A Graphics Software Architecture for High-End Interactive TV Terminals

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Abstract

This thesis proposes a graphics architecture for next-generation digital television receivers. The starting assumption is that in the future, a number of multimedia terminals will have access through a number of networks to a variety of content and services. One example of such a device is a media station capable of integrating different kinds of multimedia objects such as 2D/3D graphics and video, reacting to user interaction, and supporting the temporal dimension of applications. Some of the services intended for these devices include, for example, games and enhanced information over broadcasted video.

First, this thesis provides an overview of the digital television environment, focusing on the limitations of current receivers and hints at future directions. In addition, this thesis compares different solutions from regional standardisation bodies such as DVB, CableLabs, and ARIB. It proposes the adoption of the most relevant initiative, GEM by DVB. Unfortunately, GEM software middleware only considers Java language as an authoring format, meaning that the declarative environment and advanced functionalities (e.g., 3D graphics support) remain to be standardised.

Because in the future different user groups will have different demands with regard to television, this thesis identifies two major extensions to the GEM standard. First, it proposes a declarative environment for GEM that takes into account W3C standardisation efforts. This environment is divided into two configurations: one capable of rendering limited interactive applications such as information services, and another intended for more demanding applications, for example a distance learning portal that synchronises videos of lecturers and slides. Second, this thesis proposes to extend the procedural environment of GEM with 3D graphics support.
The potential services of this new profile, High-End Interactive, include games and commercials.

Then, based on the requirements the proposed profiles should meet, this thesis defines a graphics architecture model composed of five layers. The hardware abstraction layer is in charge of rendering the final graphics output. The graphical context is a cross-platform abstraction of the rendering region and provides graphics primitives (e.g., rectangles and images). The graphical environment provides the means to control different graphical contexts. The GUI toolkit is a set of ready-made user interface widgets and layout schemes. Finally, high-level languages are easy-to-use tools for developing simple services.

The thesis concludes with a report of my experience implementing a digital television receiver based on the proposals described. In addition to testing the application of the proposed graphics architecture to the design and implementation of a next-generation digital television receiver, the implementation permits the analysis of the requirements of such receivers and of the services they can provide.

**Keywords:** Digital TV, Software Architecture, GEM, MHP, XML, 3D Graphics, OpenGL