Scenarios in Space and Time

Kai Strehlke, Maia Engeli
Swiss Federal Institute of Technology
Zurich, Switzerland

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Abstract: New opportunities for architectonic design and representation in three-dimensional virtual spaces have arisen thanks to computers, networks, and new media in general. An environment with unique three-dimensional interfaces for the creation of spatial scenarios has been developed. The possibilities were explored in two successive courses in architecture and new media. Design in space and time, the investigation of special characteristics of digital spaces and the creation of a hyperstructure were the main topics of the creative work.

1. INTRODUCTION: EXPLORING DIGITAL SPACE

The formulation of architectonic ideas through digital three-dimensional spaces is gaining importance in the architect's work, from designing purely virtual architecture, like computer games or information spaces, to presenting planned buildings using virtual reality. Above and beyond this area's many practical applications, our interest and the focus of this paper lies in exploring the potential of these new possibilities, defining appropriate tools and interfaces, and training architects to use new media to reveal their ideas.

To be able to design three-dimensional spaces in an immersed way has become a desire among architects working with CAD tools. The challenge is to create tools that support the designer's creative thinking, allow for intuitive interaction, stimulate the design process, and help one discover additional qualities of the spatial composition. In a virtual environment, the
special qualities of digital spaces and their differences to physical spaces have to be considered in order to discover their full potential. The lack of gravity, orientation, and physical scale on the one hand, open opportunities by creating freedom for expressing ideas and, on the other hand, create challenges because the audience is not yet trained to cope with all of the aspects of this freedom. “In a participatory medium, immersion implies learning to swim” (Murray, 1997).

The design as well as perception of space goes beyond geometry and materialization. Context, event, mood, and memories influence the experience, which is always personal and subjective. The same space can have a multitude of parallel interpretations resulting from the fact that different authors are involved. To communicate such complex interrelated aspects is a challenge that can be addressed by using networked environments as a medium for representation and communication. The network serves as context and allows parallel presentations of the same space. The messages should be thought of as stories that stimulate imaginative thoughts among the audience.

The tools and interfaces created for [roomz] specifically address these aspects of revealing architectonic ideas within three-dimensional digital spaces through narrative scenarios. In [connectionz] these scenarios can be networked into a hyperstructure to allow for a multithreaded, multifaceted representation created by one or multiple authors.

“Writing stories is creating knowledge and the sharing of stories defines a culture” (Schank, 1995). The vision is that the scenarios of [roomz] become architectonic stories, and the hyperstructure of [connectionz] becomes a multithreaded narrative - a collaboratively-created architectonic knowledge space that exemplifies what Rushkoff describes as “a much more self-conscious, recapitulated experience of storytelling” (Rushkoff, 1996).

### 2. DIGITAL ENVIRONMENT AND INTERFACES

The environment for the creation of spatial scenarios is implemented as a set of web-based interfaces. The goal of these interfaces was to allow an author to design directly in a three-dimensional space in a very intuitive and interactive way. The editing environment allows one to place visual material in the form of images, video clips or three-dimensional objects in a given geometry and to define a path through this geometry. The scenario results from combining the carefully placed objects with the motion along the path. Ultimately, a scenario is about events, which occur within a space. “Events qualify spaces as much as spaces qualify events” (Tschumi, 1996). This
contingent relationship can be applied to and explored in [roomz][connectionz].

The scenarios are about digital spaces, which are not bound to the physical world and do not have to be a simulation of it. A scenario can create a space of information, a space of memories or feelings. In addition to the objects, the path is an important part of the scenario. The path allows the author to guide the reader's perception of the space.

In addition to the interfaces provided by [roomz], which allow the creation of single scenarios, the environment of [connectionz] allows one to interconnect scenarios and create a multidimensional hyperstructure. Hyperdocuments, as known from the web, are a challenging way to provide information, challenging both for the authors as well as the readers. A hyperdocument is comprised of rich multidimensional information structures where readers can enjoy travelling along various paths (Engeli, 2000). The same paradigm is applied in [connectionz] when connecting information to architectural spaces allows the architectural discourse to happen within one scenario as well as in relation to other scenarios.

2.1 Editing in Space

The most direct approach for visualizing architectural ideas about space is by directly working in three-dimensional models. Therefore a three-dimensional workspace has to be provided that allows the designer to work in a very direct way and immediately experience the result of any design decision.

