

Herbert Freeman's Book

Introduction

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From:

Interactive Computer Graphics

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Computer graphics can be said to have formally begun with the work of Sutherland in 1963. In his now classic thesis, he showed how a computer could be employed for interactive design of line drawings using a simple cathode-ray tube display and a few auxiliary input controls. Others had already connected CRTs to computers in the early fifties to generate simple output displays. But it was not until Sutherland developed his system for man-machine interactive picture generation that people became aware of the full potential offered by computer graphics.

The realization of this potential, however, was slow to develop. Three major barriers were encountered. The first was the then **high cost of computing**. It was quickly discovered that computer graphics, especially if it were to be interactive, imposed inordinate demands on the computer in terms of both processing requirements and memory size. During the sixties, the cost of meeting these demands could be justified only for research purposes in a few universities and some large industrial research laboratories.

The second barrier was **a lack of understanding of the intricacies of the picture-generating software that would be needed for an**

effective computer graphics system. It was soon learned that one had to develop a data structure that in some sense would mirror the often barely realized but visually obvious relationships inherent in a two-dimensional picture. (In fact, the origin of much of today's data management theory can be traced to early work in computer graphics.) Algorithms for hidden-line removal, shading, and scan conversion were needed and generally proved far more complex than was first anticipated. Even as ostensibly simple a task as drawing a straight line segment or arc of a circle on a digitally-oriented display turned out to require algorithms which were by no means trivial.

Finally, **the complexity of both system software and application software was grossly underestimated.** Many of the early graphics achievements were in fact mere "toys" -- impressive in themselves but quite inadequate when compared to the demands of actual, economically sound interactive graphics design applications.

Fortunately, as it has with many other technological innovations, time favored computer graphics. The cost of computer equipment kept dropping year after year, while that of labor kept increasing. Operating systems were improved, and our ability to cope with complex software became more sophisticated. Impressive progress was made in the development of algorithms for generating pictures, especially those intended to represent views of three-dimensional objects. The progress, though slow, has been sufficient that now, at the end of the seventies, computer graphics is finally becoming accepted as an effective, powerful, and economically sound tool of the engineer, scientist, designer, manager, illustrator, and -- yes -- artist.

Computer graphics entails both hardware and software technology. As with conventional numerical computing, we may have both batch and interactive modes. In the batch (or "passive") mode, the speed with which pictures are generated is of secondary importance, and they may

appear on a digitally controlled pen plotter, an electrostatic line-of-dots-at-a-time plotter, or a CRT. For the interactive (or "active") mode, the time of picture generation is critical, and the display must appear on a CRT or a plasma panel.

In the early days of computer graphics, primary attention had to be given to the hardware. This is much less true today, since excellent high-performance hardware has become available from many manufacturers. Instead, the emphasis has now shifted to the algorithms for generating the various kinds of pictures that are desired (line drawings, gray-scale shaded pictures, color pictures, perspective projections of three-dimensional objects, etc.) and to the software for conveniently programming (i.e., "drawing") the pictures.