Diorama Engine - A 3D Directing Tool for 3D Computer Animation production

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Abstract

This paper describes Diorama Engine, a 3D directing tool for 3D computer animation. The Diorama Engine is a limited but specialized tool that focuses on ease of scene construction, camera control, and shot editing. These features allow quicker and easier creation of full-length 3D animated storyboards. Furthermore, 3D data can be passed directly to later production processes, enabling the work of a director to form a data foundation for the production process. A prototype version of our tool is tested, and the evaluation results suggest that the directing tool can be integrated into an actual production process.

1. Introduction

In 3D animation production, the central role of a director is to plan the overall design of the final picture, and the transition of this plan into actual production is accomplished using the storyboard. Based on an interpretation of the story and characters, design decisions such as the allocation of scenes and cuts, visual composition, tempo, and camera settings are made. These decisions are then summarized and written into the storyboard as pictures and words sequenced in order of time. The completed storyboard is distributed among production staff, and the remaining production stages are executed faithful to this document.

While the storyboard is traditionally hand drawn on paper (Figure 1), the advent of powerful graphics software has introduced new possibilities for digital storyboard variations. The digital form is superior to the traditional storyboard mainly because of the richness of information. For example, characters can be animated, detailed camera movements can be specified, and dialogue can be recorded as actual voice. This richness provides the director with a more expressive and precise means to specify and communicate design decisions to production staff. Furthermore, this information can be passed directly to production software for purposes of reuse. With this data flow, production staffs no longer have to interpret and reconstruct from scratch, the design decisions made by the director. Instead, data is retrieved and the quality is built on top of this given foundation.

However, traditional storyboards are mainly used in actual studios, and digital techniques are used only in special cases where careful planning is required. An example of such a case is where the composition of 2D hand-drawn images and 3D rendering is required.

The aim of this research is to expand the limited application of digital methods in storyboarding, to allow the director to create a full-length storyboard in 3D. In 3D animation production, a 3D approach is suitable since the authoring canvas is compatible with that of production. This allows the director to specify design decisions accurately and intuitively in the same space as production, and the produced 3D data can be directly passed across canvases, to allow reuse of data in production.

Figure 1 Traditional Storyboard Example

As part of the C-PALS project lead by Tokyo University of Technology, we have built a prototype version of a limited and specialized 3D directing tool, called “Diorama Engine” (Diorama), tailored to allow a director to quickly create a full length 3D animated storyboard. With support from OLM Digital, a Japanese animation studio famous for creating the “Pokemon” series, we are planning to use Diorama in actual production environments in the near future.

2. Main Ideas for a 3D Directing Tool

- Intuitive user interface

The director is not a 3D application operator, nor has time for extensive training to become one. The directing tool should be useable with minimum training, via an intuitive graphical user interface.

- Real-time preview

In this context, real-time means to guarantee playback at the required frame rate, and to guarantee smooth frame updates while working in the 3D scene.

- Shot sequencing

Shot sequencing is a powerful means of storytelling. The director should not only be able to create individual shots in 3D, but connect shots together to view and confirm the full sequence.

- Direct pass of data to 3D applications

In traditional storyboards, it is necessary for the production staff to interpret written directions on the storyboard to reconstruct a scene on the production tool. Efficiency can be increased if data flows directly from the directing tool into the production tool.

3. Overview of Diorama Engine

3-1. Architecture

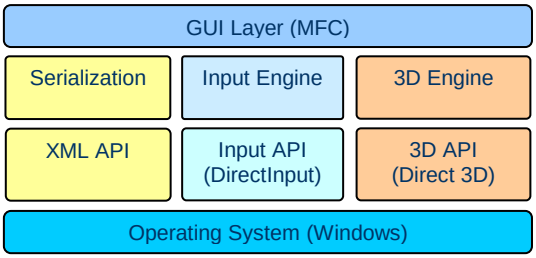

Figure 2 Diorama Engine Architecture

The software architecture has been designed with extensibility in mind, to allow further expansion of the tool in the future by both internal and external organizations. It is implemented in C++, and currently uses Microsoft Direct3D for hardware rendering and Microsoft MFC for the GUI. Since core components of Diorama are implemented independent of external libraries, library composition may change to support various platforms.

