6.837 Final Project Report

Team 30
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Abstract

This project is an animated movie about a police officer entering a Boston fraternity house. It was modeled, animated, and rendered using AutoCAD 13 and Alias | Wavefront Studio.

Introduction

After reviewing our design criteria we opted to use commercially available 3D modeling and animation software to produce a short, humorous animation. We believe that as computer resources continue to become more powerful and more (economically) available to the public, this type of activity will move beyond the realm of the computer graphics students allowing children, artists, homemakers, and people from every walk of life to tell an animated story of their own.

From our knowledge of computer graphics and the material covered in 6.837, we have a greater understanding of the advanced techniques used by the Alias | Wavefront software to model and render scenes and animation. Our knowledge of the subject allows us to better utilize such a tool and gives us a greater appreciation of the complexity involved in making this functionality available via a user interface. For example, understanding the trade-off between ray tracing and ray casting and the relative levels of complexity within each allows us to make educated decisions about how to render our wire frames.

Goals

Inspired by recent events occuring around MIT, especially on the Boston side of the river, we decided to construct a three-dimensional animation sequence involving a Boston Police officer entering a fraternity house.

The following are significant requirements of the project:

1. **Develop a three-dimensional model of our house at 526 Beacon Street.**
2. **Implement realistic character models.**
3. **Create realistic first-person camera movements for the police officer.**
4. **Use the tools we generate to tell an interesting story in a cinematic way.**

Our original goal was to produce approximately one minute of video (1800 still frames). We

deemed the most difficult portions of the project to be the complexity encountered in developing a three-dimensional model of our house and simulating the first-person point of view in terms of camera movements. Once these are accomplished we will have produced a clever and entertaining animation.