The main interface of the [roomz] workspace is called "myscenario". This interface allows for three types of interactions: changing the colors of the walls, placing objects within the space, and creating a path through the space.

Myscenario consists of the three-dimensional space the author is working on and a two-dimensional part providing the tools to create the scenario. The tools are implemented as a head-up display, which is perceived as an overlay over the three-dimensional space. This overlay technique has been successfully implemented in previously developed design tools like Sculptor (Kurmann, 1998) and xWorlds (Strehlke, 1999), leading to an enlarged modeling space and an enhanced involvement with the task at hand when compared with the traditional setup of menus and tools arranged around the workspace.
Before working in the main interface, the author has to import the visual objects that should be placed in the spaces. A special interface is provided for this preparatory task. Three types of objects can be imported: images, video clips and three-dimensional objects.

The head-up display is divided in three parts, showing the imported objects on the left, the viewpoints of the path on the right and a control panel on the bottom. The panel contains sliders to control the properties of various aspects of the objects and the path.

2.2 Visual Objects and Instances

“The skins and surface envelope of buildings become programmable surfaces, photosensitive membranes that narrate, design and inform the spatial organization of the volumes and interpret their functions. Information loaded walls that seduce” (Colafranceschi, 1995).

Visual objects provide the means to formulate the scenarios. Because the objects are always present in the workspace, the designer is able to work with them like a painter is working with a palette of paints in his hand. Multiple instances of an object can be placed in the scenario. One only has to click on the icon to create a new instance. The instance can be placed freely
in space or pasted on a wall of the model. Images can be pasted with any proportion and size by clicking on the first corner of the instance and dragging the mouse to the opposite corner. Using the control panel, images can be stretched in both x and y-directions, moved in any direction, and rotated. Furthermore, it is possible to scale the image within the instance, resulting in a repetition of the image on the same plane.

Different possibilities are enabled depending on the instance. When an instance is placed freely in the space, it is possible to freely rotate it. In a situation where this does not make sense, like when the image is pasted on a wall, free rotation is disabled. Such features enhance the performance of the designer as well as the tools by reducing meaningless efforts, and are available for video clips as well as for images. Different instances of video clips can also be created and either pasted on a wall or placed in space. The videos can be activated when they are clicked upon.

The third group of visual objects is made up of three-dimensional models imported as VRML models. Their instances are placed in space and, if necessary, the location and scale can be readjusted with the controls. The VRML models allow the space to be filled with dynamic objects.

In the physical world, a reference object is always needed in order to be able to perceive the size of a space. However in the virtual world, it is possible to redefine spaces with dynamic, moving objects, which can also use sound to enhance the scene.

2.3 Creating a Path

“Motion helps us gather information not available at a glance. It moves us from one space to another absorbing data and assembling the spaces mentally from various brief glances. Our cognitive model, while schematic, is in a way more complete than a static perception of the space” (Anders, 1998).

Motion is essential for understanding the third dimension in a digital space, since the computer screen can only display 2D images. By looking at objects or spaces from different angles, it is possible to read and understand the three-dimensional geometry.

Navigating in a virtual three-dimensional space is a new challenge when compared to navigation in the physical world. The virtual space may lack gravity, scale and horizon. One may not perceive it from a constant height and the viewing angle can change while moving. To recognize a larger context or find landmarks for orientation may be very difficult, especially when jumping from one viewpoint to another; one can easily get disoriented and eventually end up on an empty black screen.
Therefore, navigation is an important part of the whole scenario. Since the content is deliberately placed in the space, it is also important for the author to help the visitor perceive the space in the way he or she wants him to see it. Every viewpoint, camera opening angle, the speed when traveling from one viewpoint to the other, and the elements which are visible at a certain time are crucial aspects that can be controlled. The author can freely navigate in his working environment when designing the scenario, but the visitor is constrained to follow a designated path when exploring it.

Half of the myscenario interface is devoted to the design of the path through the scenario. The path consists of a sequence of viewpoints. For each viewpoint, different parameters can be defined, like the location and orientation of the viewpoint, the viewing angle, and the time needed to reach the viewpoint. The lights in the model can be adjusted and whether or not each instance of a visual object is visible or not can be determined for each viewpoint.