3-2. Workflow

The workflow in Diorama is given in Figure 3. There are two modes in Diorama, Scene Mode and Editing Mode. The director starts in Scene Mode, where an animated scene is constructed through 3D scene construction tasks. These include model import and layout, simple object animation, and camera shooting. The director then moves on to editing mode, where the main task is to create shots from footage taken from cameras in Scene Mode. The completed video storyboard is then exported to one of three formats: an AVI file for later viewing, a 3D scene file format, which can be directly imported into 3D applications, and a storyboard printout.

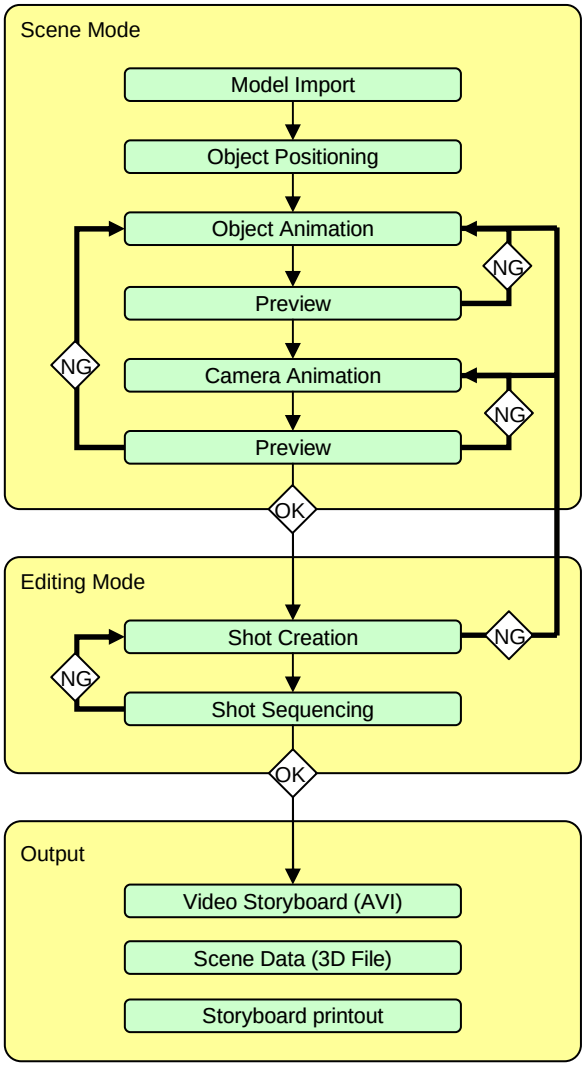

Figure 3 Workflow in Diorama Engine

4. Scene Construction

In Diorama, the focus is to provide an intuitive 3D scene construction interface that allows a director to construct a 3D scene using simple and primitive methods. The workflow is to first import pre-built models from a model database, and then add simple animation. Finally, the animated scene will be shot using the camera.

4-1. Layout

The first task in Scene Mode is object layout. The goal is to spatially position visual objects. This is accomplished by first importing pre-built models from the model database. Then the models are spatially positioned in 3D space by using a manipulator widget[1][2]. The result is a static scene with objects spatially positioned at their initial positions

The model database can be browsed directly inside the Diorama interface. As shown in the left pane of

Figure 4, a list of models is shown. When selecting a model of interest, a popup window is displayed, allowing the director to view the model in 3D from multiple viewpoints. The supported model file formats are 3D Studio Max(.max), Lightwave3D(.lwo), and Directx(.x).