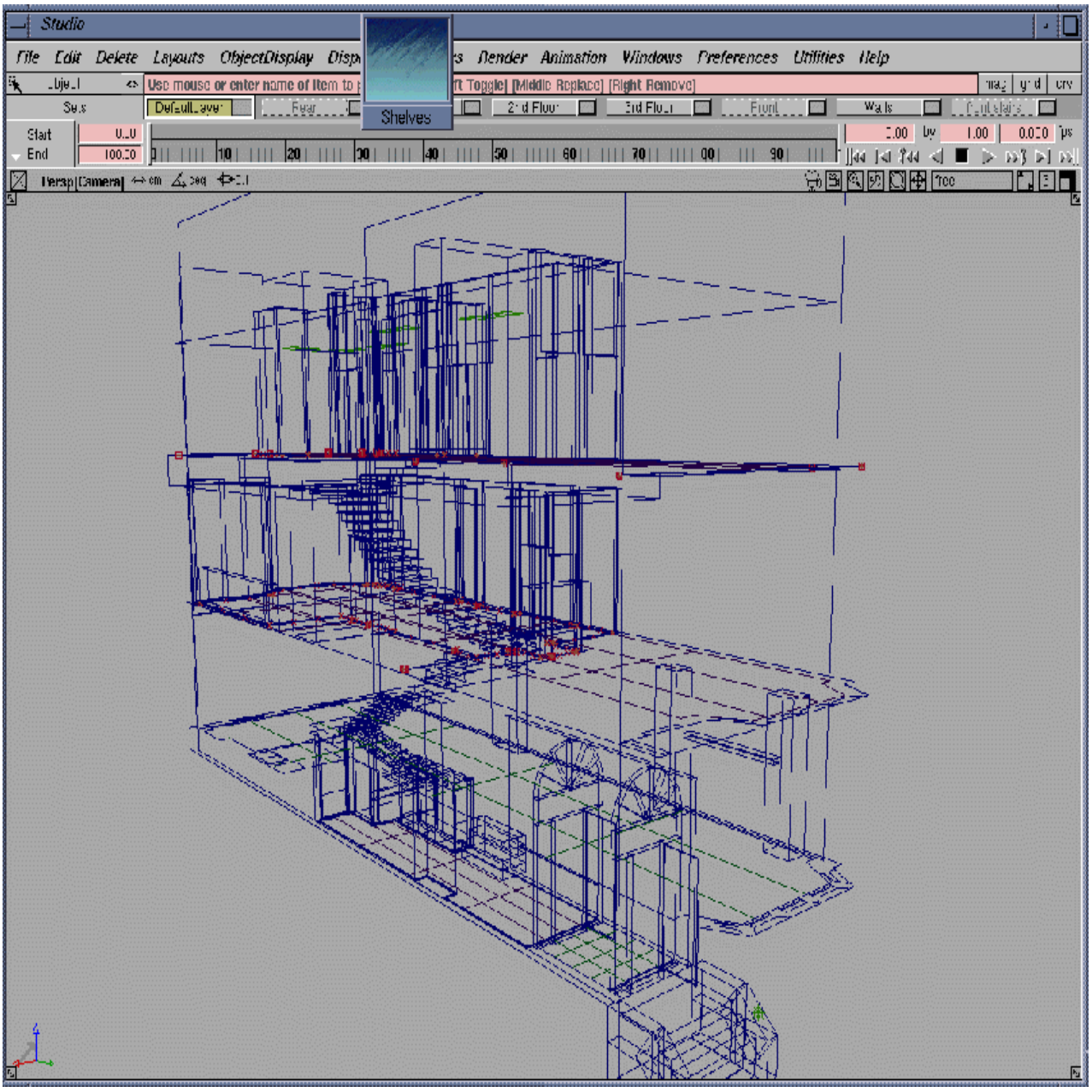
Achievements

The Model

The first step in accomplishing our goals was to build a detailed model of the first 3 floors of our house in Studio. To assist our efforts in achieving this goal we turned to our house architect, Mark Landsberg. Mark has been working for our alumni corporation since he designed the renovations done in 1988. He responded by to our request for help with a very large DXF file containing detailed floor plans of our house as well as elevations for the front and rear.

At first we had difficulty getting the DXF file to open in Alias. After attempting to use several different tools, we eventually opened the DXF file in ProEngineer and then exported it again. Opening this new file in AutoCAD, we proceeded to remove all unnecessary lines and measurements from the original file before exporting a final trimmed down version of our floor plans for use in Alias. We had expected this to be a quick, preliminary step in producing our movie. In actuality, simply preparing the file for use in Alias consumed a significant amount of time.

From this point the task remained to extract a three-dimensional model from our two-dimensional floor plans and fron and rear views of the house. Spreading the plans of the first three floors vertically and attaching the front and rear views, we had a rough outline of the house. From here, we implemented additional planes, surfaces, and cubes to define the walls, floors, stairs, and other objects of interest in an attempt to make our house come to life. Below is a view of portions of the wire frame (the front and rear layers of the model have been made invisible for ease of viewing).

