Non-Invasive Interactive Visualization of Dynamic Architectural Environments

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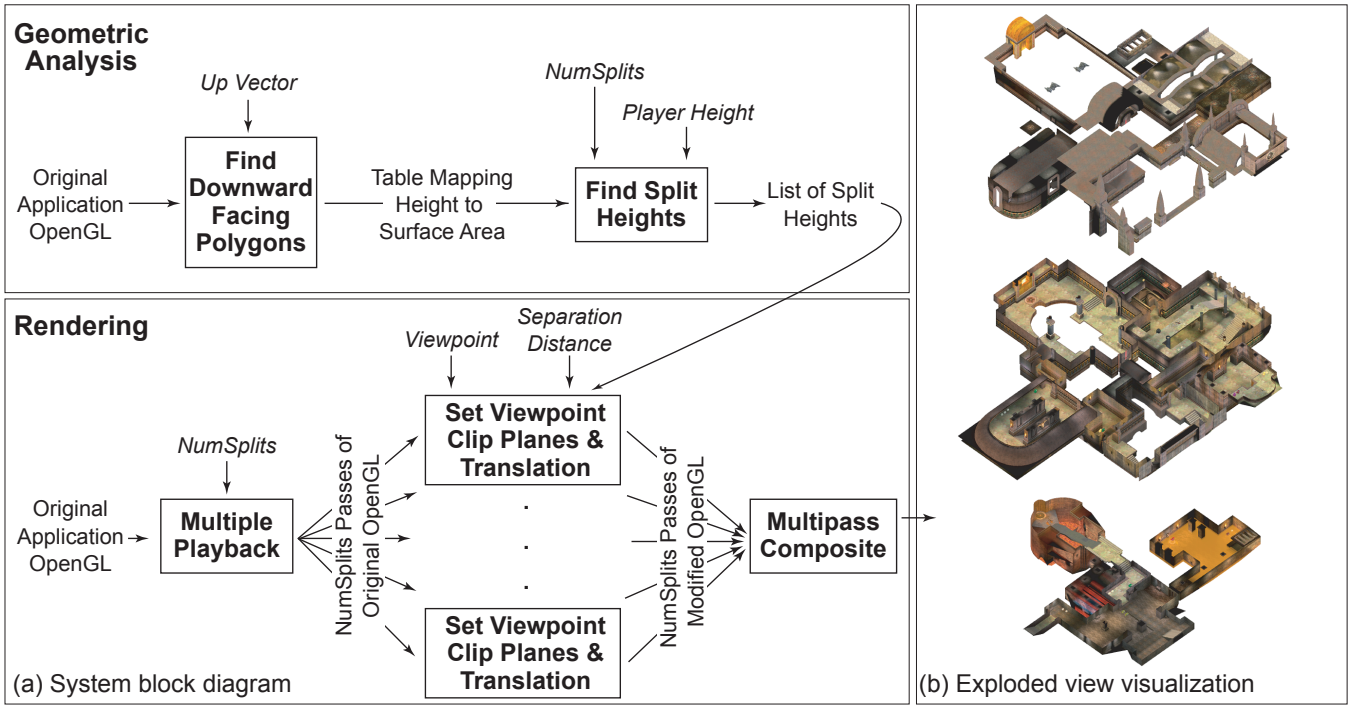

Figure 1: Overview of our visualization system. (a) The system is divided into two stages; geometric analysis and rendering. Geometric analysis occurs once and determines where to section the environment into stories. Rendering occurs every frame and produces an interactive exploded view. Each box represents a computational operation and arrows represent data. (b) An exploded view of the `dm7` environment from *Quake III* generated non-invasively by our system.

Motivation: Architects and technical illustrators often use techniques such as cutaways, transparency, and exploded views to reduce or eliminate occlusion and expose the overall structure of architectural environments. A common approach is to first section the building into stories just below the ceilings, and then separate the stories from one another to form an exploded view. These views expose both the structure of the internal spaces within each story and the vertical spatial relationships between adjacent stories. But producing such an exploded view from a 3D model of an architectural environment currently requires a designer to annotate the location of each story and a viewing application that can generate the appropriate exploded view from the annotated model.

Approach: We have developed a visualization system that generates exploded views of an architectural environment using the two stage approach shown in Figure 1. The system runs non-invasively and is designed to process OpenGL streams from existing applications without modification. The first stage, *geometric analysis*, determines where to split the architectural model into stories by analyzing the stream of polygons issued by the original application. The analysis is performed once whenever a new architectural model is loaded into the original application.

The second stage, *rendering*, draws the exploded view by modifying the OpenGL graphics stream of the original application. Based on the geometric analysis, the renderer inserts clipping planes between each story and performs multipass rendering, one pass per story, to produce the exploded view. The renderer also replaces the viewpoint specified by the original application with a new viewpoint which may be interactively specified by a viewer using our system. The rendering stage modifies every frame of the original application on the fly.

Conclusions: We have found that exploded view visualizations of architectural environments provide a much clearer view of the overall structure of the environments and the dynamic character interactions that may occur within them. Observing multi-player games from this type of third-person perspective is much more satisfying than watching the game through the eyes of a player. A complete description of our architectural visualization system can be found in [Niederauer et al. 2003].

References

Niederauer, C., Houston, M., Agrawala, M., and Humphreys, G. 2003. Non-invasive interactive visualization of dynamic architectural enviuronments. In *Proceedings of the 2003 Symposium on Interactive 3D Graphics*, 55–58. http://graphics.stanford.edu/papers/archsplit/.