

eGaLab – a New Dimension for Artists

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Abstract

There is a kind of misunderstanding between the common way of art presentation in galleries and museums and the very emerging artistic forms, directly on electronic media (e.g. net art or virtual sculpture). Though the galleries and museums are getting on-line these days, still they treat the artists and artworks in an old-fashioned way. Even the progressive net-galleries are founded just on a simple point & click navigation which is hostile to both artists and audience.

eGaLab (electronic gallery and laboratory) for virtual art reflects today's status under which the artists create and present their artworks. It introduces an intuitive approach in the field of virtual environments and communities oriented to visual arts and artistic collaboration. eGaLab combines and transforms the advantages of collaborative virtual environments with the traditional aspects of artistic creation and presentation.

In this paper we describe architecture of the eGaLab platform. We describe its networking part based on a concept of General Variables (GV) and discuss several implementation issues related to its specific character.

1. Motivation

Creation of art today is closely related with newly emerging technologies. Affordable computers capable of displaying fast 3D graphics and Internet connection available nearly everywhere, they both provide an interesting base for presenting artworks in cyberspace. Thousands of virtual museums, exhibitions and galleries can be found on the Internet nowadays. Majority of them use HTML to present 2D paintings or pictures. Some of them use QuickTime VR to provide deeper immersion to the visitor. Only dozens employ virtual environments to present new media installations consisting of 3D geometry, video, audio, integrated behavior and interaction [1, 2]. They introduce a basic idea of a visitor navigating through the virtual space and viewing the

VRML browser (Cortona)

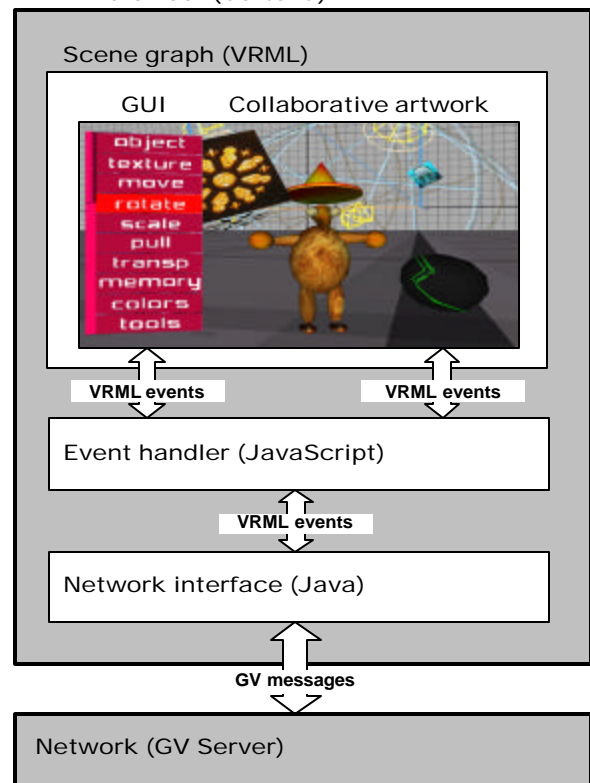


Figure 1: The overall architecture of the eGaLab client. The main part is the event handler that modifies the scene according to artist's interaction with GUI and messages received from the network. All events were queued to prevent congestions which results in high stability of the system.

virtual artworks and installations online. They vary in added features that provide interaction, improve presence and enable perceiving of other visitors. However, they still treat the artists and artworks in an old-fashioned way and provide only very limited means for contemporary new media artist.

There are also several commercially available software environments, which enable common work on multimedia content. Their common disadvantage is that the data sharing is always based on the distribution of tasks. Every person involved in the production pipeline has its own part of work and only those involved in final composition are able to watch the complete result.

eGaLab project has been designed to provide novel platform for international collaboration of new media artists and for presenting their artworks to the public. It consists of collaborative shared virtual laboratories for artistic creation and virtual gallery for presenting the creations. The gallery consists of links into the laboratories so that the visitors can watch construction of installations and live performances online. The space is not constrained by walls, floors and similar obstructions known from the real world museums and galleries. The collaborating artists are absolutely free in terms of arranging and composing their work.

Section 2 describes the overall architecture of the eGaLab platform and its basic principles. Section 3 deals with several implementation issues regarding the interactivity sharing and motion capture integration. We provide our experience with the platform in Section 4 that concludes the work.

