

# Design of a Graphics Architecture Bridging the Gap Between Modeling and Rendering

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## Abstract

3D graphics had -- and still has -- not yet become a mainstream technology for everyday application and user interface development. The major reason being that software libraries available did not provide a programming model appropriate for widespread use by developers who are not necessarily experts in 3D graphics programming.

The primary goal of the presented project is the design of an object-based (in contrast to drawing-based) modeling and rendering platform consisting of a well structured and extensible set of objects that support all necessary operations to build a full-fledged modeling and rendering system. The 3D objects are the building blocks that lend themselves to programmer customization through techniques such as subclassing. Further to the high-level 3D objects, rendering classes provide access to all levels of rendering algorithms from low-level z-buffering and Gouraud shading to ray-tracing or radiosity.

As the name **Minimal Rendering Tool (MRT)** indicates, we tried to keep the package as minimal as possible. Nevertheless, experiences with the system prove that state-of-the-art functionality as well as advanced algorithms can be (and have been) incorporated into this renderer with a minimum amount of programming. MRT significantly improves the readability of the underlying algorithms, drastically improves productivity, and, most importantly, consists of building blocks that lend themselves to programmer customization thus making 3D image synthesis more accessible.

One of the most important features of the MRT architecture is a consistent way of modeling scene objects, subscenes, and scenes. Objects keep their original representation as long as possible -- in contrast of being converted to planar or other approximate representations at an early stage of the rendering pipeline.

Experiences with our (inhomogeneous) user population prove that the system meets its design goal of being highly customizable and extendable. Furthermore, it serves as a compact testbed for various modeling and rendering aspects as well as for new algorithms 'outside' of the classical computer graphics domain.

This is supported by a cooperation with a German mobile communication network supplier. The development of a prototype package to simulate the 3D distribution of radio waves in urban environments based on MRT could be completed by one of our students within two weeks. The incredibly short development time (considering that we started from scratch) in combination with the fact that the prototype was significantly faster than what was available before made it fairly easy to attract external funding for this **CARPET** project (**C**ALCulation of **R**adio **P**ropagation **E**mploying a **T**hreedimensional model).

Another example of the gain in productivity is the VRML viewer **MRTspace** which is based on MRT and has been developed within a view weeks. Despite its short development time it not only competes in performance with commercial VRML viewers but even provides novel user interface functionality.