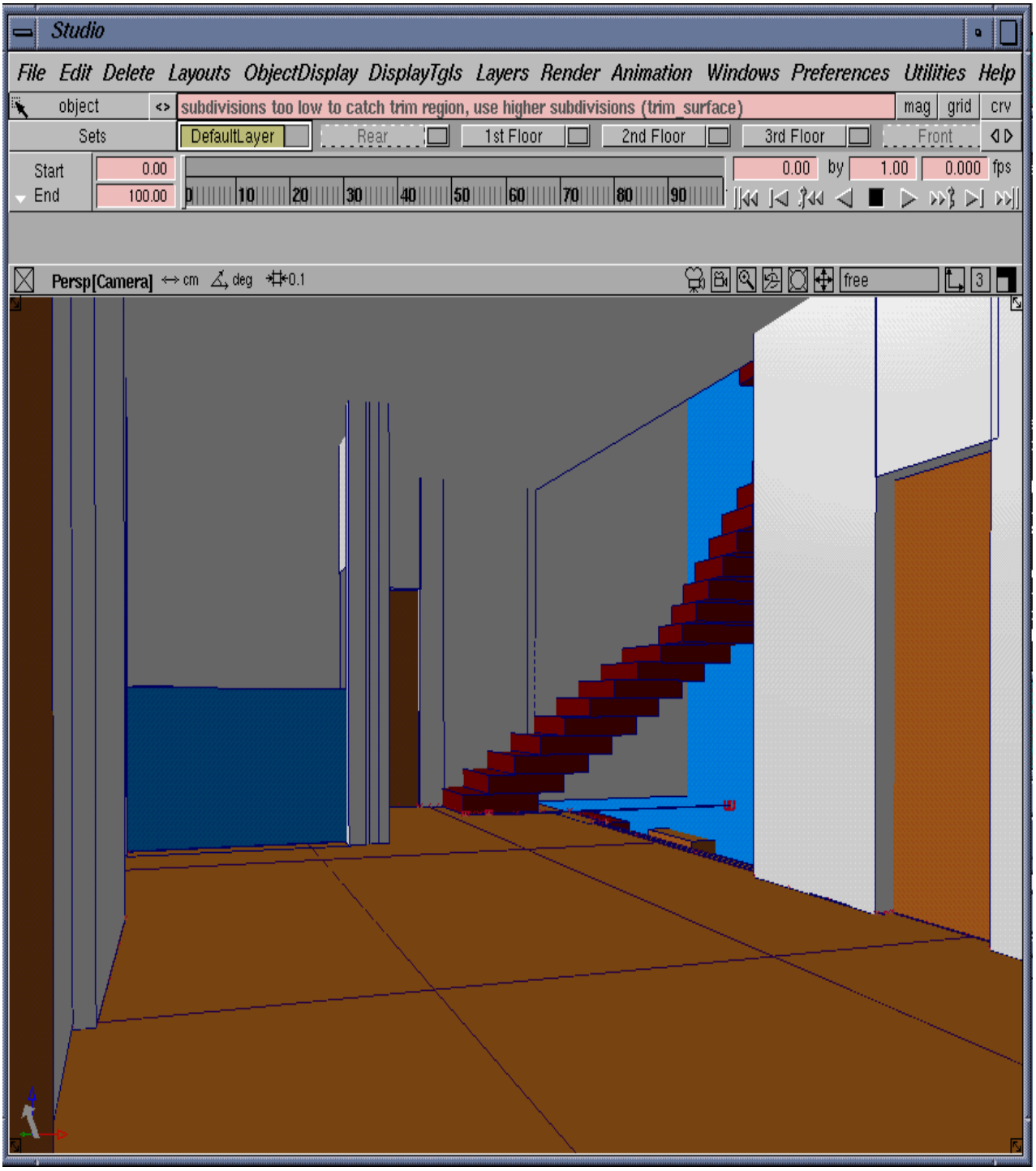


This image shows a wire frame view of our house model, something we worked with frequently in Studio.

As we proceeded in the development of our house model, we would delete the original DXF lines created when the floor plans were imported. Essentially, they acted as guides to show us how to model the complexities of our house. We also noted very early in the process that we only need model the areas