

State-of-the-Art Art

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HARDWARE, SOFTWARE AND ART

Computer imaging began not with the artists but with the engineers. It is not so much that designers felt a need for computer graphics but rather that technical people saw a possibility for it. The first to use the computer to generate pictures were engineers and scientists. The former were interested in data display and the latter were keen to do image processing, a specialized discipline whose pursuit was the stimulus for much of today's graphics capability.

The earliest computer graphics systems were based on modified oscilloscopes, instruments that could rapidly draw freestyle lines on the face of a phosphor screen. These systems were designed to display data, for example the location of planes in the vicinity of an airport, and the degree of detail in the image depended on how fast the oscilloscope could be fed information.

Vector graphics, which refers to high-speed oscilloscope systems, was soon adopted by the early practitioners of computer animation. Although most suitable for wire-frame renditions, vector graphics could be adapted to simple filled-in images by drawing a multitude of lines to cover an area. Achieving color was a messy business: three separate exposures on 35-mm film were made through a red-green-blue filter wheel.

Although much fundamental work was done on vector machines, the big breakthrough in computer graphics occurred when computer and television technology were coupled. Unlike their high-speed, free-wheeling oscilloscope brethren, television displays are disciplined creatures of habit. Beginning in the upper left corner of the screen, they methodically trace out an image line-by-line until reaching the bottom. This they do a fixed number of times per second, irrespective of how fast or how slowly the input changes.

What television systems lack in speed (they are maddeningly slow for drawing simple lines) they make up in tonal and chromatic resolution. Grey scale and color are simply added. Furthermore, such systems are easily coupled to video recorders for later playback. The semi-discrete nature of television (a fixed number of horizontal lines) soon led to identifying each picture element on the screen with a memory location in a frame buffer. Raster graphics, the name given to television-based systems, forms the core of most modern graphics computers, whether they be two-dimensional paint devices or three-dimensional animation packages.

While only 5 years ago raster images of simple objects would elicit gasps of amazement, the rapid improvement in technology, in both hardware and software, has made such

imagery commonplace. Amazement has given way to nonchalance and occasional cynicism: "Computer graphics, sure. But all those flipping logos? Where's the art?"

In the following I consider whether 'the art' is coming . . . and if so, when?

WHAT IS ART, ANYWAY?

As one with a technical background, I am ill qualified to define 'art', although in this respect I appear not to be alone. Fortunately, recognizing art seems to be somewhat easier than defining it. As a functional definition, we might say that art consists of ideas that stimulate an emotional response, packaged in such a way that others can experience them.

Thus, good packaging is a necessity for art. But by itself, good packaging, or 'technique', is not sufficient. From paintings and photographs to computer animation, there is much imagery to be seen that is technically excellent, but that few would characterize as art.

It is the confusion of technique and message that leads to disputes over the value of electronic imagery. At first, the sheer novelty of electronically produced pictures was sufficient cause for excitement. The promise of a new technique generated widespread hope amongst those who saw in computer graphics a fresh medium to be exploited. Today, the technique has reached adolescence, and the novelty is gone. If there is disappointment or criticism, it is from those who now wish to see emotional content in the packaging. The medium is not sufficient as message.

IT HAS HAPPENED BEFORE

Beginning with the Industrial Revolution, major new techniques of imaging have appeared at intervals of about 40 years. In the early part of the last century, the camera obscura made it possible for dilettantes to trace out drawings of landscapes and other static scenes without the benefit of an artist's training or talent. Much like today's camera-toting tourists, the travellers of those days took along these primitive assemblages of mirrors and lenses to record as best they could the local views. Traditional landscape artists at first re-

ABSTRACT

The author muses on the emergence of electronic art, especially computer animation, as seen from a technical perspective. The ability to make realistic imagery with computers is only a recent development, and, because of its newness, both access to and capabilities of electronic imaging are still limited. But comparison with earlier technical innovations gives some insight into how creative designers will likely react to this promising technology.

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jected but then adopted the camera obscura, ultimately finding it an aid to achieving realism, particularly in rendering perspective.

