Interactive TV using a Framework of Smart Multimedia Objects (SMO-ITV)

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Abstract
The object-oriented modelling of interactive multimedia applications in the SMO-ITV approach is designed to suggest a methodology of using a multimedia objects within a framework for configuration and management of a smart multimedia object (SMO). It also enables multimedia software developers to create comprehensive analysis and design models of multimedia software. The main purpose of this paper is to propose a new approach for the modelling of adaptable and reusable multimedia content.

Keywords: Digital Interactive Television, Smart Multimedia Object, Framework, SMO-ITV, and SMO.

1 Introduction

Interactive multimedia applications are becoming an integral part for our daily activities, and using a multimedia object in building rich and interactive content for interactive applications, which are evident phenomena that need to deal with high levels of complexity. Images, videos, audio, complex scenes and interactive graphics have become common places. A growing number of interactive multimedia applications are available, ranging from video games and movie players, to sophisticated distributed simulation and virtual reality environments.

The interactive multimedia applications will become a widely-used kind of future software systems. In anticipation of a wider adoption of multimedia in applications in the future, there has been much research and development activity in computer architecture for multimedia applications [22]. A number of major initiatives and projects have been established to investigate or to develop strategies for designing a multimedia application that needs to deal with high levels of complexity. A multimedia system for interoperable communication of complex scenes contains audio, video and graphic materials, which are arranged and defined as individual objects [1][2][4]. In most of literary works, the scene is accompanied with a description, which describes how the objects should be combined in space and time in order to form the scene intended to by the author. In the presentation of multimedia scene, the user's interaction is possible within the limits set in the scene description [1][6][24][8][9].

A new form of the interaction becomes possible with the new interactive video technologies. The user can interact with the video, and then the application can be adapted to different situations [3]. RAMO [5] has the concept of reactive and adaptive multimedia objects, which lays down the foundation of a new approach for implementing the next generation of interactive and “immersive” multimedia applications and has an object-oriented approach. The OMMA [23] is an object-oriented approach based on the Unified Modelling Language (UML) for modelling structure and dynamic behaviour of a Multimedia information system. JiTVPlayer : a multi-device player tool is used to present multimedia objects (audio, video and data) and to allow the viewer's interaction; [10] the combination of television and Internet gives broadcasters the opportunity to reach a much bigger and diverse audience. The benefit of avatars has been widely researched [9]. Hence, multimedia systems must be supported by an underlying infrastructure that transparently deals with such requirements. In order to provide such an infrastructure, this paper concisely introduces an open multimedia framework, called SMO-ITV, for configuration and management of resources and components of the middleware layer. The framework provides a general software architecture that makes simpler design and development of multimedia objects. Our research approach involves two design phases. The objective of the first design phase is to identify a set of principal elements that are generic to the design of ITV content and that relate to the three research questions (conceptual model, user interface principles, and evaluation methods). It’s related to the specification and the conception of multimedia objects. It principally indicates how the organization of these smart multimedia objects “SMO” is carried out and how to identify them under an innovative IDTV conceptual framework proposal designing and developing enhanced adaptive multimedia applications is required to set up contents’ creation and rendering frameworks. In addition,
the complementary issues of a programming library and of prototype methods for IDTV are addressed. It offers new content creation opportunities to support enhanced digital services for Web & IDTV consumers, with high interactivity and contents’ animation capabilities. The concept is based on the notion that a new dimension of interactivity can be achieved by enabling multimedia objects to fulfill the following criteria:

- To become fully autonomous;
- To be independent from predefined scenarios.

Such objects are able to react and adapt themselves to any contextual situation resulting from interactions with other objects of the application and/or from user’s actions.

The objective of the second design phase is to employ the elements identified in the previous stage into the development of an IDTV application that is evaluated by consumers against contemporary IDTV issues. We illustrate how the consumer treats with virtual objects which make avatars an obvious technique to simulate presence, humanizing users that are local or remote. This phase suggests a method of the use of these multimedia objects in this framework. In other words, this method aims to the configuration and the management of multimedia objects, which we qualify of "smart".

The framework provides a general software architecture that makes simpler design and development multimedia platforms. Its concept has to handle the content based on the adaptive and reactive multimedia object. This paper is organised as follows, section 2 presents an overview of the SMO-ITV framework, introducing the basic concepts and features and its architectural model. Then, section 3 describes the scenarios focusing on the iDTV infrastructure. Finally, section 3 concludes with some remarks and future works.

2 The “SMO-ITV” Framework

We suggest a methodology of using the concept of multimedia objects oriented for designing and developing enhanced interactive multimedia contents’ creation by following the six 06 steps as shown in figure 01:

- Object Structure and Description
- Object Autonomy
- Contextual & Embedded Objects
- Interactions Organization and Communication
- Reusability aspect
- Scene description

As mentioned before, the SMO-ITV framework has the purpose of acting as a generic framework for designing and developing of a middleware layer of a variety of multimedia object systems. In order to achieve such a goal, the proposed framework defines abstract components within a software architecture viewpoint.