These possibilities allow different approaches for formulating the path. It is possible to follow the paradigm of moving through a physical world by simulating a horizon, keeping a defined viewing angle and viewpoint height, and by moving in a more or less constant speed from one viewpoint to another. Furthermore, it is possible to tilt the space from one viewpoint to another, to change the viewing angle, or to alter the speed, from fast jumps to very slow motion, between the viewpoints. Instances can also appear, disappear or be replaced when a viewpoint is reached. With this rich palette of possibilities, how one moves through the space becomes a non-trivial design task.

2.4 Creating the Hyperstructure

![Visualization of the hyperstructure created by all the scenarios from the two courses [roomz] and [connectionz]](image)

Figure 2. Visualization of the hyperstructure created by all the scenarios from the two courses [roomz] and [connectionz]

The environment of [connectionz] allows scenarios to be linked together into a hyperstructure. The links are created by introducing gates which lead
from one scenario to another. By clicking on a gate, the viewer jumps for a defined number of viewpoints into the other scenario before being brought back to the first scenario. This allows moving through the spaces in various ways and ultimately gives access to all connected scenarios.

Links, as we know them from hyperdocuments, generally lack transparency or other means to anticipate where they lead. However in the \([\text{connectionz}]\) environment, supporting the user's decision to follow or not to follow a link seemed important to us. Two means of enhancing the transparency of gates were therefore introduced: Gates needed to be decorated with an object from the linked scenario, and clicking on the gate for the first time switched on a preview of the linked scenario. A double click let the visitor move into the linked scenario.

An important aspect to make a visit in the \([\text{connectionz}]\) environment enjoyable is to prevent broken links. Therefore the following measure was taken: If the author of the foreign scenario erases the part of a path a gate points to, this gate becomes meaningless and is removed by the system. Even though the visitor is spared some frustration, the scenario's author may gain some frustration when a gate is lost. Connections to old and finished scenarios are stable, while connections to scenarios under construction can be unstable. Connecting to an unfinished scenario means that the author does not have full control of all aspects of his work, which is more and more a fact when working in networked environments.

2.5 The Technical Setup

The interfaces run in typical web-browsers with standard plugins on the client side and are implemented with shareware tools on the server side. This approach minimizes the user's effort to become acquainted with the system and provides the possibility to work from anywhere anytime, because the interfaces are system independent and require no special software. On the server side, a MYSQL database and a set of PHP scripts create dynamic and personal HTML and VRML interfaces for the user. On the client side, a Netscape browser with a VRML plugin is needed for the author to work on his or her scenario.

Two-dimensional HTML interfaces are provided for authentication, uploading material into the system, and retrieving information like tutorials. Three-dimensional VRML interfaces, like the myscenario interface, the gates interface, and the explore interface, allow one to work in the spaces and explore them.

In the case of the myscenario interface, a PHP script generates a personal VRML world, which contains the geometry of the user's space, the objects already uploaded into the database, the instances, the path the user has
created, as well as all the tools needed for modifying them. When the work is saved, a connection to the server is opened and all of the parameters of the instances and the path are sent to a PHP script. This script saves the parameters of the new path in the database and sends a confirmation back to the user.

The gates interface allows the user to create, modify, and delete connections to foreign scenarios. In this case, a PHP script generates a VRML file including the geometries of all existing scenarios with their paths, and the tools needed to switch between the different spaces, visit the scenarios and create the gates. All of the spaces and scenarios were put into one file, because this enables one to jump between different scenarios without having to reload each file from the server. Once the gates are defined, they are saved in the same database as the scenario. In a second step, a library with the objects of the other authors can be visited and an object to decorate each gate can be selected. This object can be an image, a video clip, or a three-dimensional model.

The explore interface allows for the exploration of the scenarios and the hyperstructure. As in the previously described interfaces, a PHP script generates a VRML file that contains all the objects, the instances and the path, and enables navigation through the scenario. In this interface, the navigation mode of the VRML world is set to 'none' so that the only way to navigate inside the space is by following the path created by the scenario's author.

3.  **[ROOMZ]&[CONNECTIONZ] COURSES**

[roomz]&[connectionz] have provided the online environment for two courses about architecture and new media. The two courses spanned a period of six weeks each and were taught to 130 second-year architecture students. The students were able to work from home as well as on the university campus.