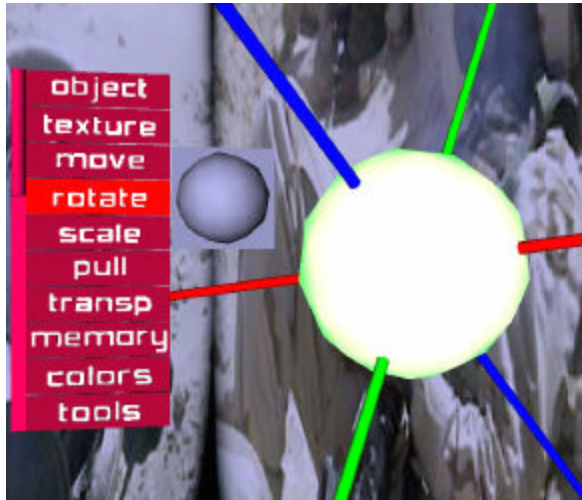


Figure 2: The *rotation* and *move* tools. The selected object can be positioned by pulling the axes. The sphere icon (on the left) is used to rotate the object.

2. Basic principles

There are always two key decisions when designing collaborative virtual environment. The first one is regarding its rendering part and the second one its networking part. With eGaLab we decided to make use of freely available VRML browser (Cortona) for the

rendering part. We are aware of number of disadvantages that VRML brings that are mostly related to the performance issues. On the other hand VRML enriched by Cortona extensions offers very wide range of possibilities to new media artists; they can seamlessly integrate 3D models with audio and video, response to visitor's interaction and implant its own logic into their installations.

The networking part is responsible for making the collaboration possible. We used our proprietary GV (General Variables) technology for distributing and storing events (variables). It is based on combination of peer-to-peer network supported by central server that stores the events and keeps the later joined clients up to date.

The overall architecture of the eGaLab client is shown in Figure 1.

2.1. Rendering part: VRML

The main purpose of the eGaLab laboratory is to enable artists to collaboratively arrange an installation. It provides a set of basic tools to facilitate this task:

- *create* a primitive object (plane surface, cube, sphere, cone, cylinder)
- *import* a 3D object in VRML
- possibility to name, delete or change the form of each object
- *select, delete, copy and paste* operations
- *move, rotate, and scale* tools to change transformation of the object
- *pull* tool to modify the shape of a plane surface
- *colors* tool to change object's color
- *transparency* tool for changing object's transparency
- *texture* tool to texture the object with still image, video, sound or text
- *input devices* to connect object's properties to an input device (i.e. motion capture)
- *memory* tool to record or reload the entire scene with all its manipulations

Figure 2 illustrates the use of the *move* and *rotate* tools. eGaLab laboratory was not designed as a full fledged VRML editor. Complex models should be designed in a specialized 3D modeling software of the artist's choice. Nowadays every standard modeling software offers the possibility to export the model to VRML. Once exported, the model can be inserted into the laboratory using the *import* tool.

The user interface as well as the creative tools were designed with respect to new situation and were subject to constant improvement and sometimes even redefinition,

as the feedback from the artist was obtained. We find the designing of the optimal user interface very complicated and time consuming, as the variety of common activities is really huge and still emerging.

2.2. Networking part: GV server

eGaLab is a specific kind of a net-VE (networked virtual environment) system. The crucial property of net-VE systems is that every user at any given moment sees the virtual environment in the same state. Maintaining this shared state is the most important part of the net-VE system.

We made an attempt to formalize the distribution and synchronization of the shared state among eGaLab users by designing and implementing the concept of *general variables* [3]. The implementation of the concept employs combination of peer-to-peer network supported by server for storing the shared state of the system. The key principle of the concept is depicted in Figure 3.

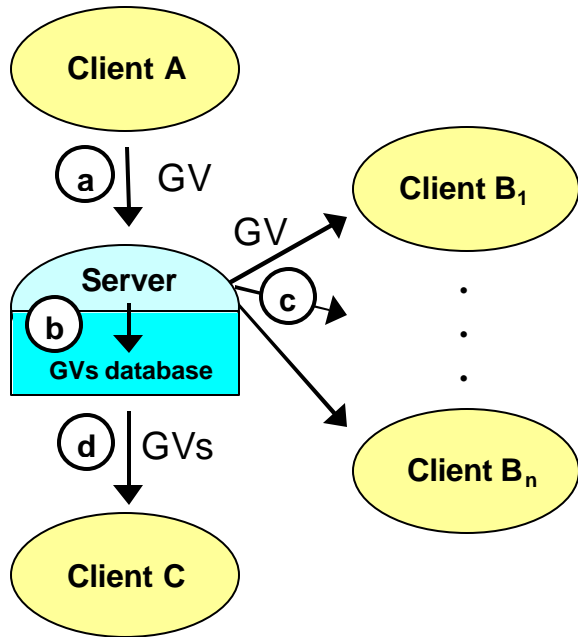


Figure 3: General variables (GV) concept. Storage and distribution of general variables. a) sending a GV to the server, b) storing the GV in the GV's database, c) forwarding the GV to connected clients, d) sending the GV's database to a late joined user.