The problem with the camera obscura was that it still involved laborious hand copying of the image. This was solved with the development of photography, and for the first time traditional artists were confronted with serious competition. Their initial response was to reject the new medium as inadequate. But as photography improved technically (and, in the process, displaced much of conventional portraiture) artists accepted the inevitable and sought expression in alternatives to realism.

Later developments improved the accessibility of photography. Once it was no longer the exclusive province of those with technical flair, photography began to be explored by creative artists. Today, no one denies that this medium can be used for artistic purposes. It has been adopted as one more 'conventional medium'.

This push-pull cycle of technology and artistic application—rejection, acceptance, exploration and finally adoption—seems to be the natural form of interplay between creative artists and new engineering developments. A similar process is now underway for two-dimensional graphics. Two decades ago, pioneering research by Ivan Sutherland resulted in the first electronic 'sketch pad', a scheme for drawing with the computer. This silicon sketch pad had less resolution—spatial, tonal and chromatic—than a real sketch pad, and it was far less handy. Nonetheless, it had a potentially important capability: it allowed the artist to *edit*. He or she could endlessly reproduce objects drawn once, cut and paste seamlessly, erase and displace. Later technological developments reduced some of the resolution limitations while improving the interface and capabilities. An additional possibility of recent vintage is the ability to 'input' (via camera or scanner) external images for further manipulation. Suddenly, electronic montage was easy. What only a decade ago still was seen as a mere technological toy is

now the workaday tool for many commercial designers. Rejection has given way to acceptance, and the appearance of 2-D paint systems in art academies signals the beginning of the phase of exploration by a wider group of artists.

Computer animation, involving as it does both motion and three-dimensional objects, is a far more intimidating medium than paint systems. Even today the best computer animation (in an artistic sense) requires considerable technical support. The construction of 3-D objects benefits from geometric insight and an analytic approach. Animation systems are still largely based on a key frame, a scheme that often suits the technologists better than skilled animators. Computer animation lags behind paint systems in terms of accessibility. Nonetheless, computer graphics, even animation, is apparently conforming to a well-established pattern. Born of the marriage of two technologies, it has seen its first efforts now improved to the point of being worthy of criticism. Rejection on esthetic grounds is giving way to its acceptance as a new medium, and some ambitious artists are already in the wings, anxious to begin exploration of its possibilities.

In this regard, it is probably fair to compare computer animation with the state of the motion picture at the beginning of the twentieth century. For a relatively long time after its invention, the motion picture was the exclusive province of the inventors. Screenplays were not filmed until 1903, and it was at this point, 15 years after Edison's first movie camera, that the new medium began really to develop its creative potential. Television experienced a similar history following its primitive beginnings between the world wars. Thus to ask "where is the art?" is premature. Where was photographic art in 1850, or cinematic art in 1890? The technology of computer graphics is still too young.

FUTURE TRENDS

Photography, cinematography and television were ultimately exploited by artists because they offered new creative possibilities. Computer animation can mechanize the tedious tasks of applying the laws of perspective and producing consistent lighting. The result is an opening of the screen with a convincing illusion of depth.

The problems of today's computer animation from the artist's point of view boil down to cost, complexity and lack of immediate feedback. Virtually all of the difficulties are engineering problems that will be largely overcome in the next decade. Creative designers will then have 'electronic clay', clay that, moreover, can move. Once the problems of accessibility have been overcome, we can expect that artists will once more begin to explore, and ultimately to adopt, this flashy new medium.

As an aside, it is worth noting that, despite the clear-cut analogy with earlier imaging technologies, not all is rosy for computer animation. The obvious future in which everyone can make animation at home (much as is the case with video today) is compromised by the difficulty of generating believable *human* characters, in terms of both shape and motion. Until this serious shortcoming is overcome, artists will have to content themselves with a medium devoid of living characters.

Computer graphics has generated a great deal of enthusiasm in its youth. But as it matures, some of the excitement inevitably palls. Attendance at last year's SIGGRAPH was down from a year before, and many of the technical sessions have become far too specialized and mathematical for the hordes of TV producers and graphics designers who used to attend. Firms specializing in computer animation have found a fickle market, and many have gone out of business. The technology is entering a new phase: one of greater accessibility, greater acceptance and less novelty. It is in the quiet backwaters of the first tidal wave of development that the art will be born.