

# Interactive Virtual Worlds in Brazilian Digital Television

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## ABSTRACT

This work describes a methodology for research involving technologies in interactive virtual 3D environments and the Brazilian digital television system, during the conduct of the study we will discuss programming techniques for digital television, description of virtual environments in X3D and the Ginga middleware architecture. The objectives of this research is to propose a solution in modules that provide portability of virtual environments described in X3d for the Brazilian digital television system.

## Categories and Subject Descriptors

H.5.1 [Multimedia Information Systems] D.4.7 [Organization and Design]: Interactive systems

## General Terms

Design, Human Factors, Standardization, Languages, Verification.

## Keywords

Digital TV, Ginga, X3D, Interactivity, Virtual Reality

## 1. INTRODUCTION

Television is the best selling appliance in the world and along with it comes a new technological and behavioral phase, that is, television is no longer a passive medium. The interactive digital TV brings viewers the opportunity to shop, participate in polls, send emails, check bank account balance, customize programming and much more just at the touch of the remote control. Another feature offered is T-Commerce, a name for e-commerce done via interactive TV.

Digital TV in Brazil spread significantly in mid-2006 and 2007. The first official broadcast took place in December 2007.

According to Oliveira and Albuquerque (2005), Brazil is in the process of deployment of Digital TV (DTV), which can be understood as an evolution of analog TV. Among other features, DTV will allow a significant improvement in quality video and audio broadcast, including mobile devices and transmission of various programs by the same broadcaster multiprogramming [1].

The main debate involving digital television in Brazil was mainly based on the DTV standard, which could be adopted.

In Figure 1 we have a vision of the specifications adopted by many countries:

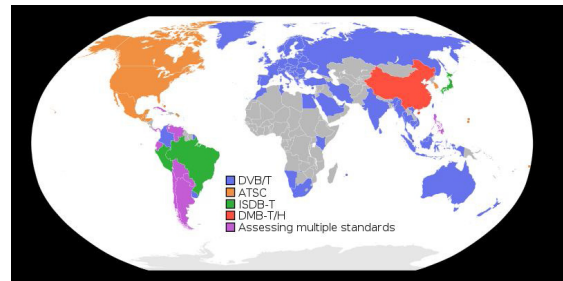


Fig 1. World Specifications [1].

The ISDB-Tb, an adaptation of the Japanese standard ISDB-T (*Integrated Services Digital Broadcasting Terrestrial*) together with technologies developed by research in Brazilian universities was defined as the official standard. The same has already been adopted in several South American countries; Peru, Chile, Argentina and Venezuela. A DTV standard is formed by sets of definitions and specifications that deal with applications, middleware, audio compression, video compression, transmission and modulation .

3D Virtual Environments, enable the insertion of the User into a virtual scenario created by software technologies, allowing the use of interactivity, navigability and immersion, characterizing the use of virtual reality.

Virtual reality is an advanced technology capable of providing the User the possibility of exploring a virtual environment in a manner similar to the real environment. In possession of the latest technology in sensors and devices, the User can navigate through the environment, finding and viewing objects at different angles, as well as acting in the scenario in which he is immersed [3].

Among the standard description of 3D environments, the format X3D is an open standard for distributing 3D content. The X3D is not an Application Programming Interface (API), nor a file format for geometry exchange. The format combines both geometry and descriptions of behaviors snapshots in a single file. The core of

the X3D specification is continually being developed by the X3D Specification Working Group [4].

It can be argued that the technology of the Brazilian DTV provides support for interactivity. The X3D standard also presents procedures for the description of interactive 3D environments. Due to the similarity in interactive features, the question arises: why not port the of navigation interactivity characteristics of X3D for the Brazilian DTV? Due to the newness of such technology in the country, there are still no studies addressing the issue of portability associated with virtual environments and the standard adopted by the Brazilian DTV.

This paper introduces the concept of virtual environments for interactive digital television. the key features associated with the two standards applicable to provide interactivity and 3D visualization will be raised.

Due to the primitive architecture of the digital image in the current decoders (Set Top Box), this work will point the directions of the requirements for the basic architecture for the support of 3D applications.

The proposed architecture will then be presented being capable of mapping the equivalence and the necessary resources in GINGA-J API and the X3D language, seeking the integration of technologies. Finally tests and analysis will be presented to validate the proposal.

## 2. BRAZILIAN SYSTEM FOR DIGITAL TELEVISION

In July 2006, the forum of the Brazilian system of digital terrestrial television was created by Decree 5820. Among other tasks, it is for this forum to consider the technical aspects of the generation, distribution and reception of high-definition digital television systems, (HDTV).

To meet certain technical issues, in April 2007, the ABNT (Brazilian Association of Standards and Techniques), installed a Special Study Commission on Digital Television (ABNT / EEC). This commission has developed various standards, such as:

- ABNT NBR 15601 - Transmission System;
- ABNT NBR 15602 - Coding of audio, and multiplexing;
- ABNT NBR 15603 - Multiplexing and service information (SI);
- ABNT NBR 15604 – Receivers;
- ABNT NBR 15605 - safety Topics;
- ABNT NBR 15606 - Data coding and transmission specification for digital broadcasting;
- ABNT NBR 15,607 - Interactivity channel;
- ABNT NBR 15,608 - Operation Guide;
- ABNT NBR 15609 - Test Suite;
- ABNT NBR 15,610 - Testing for receivers.