of the house that will be visible during the rendering of the animation. Concerned about the number of objects present and the resulting time required for rendering we analyzed the engineering trade-offs versus artistic achievement deciding to keep certain doors opened or closed based on relevence to our animation.

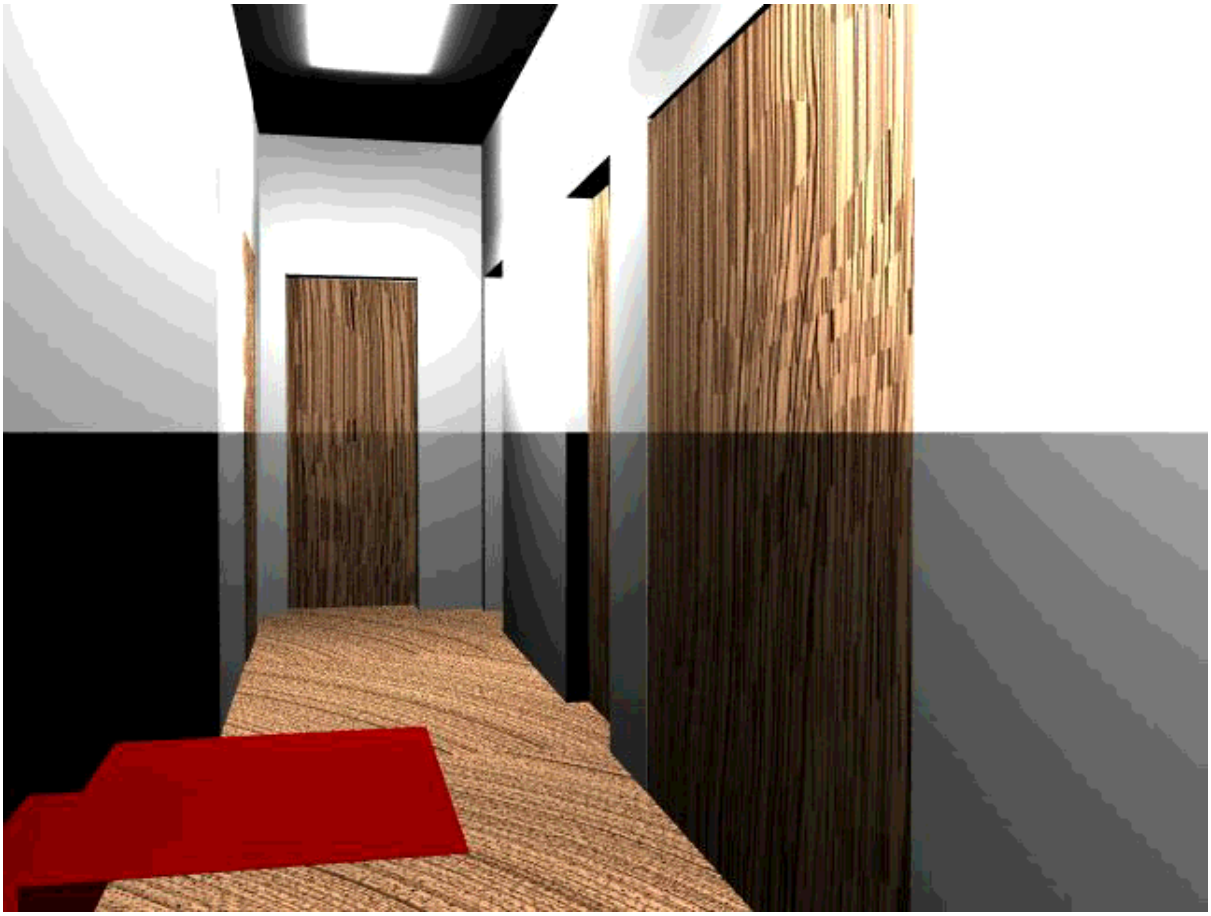
The model consists of not only geometry, but also material and color information. This