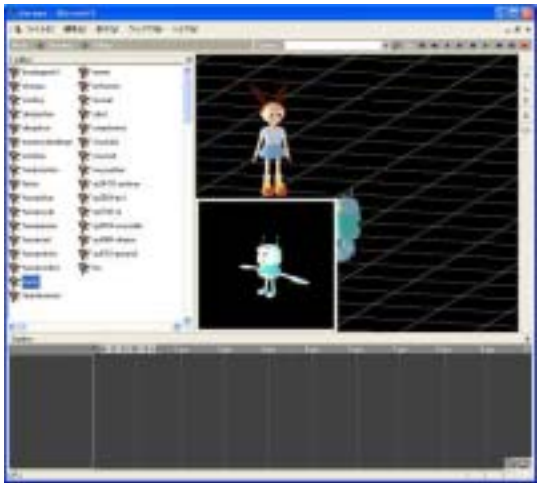

Figure 4 Layout in Diorama Engine

4-2. Animation

The next task in Scene Mode is to add animation to models that were spatially positioned in layout. Keyframe animation is used for this task.

The process of keyframe animation is well known and is intuitive. The user repeats the procedure of positioning an object at a specified time, and the computer automatically calculates the intermediate positions. The result is a smooth interpolating animation when played back.

In computer animation, keyframes can be used to animate any property of the scene. Furthermore, multiple interpolation schemes exist between keyframes. Thus, it is possible to create highly detailed motions. However, at the storyboard level, detail is not necessary. Therefore, the number of keyframe and interpolation types in Diorama is intentionally limited. For models, the keyframe types are positional, rotational, and scale. Interpolation types between keyframes can be chosen from one of spline or linear. A timeline interface supports the procedure of editing keyframes.

4-3. Shooting

Camera shooting is the final task in Scene Mode. The goal is to animate the camera to shoot camera footage. Camera properties that can be animated are spatial position/rotation, and camera zoom. The animation is specified using the same keyframe procedure explained in 4-2.

Cameras are shown as thumbnails in the interface (Figure 5). Each thumbnail displays an updated view for each camera at the current time. Therefore, when the scene is previewed, all thumbnails are updated in real-time. This multiple view interface was designed to resemble an on-set shooting scenario in real life, where the director is presented with multiple screens, each displaying a view from each active camera. We think this interface helps the director visualize the shot flow.

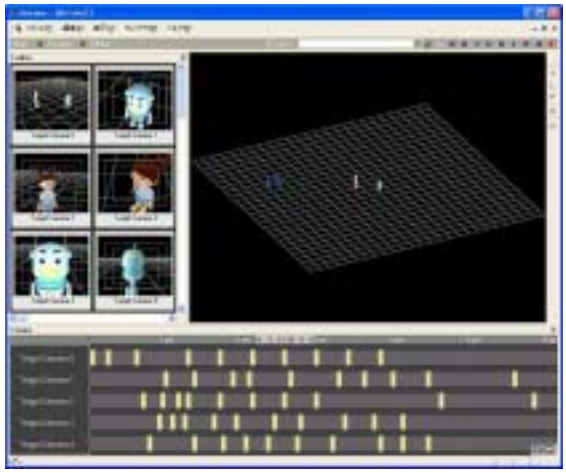

Figure 5 Camera shooting in Diorama Engine

5. Shot Editing

The idea of Editing Mode in Diorama is to provide simple shot editing functionality, so that the full storyboard sequence can be viewed and confirmed.

At this point in the workflow, an animated 3D scene and one or more cameras that capture the scene action have been made. The task of Editing Mode is to create shots from the scene cameras, and align the shots in time order to create the final sequence. This will be accomplished using the Editing Mode interface.