### 2.1 Ginga

GINGA, the Brazilian DTV system, has two lines of research and development (Ginga-NCL) and (Ginga-J). Before we can detail these two systems in full, we discuss the Ginga middleware, consisting of a set of hardware and software aimed at decoding systems generated in Ginga-NCL and Ginga-J to DTV.

In terms of distributed computing, middleware is a program that mediates between other software being used to hide communication protocols, platforms and peculiarities of the operating system from the programmer, allowing device independence.

In Figure 2 we describe the modules that make up the architecture of the middleware [5].

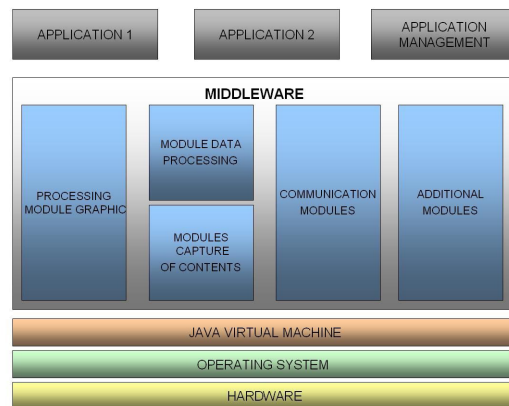


Fig 2. Structural Modules of the middleware [5].

The access terminal of interactive DTV system is represented by a layered architecture where each layer offers services to the higher layer and uses services offered by the underlying layer. Thus, the applications running on DTV make use of services of a middleware layer. [5].

Ginga is divided into two major interconnected subsystems that allow the development of applications following two programming paradigms.

Ginga-NCL was developed at PUC-Rio (Catholic University of Rio de Janeiro). Sets a presentation environment for declarative applications written in NCL (Nested Context Language) [2].

Ginga-J was developed by UFPB (Federal University of Paraíba). It provides an infrastructure for running applications based on Java.

Figure 3 characterizes the integration and structure of each language:

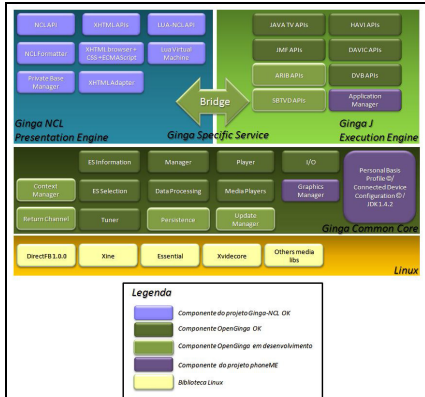


Fig 3. Integration Modules GINGA (NCL and J) [5].

In this research the programming paradigm chosen was the procedural GINGA-J based on the fact that it provided an ease of control over the code, execution and flow control.

### 2.2 The GINGA-J (javaDTV)

The Java API DTV adopted by ginga-j provides a lot of packages for the development of applications for digital TV, the language specification was published on July 17, 2009 as version 1.2.1, and the executables for using the API are not yet available to-date.

The structure of the source code of applications is called Xlet. The Xlet has 4 states and methods are called according to the changes of the state. When Xlet is loaded it's Paused and Active states repeats, until it is Destroyed, from where it cannot recover. Transition to the next state is not completed until the method executed according to the state change is complete. [6]

The process of the life cycle of applications is shown in Figure 4.

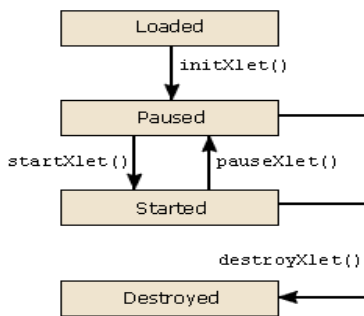


Fig 4. Xlet Life-cycle in Java-TV [6].

### 3. THE X3D

key interaction features with objects in a X3D scene can also be described. For this purpose it is important to understand the concepts of a X3D event.

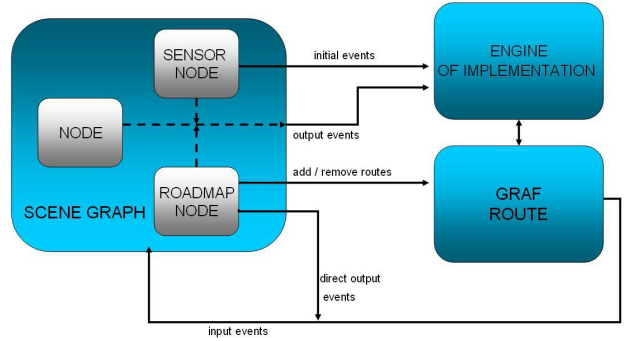


Fig 5. Events in X3D [7].

An event created from a node will spread to another node if there is a path defined between them.