A digital model of Georges Vantongerloo's sculpture, "Rapport des Volumes" (1921), provided the spaces for the scenarios. This sculpture is composed of eleven L-shaped volumes with different proportions. The students had to select three adjacent volumes as the geometry for their scenario. Working with abstract spaces that lack scale and orientation led to a freer interpretation of the spaces and the definition of their architectonic qualities by the scenarios themselves. (Strehlke, 2001)
An additional three-dimensional interface was provided to allow the student to select the volumes in a playful, intuitive way and to enter the space within them. Wherever two volumes touched, the type of opening between them had to be defined, either as a full opening, a frame, four blocks, or with slats. The interface supported the search for the openings, because only after each one was defined, was it possible to save the composition of spaces. The sculpture from Georges Vantongerloo offered a large variety of possible compositions with different characteristics. Some students composed a circular arrangement, while others aimed at a linear sequence; some compositions had an introverted character while others had many openings to the outside. The colors defined in the myscenario interface further enhanced the individual character of each composition.

3.1 Spacepixels, Re-Space, Actors in Space, and Motion&Motion

Four specific themes about architecture and new media - light, transformation, dynamics, and motion - were chosen as possible fields of concentration for the students. The respective teaching modules were called Spacepixels, Re-Space, Actors in Space, and Motion&Motion. The students had to choose one module each semester. They were allowed to select the same one twice in order to deepen their understanding of the theme and the related technologies.

Spacepixels explored the dialog between light and material as an architectural phenomenon. The influence of daylight and artificial light in a virtual model was analyzed and images with different light qualities were produced. The two-dimensional images were placed in the space or on the walls to create enhanced or ambiguous readings of the space.
Re-Space dealt with the representation, perception, and transformation of space. This module worked with the duplication of space and aspects between the original, the transformed, and the animated model of the space.

Actors in Space involved placing dynamic objects into the space. These objects could be seen as digital organisms, animated geometry, and visual statements that established relationships with the space by introducing aspects of orientation, scale, and meaning.

Motion&Motion focused on the combination of two kinds of motion: Motion shown by animations and motion through the space. Animations and videos were retrieved from the Internet, created directly from the digital model of the space itself, or recorded with a video camera and then placed in the space.

In addition to the chosen module, the students were confronted with the themes and the design possibilities of the other modules by being able to view work-in-progress through the common online environment and reviews in class.

3.2 **Scenarios and Hyperstructure**

*Figure 4. Four examples of student works: Eyes tracking the visitor, images enhancing the motion, renderings extending the virtual space of the sculpture and images serving as gates to other scenarios.*
In the first course, [roomz], the students were asked to create a scenario. They started by selecting the spaces from the sculpture and a module and then created the visual objects they wanted to place inside their spaces. After placing the objects in the spaces, they designed a path through the geometry.

Although the students tended to very carefully create the visual objects and place them into the sculpture, the time provided to create the path proved to be a little short, leading to very simple paths mostly composed of viewpoint sequences that visited all the instances placed inside the spaces. Only a few groups worked in a conceptional way, exploring the possibilities of designing the path itself. They designed a motion inside the space by defining the time between the scenes, changing the viewing angle between the scenes, and defining the orientation for each scene. The end result of the first course was a collection of visually appealing scenarios inside the same sculpture but without any connections between them.

The goal of the second course, [connectionz], was to create a hyperstructure that contained the scenarios from the first course as well as new ones. The students were again asked to compose their own space from Georges Vantongerloo's sculpture, choose a module, and create an architectural experience in the selected space. To put more emphasis on the motion through the space, the path had to be created before placing objects inside the spaces. As a result, interesting ideas were developed for the motion through the spaces and the path gained relevance in the overall design of the scenarios.

In addition, each new scenario in [connectionz] had to be connected with one or more other ones with gates.

3.3 Gates into Completed versus Changing Scenarios

A gate is a link between two scenarios. When the students created a gate, they had to select the portion of the path in the linked scenario that the gate should connect with. A specially developed interface allowed them to easily select the entry and exit points of the path in the foreign scenario. In addition, an image from the foreign scenario had to be chosen to represent the gate.

The different strategies invented by the students to connect the scenarios proved to be very interesting: They involved the relations between different geometries, motion, and the objects of the connected scenarios.

The students could create gates to completed scenarios from the previous course as well as to scenarios being created in the current course. If a scenario from the current course was chosen, the connection was not stable, since the path as well as the appearance of the linked scenario could still be altered. The ability to connect to a scenario-in-progress gave the students the
opportunity to work in an interconnected, dynamically changing environment - an experience only a few were eager to make. Many students connected their new scenario to their scenario of the previous semester.