When a user attempts to interact with the world, the client application creates adequate variable containing a value representing the user's action. The variable is then sent to the server, which updates the GV's database and broadcasts the variable to other connected clients. The

variable can be also multicasted directly to other clients without passing through the server. The actual distribution pattern comprising network protocol, echoing, reliability and sorted delivery options depends on GV's flags settings. Receiving clients should decode the meaning of the variable and replay the original action locally. If a new client (*late join*) connects to the system, the server sends it the content of the GV's database so that the late joined client can update its state promptly.

While the concept covers the data distribution and synchronization, the concrete meaning of the data stored in general variables is left up to the application. Thus, the general variables can represent user interaction and modifications of the virtual environment, properties of the shared objects or other application specific data.

It is obvious that not every change of the shared state is of particular interest for every user. This filtering technique is referred to as *interest management* in net-VE systems. GV concept provides means to partition the shared state (represented by general variables) into *domains* and *sub-domains*. Domains represent categories of areas of interest, sub-domains represent their instances. Any state variable can belong to any number of domains that define the scope of the variable. For specifying users' interest we adopt the general aura-nimbus interest management model [4].

3. Implementation issues

VRML97 is an international standard for describing a 3D scene and its behavior. It offers only a basic set of structural 3D elements and no means to support the creation of multi-user applications. Several working groups proposed their extensions to VRML that resulted in X3D standard draft. Since it is still under development, there are no freely X3D browsers available yet that would provide reasonable quality and performance.

In following two sub-sections we describe our extensions of VRML97 capabilities and its standard functionality provided by Cortona.

3.1. Shared interactivity

The *import* tool for importing VRML models enables the artists to insert an arbitrary 3D object including its functionality stored in VRML format into the laboratory. VRML file can contain not only the geometry but also interactions using sensor nodes and routes. Sensors react to the user interaction (navigating, mouse pointing, clicking or typing) and generate events that are distributed by routes to destination nodes. These nodes process the incoming events and generate appropriate response (change color of object, generate a sound, start playing a video clip or animation).

To fulfill the basic requirement that all visitors see the laboratory in the same state, all interactions should be shared among all clients. However, there are also interactions that should not be shared. It will enable visitors to explore the installation independently without interfering with each other (like in case of an interactive artwork that should be manipulated only by one visitor at a time). The final decision whether to share the interactivity or not is up to the artist.

In eGaLab we provide technical facility to distribute the interaction that is based on Living Worlds draft specification of *Networkstate* nodes [5]. The principle is that every route that delivers shared events is interrupted by an appropriate *Networkstate* node. The existence of the *Networkstate* node indicates the VRML browser that every event passed through it should be shared. Such an event is delivered to other clients and injected to the corresponding *Networkstate* node where it reaches its original destination.

Since the current release of Cortona VRML browser does not support the Living Worlds extension, the event handler part of the client emulates the functionality. Every imported VRML scene is searched for the existence of *Networkstate* nodes. They are registered and all events passed through them are compiled into a GV and distributed.

We are aware that popular 3D modelers do not support the Living Worlds specification and not all artists are familiar with VRML to modify the interactions themselves. Thus, we have developed a simple command line tool that helps the artists to automatically convert the interactions in VRML file to *Networkstate* nodes. It parses the VRML file and searches for all routes that originate in sensor nodes. Such routes are split into two routes connected to an instance of the appropriate *Networkstate* node.

3.2. Input devices: motion tracking

As stated in the first section, eGaLab's laboratory is used not only for collaboration, but also for presentations including live performances. During the live performance the collaborating artists dynamically move the objects and manipulate their visual properties in real time. Since the manipulation using the regular input devices (keyboard and mouse) has inherent limitations, the artists demanded integration of more complex devices including a motion tracking device.

For eGaLab we developed a simple concept of input device modules. The module receives data from input devices and translates it according its actual settings to VRML events. The output events can be connected to objects to dynamically change their properties. We implemented an input device module for Polhemus' ULTRATRAK PRO tracking system that features 12

sensors for position and orientation measuring. The output data of the system were translated by our input module to 24 VRML events (12 SFVec3f and 12 SFRotations). The artists were then able to connect the output of the module to objects in the laboratory thus producing human-like movements of selected objects.

Some artists also demanded more realistic performances that would include human like characters driven by the tracking system. We tried to obey their aesthetic requirements while still keeping the performance of the system at reasonable level. After some period of experiments we found a balanced solution represented by avatars produced by AvatarStudio [6]. Freely available AvatarStudio produces VRML animated characters that were originally used by Blaxxun [7] in their popular networked environments. The characters are fully articulated and their geometry is seamless which was the crucial aesthetic requirement of the artists.