2.1 Basic Concepts and Features

Our framework focuses on representing multimedia object concepts and components, as well as handling and presenting them. Its components provide some APIs (Application Programming Interfaces) that abstract away details and characteristics of resources, operating systems and underlying communication technology. Such APIs give support to control, management, distribution and presentation of a diversity of multimedia data. Despite that, such interfaces are introduced in a hierarchical structure of interfaces, making easier the design and adaptation of components of the middleware, which can be required by specific features of platforms and applications.

In order to cope with the diversity of concepts and requirements, our framework is structured in several hierarchies: model, interfaces, components, factories, resources and services. The interfaces related to property negotiation give support to configuration, management and adaptation tasks.

2.2 The “SMO-ITV” Model

2.2.1 General

The SMO-ITV model promotes the build of dynamic multimedia presentations with new levels of interactivity and immersion of end-users. It specifies the design and development process of applications based on autonomous and living smart multimedia objects (SMO), from their authoring up to their rendering.

2.2.2 Organization of scenes

The model proposes the setting up of applications as a composition of multiple multimedia scenes. A SMO-ITV Application handles the management of scenes, information requests towards the rendering platform or distant resources’ repositories for instance. A SMO-ITV Scene manages its objects’ dynamic composition, the graphical and audible layout or high level objects’ conflicts solving
for instance. Scenes are populated by SMO-ITV objects they supervise. The formers are derived into two main kinds: Contextual and Embedded Multimedia objects (CMMO and EMMO - Figure 02).

The Embedded SMO-ITV Objects are dedicated to the establishment of multimedia contents and their management, i.e. alteration of metadata descriptions, of the multimedia contents, and of its own processes to be fully dynamic. They emulate self-animated entities via sensorial representations and life-like behaviours. Contextual SMO-ITV Objects are backstage managers of Scenes. They articulate and support objects organisation, e.g. relaying Objects messages, retrieving of matching properties with neighbour objects, leading of collective tasks, or management of end-user interactions. SMO-ITV Scenes differ from other SMO-ITV objects due to their role in the application. They can be considered as Contextual objects or as a composition of Contextual objects. Whatever their kind, Embedded SMO-ITV Objects, Contextual objects, or Scene, the SMOI-TV objects rely on a common functional architecture.

Figure 02: Formal example of a composition model for SMO-ITV-based applications

Figure 02. Shows how a multimedia application can be structured, i.e. as a composition of SMO-ITV objects. Granularity, flexibility and extensibility of SMO-ITV components are inherent to this generic and modular organizational model. CMMO (Contextual Multimedia Object) Interactions Managers provide key features to SMO-ITV Scenes since they enable setting up communication networks among all types of objects. This might result in the constitution of sub-groups of interrelated actors, able to interact among them and at any other levels, depending on their CMMO supervisors’ properties. As objects might be attached to several CMMO interaction managers, complex interaction and thus content animation possibilities are made possible.

3 Scenario description

The scenario consists in a TV-show where players have to answer questions. As a classic TV-show, the scene is a straight broadcast of a filmed studio session but originality is that players in studio defy players, who are at home (figure 03). They play from their living room watching the game and participating thanks to their own remote control via their Set-Top Box.

Figure 03: scene rendering

They are represented in studio by virtual entities: the avatars. Avatars are supposed to represent their TV-viewer personality and react to their contextual environment as human behaviors.

In consequence, the studio scene is composed of a real scene, the live show, and a virtual scene where avatars simulated their viewer’s behavior, the SMO-ITV virtual scene. In addition of players, real or virtual, the TV-show owns a studio moderator that can act on scene settings through a special PC to regulate or guide the show. At last, the application server links all actors involved to provide the final rendering on the DVB server (see the figure 04 below):

Figure 04: scene creation
4 Conclusion

We have presented SMO-ITV, an object oriented modeling framework, for interactive multimedia applications and especially for IDTV. This model uses a methodology based on smartt multimedia objects. By comparison with other existing approaches, SMO-ITV is putting forward a new way to support configuration and management of multimedia objects. Essentially, based on component properties, the proposed framework differs from other approaches in sense that SMO-ITV deals with functional requirements during configuration and execution time. SMO-ITV takes into account the reuse aspect of multimedia object and allows reactive and proactive adaptations. Currently, SMO-ITV is evaluated in different scenarios. Furthermore, It is investigated whether more elaborate features for the specification of synchronizing objects have to be incorporated into SMO-L (Smart Modeling Object – Language) to specify a language for the Object-Oriented Modeling of Multimedia Applications that is based on the Unified Modeling Language (UML). The structural and behavioral diagram types of UML will be analyzed and are adapted and extended according to multimedia application characteristics.

5 References