In the case of a connection to a scenario-in-progress, the authors sometimes decided to communicate over email to coordinate their efforts and keep the other informed about possible future alterations. Another special issue leading to interesting strategies was the decoration on the gate, which had to be chosen from the library of visual objects of the linked scenario. Some students did not want to place any of the foreign objects in their scenario. So, in order to control the appearance of the gate, they emailed an object to the other group and asked them to upload the image into the database so that they could select this image as the representation of their gate.

4. EVALUATION AND CONCLUSIONS

The goal of this work was to create an environment to express architectonic ideas in and of digital spaces by offering intuitive and widely accessible interfaces. In the following discussion, different aspects will be considered: The focus and limitations of the tools, composing in the myscenario interface, and the results of the described course in architecture and new media.

4.1 Focus and Limitations of the Tools

The tools and interfaces can be used to create three-dimensional scenarios and visual objects can be imported, but the geometrical shape of the given spaces cannot be influenced in the current version of the interfaces. The scenarios themselves primarily allow navigation through the given hyperstructure but only very limited interactivity. For the designer as well as the viewer, these limited possibilities allow one to very quickly master the interface and use it in an intuitive way. Additions to the current functionality are possible within the current interfaces or by adding new interfaces, but require a careful rethinking of the interface concept.

The results from the courses show that the current interfaces already offer great potential. While some of their limitations enhance ease of use and creative work in the three-dimensional realm, there are others, inflicted by the software, the hardware or the interface paradigm, which hinder creative efforts. One of the major disadvantages is the need to click on movies in order to start them. Ideally they should start on their own, but even our most powerful computers struggled with this task. In addition, moving through the
space can only be accomplished by hitting the 'next'-button to reach the next viewpoint. Ideally it should be possible to design a smooth motion without stopping at every viewpoint, rather using stops at points where the user can make a decision or interact in other ways. This is again a problem of computing power. In the myscenario interface, a method of manipulating instances that is more direct than using control panels would be desirable. However this is currently not possible, because the interaction paradigm is dictated by VRML and is, in this regard, hard to overcome.

4.2 Composing in the myscenario Interface

The myscenario interface was created to allow the designer to create a scenario that presents interesting aspects of the space to the reader. In the course, we discovered that it has even far greater potential. First of all, it allows the students to explore the space at hand and interactively explore its qualities. It challenges spatial thinking, something that happens mainly in the process of placing visual objects and defining the appropriate viewpoints. This turned out to be a non-trivial task, since the motion to and from the viewpoint had to be taken into account as well. The introduction of the objects also led to the discovery of new qualities of the space. Finally, the design of the whole scenario demanded for a story-like structure and an idea of the future audience; the result can be considered a narrative in space. The step of creating gates into other scenarios is similar to making cuts in movies, but is less controllable.

4.3 Results from the Architecture and New Media Course

The 130 students that participated in the two courses helped us discover many of the flaws and qualities of the interfaces. The flaws were immediately improved during the courses and the qualities pointed out during the lectures and individual sessions with the students. This led to interfaces with a high level of consistency and usability even though they were developed in a very short period of time. In the end, they profited tremendously from the collective exploration.

The teaching concept of the [roomz]&[connectionz] courses led to a variety of learning experiences. Architecture, multimedia, and the connected environment were the central theoretical issues. Learning how to use software applications was a pragmatic necessity in order to be able to adequately express ideas. The three-dimensional interface was an important development for this course, taking the architectural discourse to a higher degree, from digital images to digital scenarios, and creating new challenges
for the students. The resulting hyperstructure of the [roomz]&[connectionz] course sequence shows the great potential of this approach.

The results also showed very appropriate use of the media. One of the greatest challenges was to make sound choices out of the endless possibilities. Often the final scenario included only a small selection of the material that was produced in favor of a clearer but nevertheless interesting story. Also the hyperstructure, the common achievement of the whole class, gained qualities thanks to decisions which led to the design of clearer and more unique scenarios. Vantogerloo's sculpture, which in the beginning of the course consisted of 11 empty volumes, became a powerful, multithreaded narrative space containing the thoughts of 130 authors.

The [roomz]&[connectionz] hyperstructure can be explored at http://alterego.arch.ethz.ch/connectionz.

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6. REFERENCES