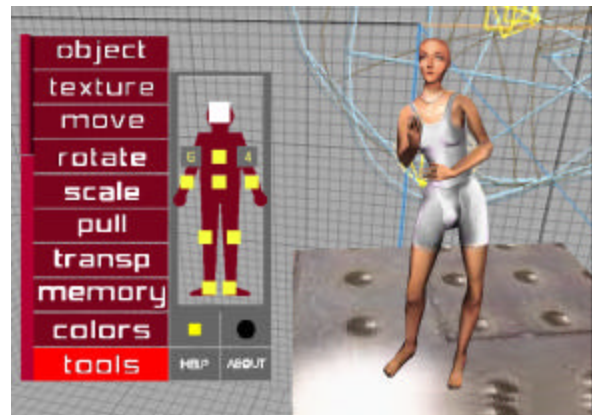


Figure 4: GUI of the input device module for a tracking system. Sensors can be connected to control an arbitrary geometry or to animate a human like character. AvatarStudio character is on the right.

When integrating the characters from AvatarStudio into eGaLab we had to solve two problems. First, even if the characters are articulated, they are only capable to replay a limited set (10) of predefined gestures. Second, the avatars from AvatarStudio were accelerated for use in Blaxxun. They exploit Blaxxun's extensions for fast animations of the avatar's seamless geometry consisting of one IndexedFaceSet node.

We solved both problems by implementing a conversion utility that modifies characters from AvatarStudio to be HAnim [8] compliant. The utility makes the rotations of joints publicly accessible. It orients the coordinate system for each joint to align with that of the overall character and sets the joint rotations for the initial standing position to zero.

We have also exploited an undocumented extension of Cortona VRML browser to accelerate the animations in a similar way as the Blaxxun browser. Once the character has been converted by our utility, it can be imported into the laboratory and connected with input device module to reproduce movements of the person being captured by the tracking device (see Figure 4). In this case the rotations cannot be applied directly to H-Anim joints, but parent-child relations of the character's segments has to be considered as described in [9]. Input module offers the option to turn these calculations on or off depending on the type of the object.

4. Experience and lessons learned

eGaLab (www.egalab.net) is an outcome of one year cooperation among CIANT (International Centre for Art and New Technologies in Prague), CYPRES (Centre Interculturel de Pratiques, Recherches et Echanges Transdisciplinaires), MIDE (Museo International de Electrografia) international cultural centers that associate artists, technicians and computer scientists. CIANT also closely cooperated with Computer Graphics Group at Czech technical university in Prague that provided the GV technology and valuable advice.

The artists demanded a construction of an interactive 3D digital space in VRML, constituted with digital phonemes, modeling and animations, texts, digital or digitized photos, of video sequences and sound fragments, molecules – bases of a dynamic audiovisual architecture broadcasted and shared on Internet.

One of the most interesting aspects of building eGaLab was the cooperation among artists and technicians. Sometimes it was very difficult to find the solution that would meet the artistic requirements and keep the project coherent and manageable until its final presentation. We have often experienced misunderstandings between these two groups caused by their different points of views. To provide an example: when we finally finished the first release of the motion capture device module, the movements of the character were not very realistic. We strived for more realistic movements of the animated character and spent significant time implementing the corrections. Then we presented our results to the artists, but by mistake we left out the calibration phase. The character started to perform unnaturally distorted movements that did not resemble anything we had seen before. While we classified it as a buggy situation, the artists were astonished since they had just revealed something different that had pushed their perception in another direction.

The final public presentation (see Figure 5) took place in Prague in two days on March 28th and 29th 2003. It was joined by members of all cooperating centers that together prepared several live public performances. The visitors



Figure 5: Public presentation of eGaLab in Prague. The dancer is connected to a motion tracking device. The collaborative space is projected on the screen in the background.

could either come to the venue and watch the performances projected on large screens or stay home and watch it directly on their computers through the Internet.

According to the performing artists we succeeded in creating a shared virtual environment that enables collaboration among its participants. They complained about several issues related mostly with the performance of the system although we spent significant amount of time optimizing the code. VRML is a very powerful and universal tool for visualization. Its universality and complexity is the main reason why VRML browsers can never perform as fast as narrowly specialized visualization engines.

5. Future work

eGaLab is definitely not a final and complete product. Rather, we consider it a prototype that largely contributed to an ongoing discussion about art in cyberspace.

During several weeks of using the platform we have received number of ideas and thoughts how to improve and enhance the system. We will take them into account

in ALTERNE (Alternative Realities in Networked Environments) project aimed at construction of an Alternative Reality platform to support the development of the digital, interactive and participative artistic activities.

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