Computer graphics has grown spectacularly in the last decade. From an esoteric art which produced human-understandable computer results to simulators that rival reality, this field now is a handmaiden to the most diverse scientific endeavors. The number of people who now have, or profess to have, an abiding interest in developments in computer graphics is astounding. One indicator of this is the attendance at the annual SIGGRAPH conferences: in 1974 there were about 500 attendees; in 1985, the conference drew more than 27,000 people.

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What has made computer graphics so popular is the continuing steep decline in hardware cost, and the marked increase in hardware capabilities. These trends were set quite outside of the realm of this field; we are just the beneficiaries of the computer revolution. Twenty years ago, the cost of a 32K-word \( \times \) 36-bit memory was about $1 million; 10 years ago it was about $10,000; today it is about $1500 per megabyte. The cost of a megabyte of memory chips is only about $100 today, allowing experimenters to devise many special “home-built” devices. Thus low cost has allowed a proliferation of ideas which can now be pursued to a running prototype.

It is also true that with the reduction of cost, there has not been a corresponding decrease in cycle times. The memories of 20 years ago worked about six times slower than today's DRAMs. Thus the hardware solutions today are remarkable mostly for the amount of memory in them, and for the amount of processing power that is packed on a chip. There has not been a great change in the types of circuits and types of approaches used.

While the graphics display system designer of a few years ago was severely limited by the cost of the building blocks available, new display systems are increasingly turning to customized VLSI chips. Thus the graphics device engineer must become conversant with VLSI: by now all of us should have a working knowledge of the materials in Mead and Conway.\(^1\) It appears that soon graphics systems designers will either be architects of VLSI circuits or merely assemblers of others' VLSI building blocks.

The articles in this special issue on computer graphics hardware were received in response to a call for papers in the May issue of IEEE CG&A, and reflect graphics systems trends.

Generating interactive graphics

One of the major applications of computer graphics is in the design of mechanical and electronic components. Typically these designs are presented to the designer as large drawings. The components in these drawings are in “random” order, that is, in the order the designer worked on them. If the drawing was made on a line plotter, then the production of the drawing can closely follow the order in which the components are kept in the drawing database.

However, if an electrostatic plotter was used, the drawing must be converted to scan-line order plot. Of course, this is a standard problem in raster graphics; what makes the electrostatic plotter case unique is the size of the drawing. The first article in this issue describes a memory-intensive solution—a hardware item for “...producing truly prodigious drawings.”

An approach to providing useful interactive graphics is to combine careful algorithm selection, a restricted visual model, and a dedicated graphics controller that uses off-the-shelf items, as is described in the second article. The production of an image for interactive design requires not only the manipulation of large databases but high display rates to avoid image flicker. Different applications may require diverse display and data massaging operations. One way of providing these capabilities is to use dedicated controllers as outlined in the third article. Yet another procedure is to use a microcoded processor. The fifth article describes such a devise and gives many ways it might be used.

The fourth article looks to the future, describing a scheme for providing not just large memories, but also large amounts of processing power for image generation. The solution relies on specialized VLSI hardware items which can be cheaply replicated for a processor-per-pixel display device.

The final article presents a digital, video-based image manipulation scheme. This process solves some aliasing problems in real time, and allows smooth zooming of drawings and rendered images. Digital video techniques are real-time operations, and special care is taken to preserve image quality. These two aspects of image generation and handling are expected to receive increased attention in graphics display systems of the future.

Although the computer graphics field is now in its second decade, it is still in a “take-off” situation. Recently, it has been estimated that computer graphics has only about 10 percent market penetration in most application areas.\(^2\) Thus there is a great demand for more (and better) graphics; its continued success will depend on better-yet devised and display systems. I hope this issue points to new ideas and inspires others to get more deeply involved in this lucrative field-of-the-future.

References


John Staudhammer is coauthor of an article appearing on p. 26 of this issue of IEEE CG&A. His biography and photo appear at the end of that article.

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