information is encoded by shaders. Studio allowed us to preview the basic diffuse color of the shaders. Each primitive in the scene is assigned a shader which controls its material properties for ray tracing, as well as texture mapping.



This images shows the "shade" display toggle turned on, useful not only for checking shader assignments, but also for better visualizing the geometry (since it shows occlusion).

To complete the model, we needed to add light sources that matched up with the real lights in the house as well as making sure that they provided enough light to generate a good rendering of the scene. Texture maps for wooden surfaces also enhanced the realism of our rendered scenes, so we added them as well. A few difficulties arose from the size of the model versus the texture mappings (especially the wood). We generated the model on a much smaller metric scale than the actual size of our house to reduce the precision necessary for aligning objects. As a result we had to experiment with variations of each texture mapping to make the effects seem realistic.



This image shows a rendered view, with texture mapping and light sources.

The Characters

After building the model, we needed to add the characters into the scenes. The first step to this process was creating the actual character models.

Using alias's character model as a basis, the body was muscularily enhanced to create a more realistic portrait of the "good guys." This was done through the use of keypoints and hulls to stretch out the arms and chest so that they appear more muscular. The lips were also enhanced as to give a slight smirk of confidence.

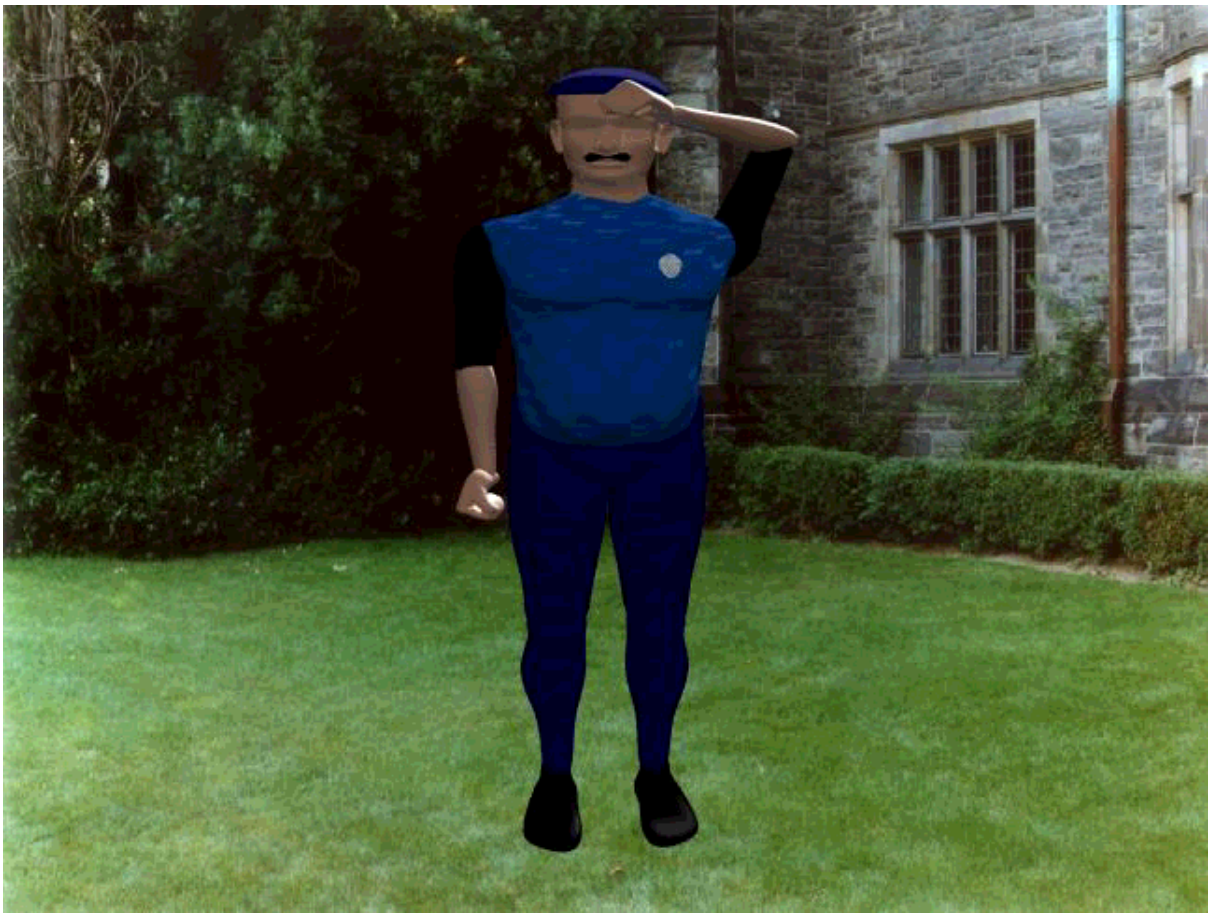
Various texture maps and bump maps were used to present a more realistic and futuristic

character image. The hair surface was created by splitting up the head surface into two surfaces uses alias's detach tool, and then separating the top surface, changing the shading parameters, to create hair.

The policeman's badge was created by making an oval curve on the chest surface and then making a separate surface out of this oval curve. Then the surface was slightly translated off of the chest to avoid surface overlap.

The positioning and animation of the characters is be aided by the use of a full body skeleton and multiple ik handles. Below we have two examples of characters used in our animation.

This is a rendered view of one of the "good guys" in our movie.



This is a rendered view of the police officer character.

The Cameras

Finally, once we had our virtual set and chracters, we had to script the movement of the camera. The process of animation was also quite time-intensive and subject to many aesthetic and stylistic decisions. We decided to use the "long take", a shot made famous by Welles and other filmmakers. Having a continuous shot allows the viewer to maintain a sense of spatial coherence.

Individual Contributions

Zac Warren
character modeling, animation

Blair Dunn
importing and converting AutoCAD, set modeling

Ben Chun
set modeling, storyboard, animation

Lessons Learned

In the completion of this project, we learned how to use the Alias | Wavefront Studio software package. Learning how to use a 3-D modeling and animation package was not trivial. The process took much longer than we expected. Modeling and animation are related but very much distinct.

The choice of using the DXF files as a basis for modeling had both good and bad effects. The guidelines allowed us to very accurately model the physical structure of our house, but it also made the task much more precision oriented. The additional complexity imposed by the DXF floor plans caused us to spend more time on modeling the physical structure and less time on the intricacies of the model and texture mappings.

We all now know how to model and animate in Studio, and have a much greater respect for the art of 3D animation.

Acknowledgments

We would like to thank the designers of the following applications (and those who wrote the tutorials and manuals):
Alias Wavefront
ProEngineer
AutoCad

And also Mark Landsberg for creating the orginal DXF drawing.

We credit the recent series of events surrounding fraternities in the MIT and Boston community for providing our inspiration for the project.