114

[4] Zhang H. J., Keynote Speech, "Adaptive Content Delivery: A New Research Area in Media Computing", *Proc. of the 2000 Int. Workshop on Multimedia Data Storage, Retrieval, Integration and Applications*, Hong Kong, Jan. 13-15

[5] George Lawton: “New Technologies Place Video in Your Hand”, *IEEE Computer 34(4)*: 14-17 (2001)

[6] Kerherve B., “Challenges for Creator in Media Arts” *Perspectives Workshop: Multimedia Research - where do we need to go tomorrow?*, R. Jain, S. Boll, T.-S. Chua, N. Dimitrova. March 2-4, 2005, Dagstuhl, Germany.

[7] Ouali A., Kerhervé B., and Landon P. 2005, “An adaptation framework for new media artworks”, In *Proceedings of the 13th Annual ACM international Conference on Multimedia* (Hilton, Singapore, November 06 - 11, 2005). MULTIMEDIA '05. ACM Press, New York, NY, 586-589.

[8] Paton N. W. and Díaz O. “Active database systems”, *ACM Compuing. Surveys* 31, 1 (Mar. 1999), 63-103.

[9] http://www.paullandon.com

[10] eXist, *eXist home page*, http://exist-db.org/, April 2006

[11] Boag S., Chamberlin D., Fernández M. F., Florescu D., Robie J., and Siméon J., “XQuery 1.0: An XML Query Language”, W3C Working Draft 04 April 2005, http://www.w3.org/TR/xquery