Figure 6 Shot editing in Diorama Engine

The director will first decide on a camera that will be used in the final sequence. By dragging the camera thumbnail from the thumbnail view into the timeline interface, a span will be added which represents a single shot inside the sequence. This procedure will be repeated

until all cameras of interest are added to the sequence. Next, the length of each shot can be adjusted graphically by dragging the end grippers. The ordering of shots may also be changed by a simple drag into the new position. The full sequence can be previewed at any time to confirm the results.

6. Output

The final stage in the Diorama workflow is output of the animated storyboard to various formats. Currently, three formats are supported: AVI movie file, storyboard printout, and 3D file format.

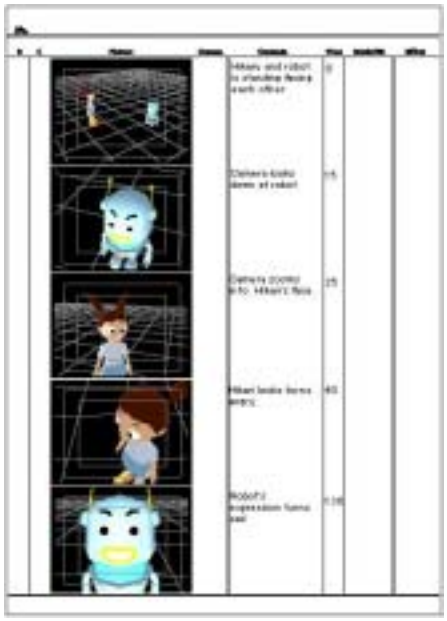

Figure 7 Storyboard printout

The former two are convenient for handing out documents to production staff. In cases where an installation of Diorama cannot be accessed, an AVI file is convenient since playback is possible in most computer environments. A storyboard printout is useful since addition of notes and sketches is easy.

3D data produced in Diorama can be passed on to 3D staff, who will use the data as a base for scene construction in 3D applications. Currently, output to 3D Studio Max (.max) is supported.

7. Evaluation

7-1. User Test

To evaluate the functionality of the tool, the implemented prototype was user-tested by 100 students studying motion picture production at School of Media Science, Tokyo University of Technology. The exercise was executed as follows.

a. A 90 minute exercise with an assignment to create an animated storyboard based on a particular theme
b. Installation of the tool on students' notebook PCs (15 minutes)
c. A simple lecture on operating instructions, and exercise explanation (20 minutes)
d. Exercise (45 minutes)

In spite of their first experience, most students were able to operate the tool without problems, and there were submissions which exceeded our expectations. Ample results were gathered as a first step towards practical use.

7-2. Practical Use in Animation Production

In addition to the user test in 8-1, the prototype was used in actual animation production led by students at Keio University The director of two teams created a full length video storyboard in Diorama to communicate visual ideas to the production team. Both directors had experience with hand drawn storyboards as well as creating video storyboards using 3D applications.

Concluding from the production report, a single animated shot which averaged 5 seconds in length took an average of 5 minutes to create. According to the director, the simplicity of the tool allowed for a short learning span and quick video storyboard creation compared to conventional 3D applications.

8. Conclusion and Future Work

In this paper, we have presented Diorama, a 3D directing tool for 3D computer animation production. In our future work, we intend to add the following functionality on top of the current architecture. Also, the stability of the tool will be increased to withstand actual use in production environments.

1. Simpler camera positioning interface
2. Collision Detection between objects and ground
3. Insertion of text captions and remarks
4. Addition of sound, music, and dialogue in Editing Mode

References

1. Conner D.B., Snibbe S.S., Herndon K.P., Robbins D.C., Zeleznik R.C., Nav Dam A., "Three-Dimensional Widgets", SIGGRAPH Symp. On Interactive 3D Graphics, 1992, pp. 183-188
2. Strauss P.S., Carey S., "An Object-Oriented 3D Graphics Toolkit", SIGGRAPH '92 Proceedings, 1992, pp. 341-349
3. "Designing Real-Time 3D Graphics for Entertainment", SIGGRAPH 96 Course Notes #33, 1996