Another important concept is that the fields of one node work as an attribute and at the same time as a function. In the specification of the X3D components the fields of a node are marked as `inputOnly`, `outputOnly` and `inputOutput` [7].

X3D offers features that allow the drawing of geometric figures, text, inserting pictures and manipulation of animated figures, as well as scenarios, objects and 3D worlds.

## 4. A PROPOSAL FOR VISUALIZATION AND INTERACTION OF 3D ENVIRONMENTS IN THE BRAZILIAN DIGITAL TV

Chapter IV will address a study on the technology required for implementation, and the architecture model proposed, as well as the methods needed to implement the proposal.

The methodology used in this article is an analysis of programming techniques for digital television and virtual environments. Researching the basic drawing primitives in X3D and making the relationship with packages, classes and methods needed for portability on DTV. Enabling perhaps a new feature for the Brazilian DTV.

### 4.1 The X3D-GINGA Architecture

The X3D-GINGA execution machine is the end product of our work and serves the purpose of the porting virtual environments described in X3D into the Brazilian DTV system. The modules that make up the execution engine are responsible for standardization of 3D content.

The model consists of three modules used during its implementation.

- The reduction module is intended to simplify the content so that the application is not too heavy due to hardware limitations imposed by the GINGA middleware;
- The rendering module prepares the content before it is transformed into an application acceptable by the DTV standard;
- The conversion module is responsible for standardization and adaptation of content for DTV, making the content readable and compatible with the application management middleware.

The flow and execution and communication can be shown in Figure 6.

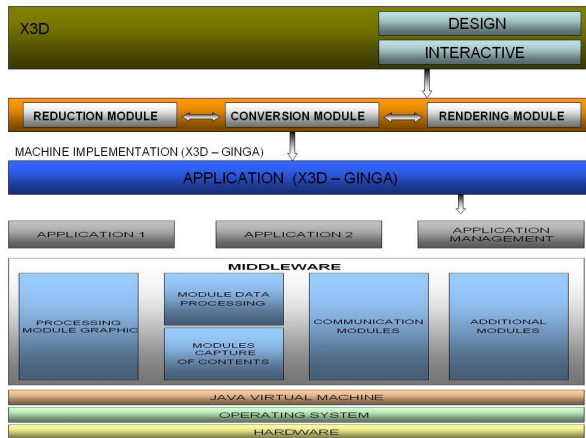


Fig 6. Conceptual model for X3D-GINGA architecture

## 4.2 X3D – Ginga Execution Machine

Firstly, the study of the behavior and needs for the use of X3D language needs to be carried out. Interactive virtual environments are formed by a set of primitive interconnected, related and synchronized forms.

We can say that implementation of an execution engine responsible for portability between different environments and technologies, requires a mapping of basic commands of the technologies, in order to provide an input / output library of our system.

A study in the javaDTV specification led to the use of the API packages LWUIT incorporated in the javaDTV specifications, in order to facilitate the interface handling, design of shapes and animations.

Packages that possess classes and methods needed to create the classes that make up the X3D-GINGA execution machine are:

- The package `com.sun.dtv.lwuit.Graphics` used for the development, design of objects and geometrical figures;
- The package `com.sun.dtv.lwuit.animations`, has classes for both animation of forms;
- The package `com.sun.dtv.lwuit.geom` contains classes related to geometry and local calculations.

Using the forms of X3D content and packages necessary for the creation of corresponding classes, we created the X3D-ginga execution machine.

## 5. TESTS

Application development (X3D-GINGA) started from the complete relationship of tasks from both technologies.

Figure 7 describes the mapping of common features in the languages and how it was done the mapping.

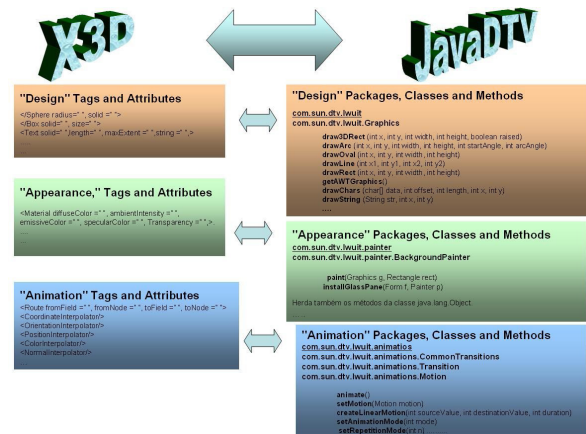


Fig 7. Relationship characteristics and procedures in languages.

Since the API specification is the only available resource, implementation will occur in the near future.

## 6. CONCLUSION

Hence technologies involving the Brazilian system of DTV were studied, along with the description of 3D virtual environments thereby emphasizing the technologies (Ginga middleware, ginga-j and X3D). This study brought into light an unpublished research proposing the conversion and porting of interactive 3D environment settings into digital television.

At the end of the study evidence was obtained that there are viable possibilities for the implementation of virtual environments, i.e., files with 3D extension support and portable to the Brazilian digital television system.

## 7. REFERENCES

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